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Genetic variability and character association for growth and yield characters in Dolichos bean (*Lablab purpureus var. typicus*) under rainfed semi-arid conditions

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Abstract

The genetic variability and character association were studied in 60 genotypes of dolichos bean (*Lablab purpureus var. typicus* L.) during 2018-2023 at Central Horticultural Experiment Station (ICAR- CIAH), Panchmahals (Godhra), Gujarat. A degree of variation was observed for all characters. High Phenotypic Co-efficient of Variation (PCV) and Genotypic Co-efficient of Variation (GCV) were recorded for primary branches/plant, number of pods/plant, Pod length, pod weight and pod yield/plant. The high PCV and GCV were recorded for primary branches/plant, number of pods/plant, pod length, pod weight and pod yield/plant indicated maximum variability in the genotypes. High heritability coupled with high genetic advance as per cent mean was observed for plant height, number of primary branches/plant, number of pods/plant, pod length, pod girth, pod weight and pod yield/plant indicating that these characters are controlled by additive gene action. Thus, selection for these characters will improve the yield. Pod yield/plant exhibited positive and highly significant correlation with number of branches, number of pods/plant, pod length, pod girth, pod weight at both genotypic and phenotypic levels. Hence these traits should be considered as important selection criteria for improvement of pod yield/plant.

Key words: GCV, PCV, Heritability, Association, Genotype

Dolichos bean (*Lablab purpureus* L) 2n=22, family of Fabaceae and is an ancient and important cultivated leguminous vegetable crop (Raghu *et al.,* 2018). There are two types of Dolichos bean have been recognized (Gangadhara *et al.,* 2023c) *Lablab purpureus* var. *typicus* which is a garden type bean having soft edible pods with less fiber content in pod walls. The second type is *Lablab purpureus* var. *lignosus*, is a field bean grown for dry seeds as a pulse.

The fresh pod contains 86.1% moisture, 3.8% protein, 6.7% carbohydrates, 0.7% fat, 0.9% minerals and 312 I.U, Vitamin-A (Singh *et al.,* 2004), while mature dry seeds contain 23% protein, 62% carbohydrates and 340 calories per 100g of edible portion (Tindall, 1983; Shulee *et al.,* 2021). Improvement in yield is possible only through selection for desired characters. Hence knowledge of association between yield and its component characters is essential for yield improvement through selection programme.

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Material and Methods

The study was carried out to assess the variability and character association in 60 diverse genotypes of dolichos bean at ICAR- CHES, Vejalpur, Panchmahals (Godhra), Gujarat. These genotypes were grown in a RCBD with three replications during the year 2018. 2019, 2020, 2021, 2022 and 2023 and four locations ((CHES,Vejalpur, Godhra, Gujarat, KVK-Panchmahal, Gujarat, CIAH, Bikaner, Rajasthan and ICAR-KVK, Kalaburagi-II, Karnataka) to evaluate for their growth, yield, quality and insect pest and disease incidence. The experimental site was located at (22° 41" 38" N latitude and 73° 33'38" E longitude at an altitude of 113 to 115 m above mean sea level which is characterized by semi-arid hot climatic conditions. The seeds were dibbled in ridges and furrows at a distance of 1m × 1.5m and the recommended dose of FYM (10-15t/ha) and fertilizers N.P.K. (25:75:60kg/ha) was also applied. The variance components and coefficients of variation were computed (Burten, 1952). The heritability in broad sense and expected genetic advance were determined by using the formula (Johnson *et al.*, 1955). The correlation

co-efficient among all possible character combinations at phenotypic and genotypic level were estimated by employing formula (Al-Jibouri *et al.,* 1958).

Results And Discussion

The analysis of variance for different quantitative characters for 60 genotypes indicated highly significant (P=0.01) difference among all genotypes for all characters. This indicated the presence of high degree of variation within the genotypes. Range of variation for various genetic parameters was observed for all traits indicated the presence of sufficient variation among the genotypes for all the nine characters (Table 1).

The high PCV and GCV were recorded for primary branches/plant (21.13 and20.51), number of pods/plant (86.21 and 85.62), pod length (29.05 and 28.86), pod weight (33.96 and33.61) and pod yield/plant (84.15and 83.66) respectively. The characters recorded for high PCV and GCV indicated maximum variability present in the germplasm for these characters. Moderate PCV and GCV were recorded for plant height (11.14 and10.34) and pod girth (14.46 and 13.61), whereas, low PCV and GCV were recorded for days to first flowering (5.28 and 5.26) and days to first harvesting (4.36 and 4.30) respectively, indicating the existence of limited variability in the germplasm. The higher estimates of PCV than GCV indicated towards the environmental influence in the expression of all the characteristics (Chaudary *et al.,* 2017; Gangadhara *et al.,* 2018; Gangadhara *et al.,* 2023c; Singh *et al.*, 2023).

High heritability in broad sense is useful in identifying appropriate character for selection and enables the breeder to select superior genotypes on the basis of phenotypic expression of quantitative traits. In our study, heritability ranged from 86.10% (plant height) to 99.0% (days to first flowering). High heritability was noticed for plant height (86.10%), number of primary branches/plant (94.10%), number of pods/plant (98.60%), pod length (98.70%), pod girth (88.60%), pod weight (97.90%), days to first flowering (99.0%), days to first harvesting (97.0%) and pod yield/plant (98.80%), indicating that these characters are less influenced by environmental factors and are under the control of additive gene effect and selection for improvement of such characters would be rewarding. Burten (1952) suggested that, GCV along with heritability estimates would provide a better picture of the amount of advance expected by phenotypic selection. Heritability estimates in conjunction with genetic gains are more effective and dependable in predicting the improvement through selection (Johnson *et al* 1955). High genetic advance as per cent mean was observed for plant height (20.17%), number of primary branches/plant (40.99%), number of pods/