



Estimation of Genetic Variability and Genetic Divergence in Dolichos Bean [*Lablab purpureus* (L.) Sweet.] Genotypes

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ABSTRACT

Background: Dolichos bean is an important leguminous vegetable having a wide range of variation in different quantitative characters. Assessing genetic diversity among dolichos bean accessions can ensure development of suitable high-yielding and adapted varieties with suitable maturity period.

Methods: Fifteen genotypes were evaluated for different characters in Dolichos bean at two locations of Dr. Rajendra Prasad Central Agricultural University viz. Vegetable Research Farm, Pusa and Krishi Vigyan Kendra, Birauli, Samastipur, Bihar during the year 2018-19 and pooled data was analyzed. The genotypes were evaluated for genetic variability and genetic divergence for 14 characters. For the assessment of genetic diversity among the fifteen genotypes of dolichos bean, Mahalanobis (D^2) statistic (Mahalanobis, 1936) was used, following the procedure given by Rao, 1952. Grouping of genotypes into clusters was done using Tocher's method as described by Rao, 1952.

Result: Phenotypic Coefficient of Variation (PCV) was slightly higher than Genotypic Coefficient of Variation (GCV) for all the characters indicated that the characters were less influenced by environment. The characters having high heritability and high genetic advance include harvesting duration, number of pods per plant, pod length, pod diameter, individual pod weight, weight of seeds per pod, 100 fresh green seed weight, pod yield and percent incidence of yellow mosaic virus. Therefore, selection for above characters is highly effective. Genetic diversity analysis evaluated that all genotypes could be placed into 6 clusters. Genotypes grouped in Cluster III and I have highest mean value for all characters as well as highest inter-cluster distance.

Key words: Cluster analysis, Divergence, Genetic advance, Genetic variability, Heritability.

INTRODUCTION

Dolichos bean or Egyptian bean or Hyacinth bean or Sem [*Lablab purpureus* (L.) Sweet] is one of the important vegetable crops grown throughout India. It is grown in almost all types of soils of average fertility like other beans (Salim *et al.*, 2013). In India, Dolichos bean is basically cultivated in Southern India especially in Karnataka, Tamil Nadu, Andhra Pradesh along with Maharashtra. Dolichos bean is a multi-purpose crop grown for pulse, vegetables for human consumption and also used for forage purpose for animals (Murphy and Colucci, 1999; Ansari *et al.*, 2019). Fuller (2003) mentioned that *Lablab* bean is an ancient crop in India with the earliest finds from before 3500 BC. The name "*Lablab*" is an Arabic or Egyptian name describing the dull rattle of the seeds inside the dry-pod. *Lablab* is remarkably adaptable to wide areas under diverse climatic conditions such as arid, semi-arid, sub-tropical and humid regions where temperatures vary between 22°C-35°C, low lands and uplands and many types of soils and the pH varying from 4.4 to 7.8. Being a legume, it can fix atmospheric nitrogen to the extent of 170 kg/ha besides leaving enough crop residues to enrich the soils with organic matter. Young immature pods are cooked and eaten like green beans. Dried seeds should be boiled in two changes of water before eating since they contain toxins cyanogenic glucosides. It is cultivated either as a pure crop or intercropped with finger millet, groundnut, castor, corn, pearl millet or sorghum. The major problem

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to breeders and growers is flower abortion, with low pod setting. Genetic diversity is pre-requisite for any crop improvement program. Assessing genetic diversity among dolichos bean accessions can ensure development of suitable high-yielding and adapted varieties with suitable maturity period. Therefore, the present investigation was conducted to evaluate genetic parameters for yield attributing traits as well as to measure the genetic diversity among available dolichos bean genotypes.

MATERIALS AND METHODS

Research was conducted using fifteen genotypes of dolichos bean (SwarnaUtkrist- check, ArkaVistar, PusaSem-3, ArkaPrasidhi, ArkaAdrash, RAUDB-1, RAUDB-2, RAUDB-2, RAUDB-4, RAUDB-5, RAUDB-6, RAUDB-7, RAUDB-8, RAUDB-9 and RAUDB-10) in Randomized Block Design (RBD) in three replications. The planting materials were collected from different parts of India. Evaluation of the genotypes were done on the basis of fourteen quantitative characters viz., Days to first flowering, Days to 50% flowering, Days to 1st pod harvest, Days to last pod harvest, harvesting duration (days), number of pods per plant, number of seeds per pod, pod length (cm), pod diameter (cm), Individual pod weight (g), weight of seeds per pod (g), 100 fresh green seed weight (g), pod yield (q/ha), per cent incidence of yellow mosaic virus. Present investigations were conducted in two locations of Dr. Rajendra Prasad Central Agricultural University viz. Vegetable Research Farm, Pusa and Krishi Vigyan Kendra, Birauli, Samastipur, Bihar during the year 2018-19 and pooled data was analyzed. ANOVA was carried out based on the methodologies proposed by Panse and Sukhatme (1978). Phenotypic and Genotypic coefficients of variation were evaluated on the basis of methods suggested by Burton (1952). Heritability in broad sense can be defined as the ratio of genotypic variance to the total variance and genetic advance as percent of mean were obtained by the formula given by Lush (1949) and Johnson *et al.* (1955). For the assessment of genetic diversity among the fifteen genotypes of Dolichos bean, Mahalanobis (D^2) statistic (Mahalanobis, 1936) was used, following the procedure given by Rao, 1952. Grouping of genotypes into clusters was done using Tocher's method as described by Rao, 1952.

RESULTS AND DISCUSSION

Analysis of variance clearly depicted that significant genetic variation was observed for eight characters under study (Table 1). The fifteen genotypes included in the study were genetically diverse and considerable amount of variability were present among the genotypes. Hence there are relevant prospects for isolating promising genotypes for high yield and other desirable parameters. The estimate of Genetic parameters of dolichos bean is presented in Table 2. Phenotypic Coefficient of Variation (PCV) was slightly higher than Genotypic Coefficient of Variation (GCV) for all the characters indicated that the characters were less influenced by environment. This result is in conformity with Parmer *et al.*, 2013.

Low GCV was recorded for the characters days to first flowering (6.06), days to 50% curd initiation (5.81), days to 1st pod harvest (3), days to last pod harvest (3.68) and number of seeds per pod (7.31). Low PCV was recorded for the characters days to first flowering (7.17), days to 50% flower initiation (6.66), days to 1st pod harvest (4.39), days to last pod harvest (4.67) and number of seed per pod (8.16). Moderate GCV were recorded for traits like harvest duration

(14.96), pod length (10.97), pod diameter (15.87) and pod yield (11.81). Moderate PCV was also recorded for traits like harvest duration (15.36), pod length (11.45), pod diameter (16.33) and pod yield (12.36). High PCV and GCV were recorded for the traits like number of pods per plant (23.69, 23.36), individual pod weight (29.38, 29.14), weight of seed per pod (26.83, 26.81), 100 fresh green seed weight (23.23, 22.93) and percent incidence of yellow mosaic virus (30.76, 30.55). This suggests that selection for improvement of characters is possible and effective on phenotypic basis. Similar results are in accordance with findings of Parmer *et al.*, 2013 and for characters like pod and days to maturity in dolichos bean, high PCV was recorded by Borah and Shadeque, 1992. Heritability is transmissibility of traits from parents to offspring (Falconer, 1981). All the characters were found to be highly heritable except days to first pod harvest (47%) (Table 2). Selection is not much effective on the basis of only high heritability. Therefore, genetic advance coupled with high heritability is relevant for selection. High genetic advance as percent (%) of mean was observed in harvest duration (30.01%), number of pods per plant (47.44%), pod length (21.68%), pod diameter (31.78%), individual pod weight (59.51%), weight of seed per pod (55.19%), 100 fresh green seed weight (46.61%), pod yield (23.24%), percent incidence of yellow mosaic virus (65.52%). Moderate genetic advance as 5% mean was observed in number of seed per pod (13.50%), days to first flowering (10.53%) and days to

Table 1: Analysis of Variance for fourteen characters in dolichos bean.

| Traits | Source of variation | | Mean squares | | |
|--------------|---------------------|---------|--------------|------------|-------|
| | df | 2 | Replication | Treatments | Error |
| | | | 14 | 28 | |
| DFF | | 588.39 | 300.54 | 226.19 | |
| D50%F | | 729.04 | 303.19 | 260.27 | |
| DFPH | | 1088.26 | 288.78 | 284.6 | |
| DLPH | | 2184.7 | 864.61 | 871.98 | |
| HD (Days) | | 214.46 | 498.08** | 162.37 | |
| NPPP | | 537.43 | 2342.83** | 329.61 | |
| NSPP | | 0.99 | 0.83 | 0.54 | |
| PL (cm) | | 3.76 | 7.42** | 1.86 | |
| PD (cm) | | 0.21 | 0.51** | 0.14 | |
| IPW (g) | | 1.78 | 27.96** | 1.54 | |
| WSPP (g) | | 0.74 | 1.61** | 0.05 | |
| 100 FGSW (g) | | 196.01 | 696.86** | 64.46 | |
| IYMV | | 407.01 | 1134 | 595.79 | |
| PY (q/ha) | | 14.08 | 94.79** | 7.57 | |

** Significant at 1% level.

DFF: Days to first flowering; D50%F: Days to 50% flowering, DFPH: Days to 1st pod harvest, DLPH: Days to last pod harvest, HD: harvest duration (days), NPPP: number of pods per plant, NSPP: number of seeds per pod, PL: pod length (cm), PD: pod diameter (cm), IPW: Individual pod weight (g), WSPP: weight of seeds per pod (g), 100 FGSW: 100 fresh green seed weight (g), IYMV: percent incidence of yellow mosaic virus, PY: pod yield (q/ha).

Table 2: Genetic parameters of fourteen characters in dolichos bean.

| Characters | σ^2g | σ^2p | GCV | PCV | h ² (Broad sense %) | GA | 5% GA as percent of mean |
|-------------|-------------|-------------|-------|-------|--------------------------------|-------|--------------------------|
| DFF | 32.21 | 45.21 | 6.06 | 7.17 | 71 | 9.87 | 10.53 |
| D50%F | 33.50 | 44.02 | 5.81 | 6.66 | 76 | 10.40 | 10.45 |
| DFPH | 10.60 | 22.68 | 3.00 | 4.39 | 47 | 4.59 | 4.23 |
| DLPH | 45.81 | 73.69 | 3.68 | 4.67 | 62 | 10.99 | 5.98 |
| HD(Days) | 126.52 | 133.40 | 14.96 | 15.36 | 95 | 22.57 | 30.01 |
| NPPP | 674.69 | 694.07 | 23.36 | 23.69 | 97 | 52.76 | 47.44 |
| NSPP | 0.11 | 0.14 | 7.31 | 8.16 | 80 | 0.61 | 13.50 |
| PL(cm) | 1.18 | 1.28 | 10.97 | 11.45 | 92 | 2.14 | 21.68 |
| PD(cm) | 0.13 | 0.14 | 15.87 | 16.33 | 95 | 0.72 | 31.78 |
| IPW(g) | 7.81 | 7.94 | 29.14 | 29.38 | 98 | 5.71 | 59.51 |
| WSPP(g) | 0.45 | 0.45 | 26.81 | 26.83 | 100 | 1.38 | 55.19 |
| 100 FGSW(g) | 185.69 | 190.61 | 22.93 | 23.23 | 97 | 27.71 | 46.61 |
| IYMV | 283.15 | 288.35 | 11.81 | 12.36 | 91 | 31.92 | 23.24 |
| PY(q/ha) | 29.10 | 29.41 | 30.55 | 30.76 | 99 | 11.02 | 62.52 |

Where, σ^2g = Genotypic variance, σ^2p = Phenotypic variance, GCV= Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h² = Heritability and GA= Genetic advance. DFF: Days to first flowering; D50%F: Days to 50% flowering, DFPH: Days to 1st pod harvest, DLPH: Days to last pod harvest, HD: Harvest duration (days), NPPP: Number of pods per plant, NSPP: Number of seeds per pod, PL: Pod length (cm), PD: Pod diameter (cm), IPW: Individual pod weight (g), WSPP: Weight of seeds per pod (g), 100 FGSW: 100 fresh green seed weight (g), IYMV: Percent incidence of yellow mosaic virus, PY: Pod yield (q/ha).

50% flowering (10.45%). Low genetic advance as per cent (%) mean was recorded in days to last pod harvest (5.98%) and days to 1st pod harvest (4.23%). High heritability coupled with high genetic advance were observed for harvest duration (95%, 30.01%), number of pods per plant (97%, 47.44%), pod length (92%, 21.68%), pod diameter (95%, 31.78%), individual pod weight (98%, 59.51%), weight of seed per pod (100%, 55.19%), 100 fresh green seed weight (97%, 46.61%), pod yield (91%, 23.24%), percent incidence of yellow mosaic virus (99%, 62.52%). These characters were governed by additive gene action. Therefore, simple selection will be effective for improvement of the above characters. The above findings are in conformity to the findings of (Basu *et al.*, 1999; Ganesh *et al.*, 2006 and Vaggar *et al.*, 2020).

Genetic diversity is of high relevance for crop improvement since the diversified genetic combination promotes better heterosis. Quantitative as well as qualitative estimation of genetic divergence among different individuals

enabled plant breeders to understand racial affinities and evolutionary pattern in different crop species as well as in selection of desirable parents in hybridization. On the basis of relative magnitude of D² value, the fifteen genotypes of dolichos bean were grouped into six clusters (Fig 1, Table 3)

Table 3: Clustering pattern of fifteen genotypes of dolichos bean on the basis of D² statistics.

| Cluster | No. of Genotypes | Name of genotypes |
|---------|------------------|---|
| I | 4 | RAUDB-9, RAUDB-10, ArkaPrasidhi, RAUDB-8 |
| II | 4 | SwarnaUtkrist, RAUDB-5, RAUDB-3, Pusa Sem-3 |
| III | 2 | RAUDB-2, RAUDB-7 |
| IV | 2 | RAUDB-1, RAUDB-6 |
| V | 2 | ArkaAdrash, RAUDB-4 |
| VI | 1 | ArkaVistar |

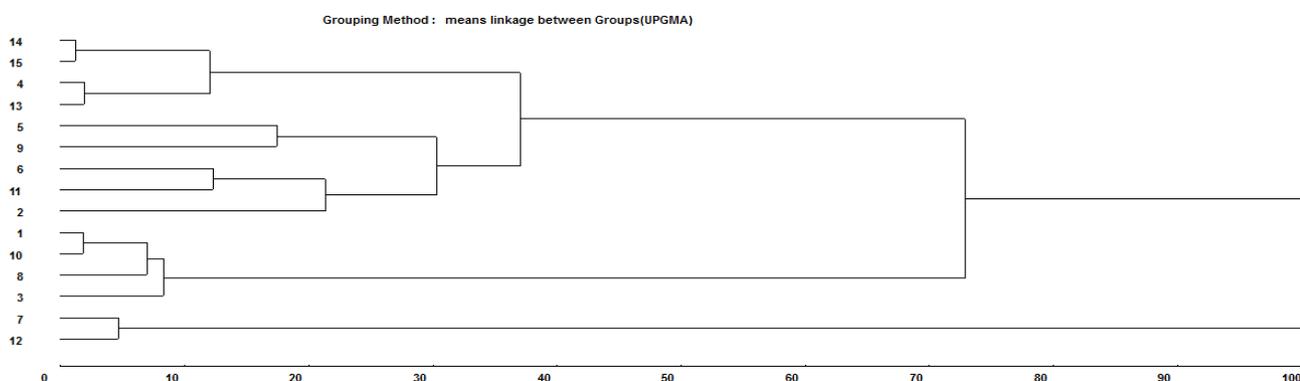


Fig 1: Clustering pattern of 15 dolichos bean genotypes on the basis of D² statistic by Tocher's method.

Table 4: Intra and inter cluster distance (D²) among six clusters in dolichos bean.

| Clusters | I | II | III | IV | V | VI |
|----------|--------|--------|--------|--------|-------|--------|
| I | 221.26 | 2483.9 | 3918.8 | 910.04 | 1114 | 748.34 |
| II | | 175.58 | 2219.5 | 1569.3 | 1430 | 1069.4 |
| III | | | 121.4 | 1891.6 | 1650 | 2047.2 |
| IV | | | | 317.52 | 759.7 | 552.97 |
| V | | | | | 451.1 | 839.89 |
| VI | | | | | | 0 |

Table 5: Cluster mean of fourteen characters in dolichos bean.

| | DFF | D50%F | DFPH | DLPH | HD (Days) | NPPP | NSPP | PL (cm) | PD (cm) | IPW (g) | WSPP (g) | 100 FGSW (g) | IYMV | PY(q/ha) |
|-----|--------|--------|--------|--------|--------------|--------|------|------------|------------|------------|-------------|-----------------|--------|----------|
| I | 101.53 | 105.67 | 112.00 | 177.31 | 65.14 | 80.97 | 4.59 | 10.43 | 1.94 | 9.55 | 3.29 | 75.05 | 120.61 | 23.92 |
| II | 85.11 | 93.20 | 100.23 | 165.10 | 64.48 | 105.98 | 3.93 | 7.80 | 2.14 | 7.03 | 1.61 | 48.73 | 137.95 | 11.75 |
| III | 83.97 | 89.51 | 97.66 | 193.60 | 95.95 | 151.55 | 5.12 | 10.42 | 3.01 | 14.93 | 1.93 | 38.10 | 165.08 | 13.51 |
| IV | 95.15 | 101.49 | 109.67 | 189.54 | 79.87 | 131.22 | 4.52 | 9.73 | 1.95 | 6.49 | 2.73 | 49.74 | 134.06 | 20.62 |
| V | 91.04 | 97.00 | 110.32 | 188.45 | 77.96 | 98.39 | 4.40 | 10.29 | 2.30 | 9.95 | 2.81 | 68.03 | 125.74 | 13.29 |
| VI | 85.67 | 90.67 | 109.33 | 188.67 | 79.34 | 119.33 | 4.13 | 11.01 | 2.37 | 11.83 | 2.30 | 62.93 | 133.17 | 22.72 |

DFF: Days to first flowering; D50%F: Days to 50% flowering, DFPH: Days to 1st pod harvest, DLPH: Days to last pod harvest, HD: Harvest duration (days), NPPP: Number of pods per plant, NSPP: Number of seeds per pod, PL: Pod length (cm), PD: pod diameter (cm), IPW: Individual pod weight (g), WSPP: weight of seeds per pod (g), 100 FGSW: 100 fresh green seed weight (g), IYMV: percent incidence of yellow mosaic virus, PY: pod yield (q/ha).

with an assumption that those within a cluster had smaller differences in D² value among themselves than those of other clusters. Maximum four numbers of genotypes were grouped in cluster I and II followed by cluster III, IV and V which have two genotypes each. Only one genotype was grouped in cluster VI. Maximum intercluster distance was observed between cluster III and I followed by cluster II and I and cluster III and II. So, genotypes placed in cluster II and I may be used to get the heterotic recombinant. Inter cluster distance were higher than intra-cluster distance which indicated the presence of wider genetic diversity among genotypes included in these cluster (Table 4). Occurrence of such diversity contributes to heterosis. Intracluster distance was maximum in Cluster V (451.1) which indicated that genotypes in this cluster were relatively more divergent than genotypes in other cluster. The findings are in accordance with Magalingam *et al.*, 2013. These above results were supported by Patel *et al.*, 2014; Borah and Khan (2001) and Golani *et al.* (2007). Highest mean value of days to first flowering (101.53), days to 50% flowering (105.67), days to 1st pod harvest (112), pod length (10.43), weight of seed per pod (3.29), 100 fresh green seed weight (75.05) and pod yield (23.92) was observed in cluster I whereas highest mean value of days to last pod harvest (193.60), harvesting duration (95.95), number of pods per plant (151.55), number of seed per pod (5.12), pod diameter (3.01), individual pod weight (14.93), percent incidence of yellow mosaic virus (165.08) observed in cluster III (Table 5). The characters present in cluster I with highest mean value can be improved by using genotypes present in cluster I viz. RAUDB-9, RAUDB-10, ArkaPrasidhi, RAUDB-8 and

Table 6: Contribution percentage of fourteen characters towards genetic divergence in dolichos bean.

| Traits | Contribution (%) |
|--------------|------------------|
| DFF | 0.015 |
| D50%F | 0.000 |
| DFPH | 0.000 |
| DLPH | 5.167 |
| HD(Days) | 4.181 |
| NPPP | 11.505 |
| NSPP | 0.848 |
| PL (cm) | 1.833 |
| PD (cm) | 1.324 |
| IPW (g) | 15.305 |
| WSPP (g) | 31.721 |
| 100 FGSW (g) | 8.419 |
| IYMV | 0.325 |
| PY (q/ha) | 19.357 |

DFF: Days to first flowering; D50%F: Days to 50% flowering, DFPH: Days to 1st pod harvest, DLPH: Days to last pod harvest, HD: Harvest duration (days), NPPP: Number of pods per plant, NSPP: Number of seeds per pod, PL: Pod length (cm), PD: Pod diameter (cm), IPW: Individual pod weight (g), WSPP: Weight of seeds per pod (g), 100 FGSW: 100 fresh green seed weight (g), IYMV: Per cent incidence of yellow mosaic virus, PY: Pod yield (q/ha).

characters present in cluster III with highest mean value can be improved by using genotypes present in cluster III viz. RAUDB-2, RAUDB-7. The characters contributing towards maximum divergence should be given greater emphasis for deciding on cluster for the purpose of further

selection and choice of parents for hybridization. Maximum contribution percentage was recorded for weight of seeds per pod (31.72%) followed by pod yield (19.357%), individual pod weight (15.305%) and number of pods per plant (11.505%). These findings are in conformity with Magalingam *et al.*, 2013; Ushakumari *et al.*, 2000 (Table 6).

CONCLUSION

From the above investigations we can conclude that, the characters having high heritability and high genetic advance include harvesting duration, number of pods per plant, pod length, pod diameter, Individual pod weight, weight of seeds per pod, 100 fresh green seed weight, pod yield, per cent incidence of yellow mosaic virus can be improved by simple selection. Cluster I and III has highest mean value for all characters as well as highest inter-cluster distance. Therefore, genotypes present in cluster I and III can be utilized for further selection and give highest recombination, if used in hybridization program.

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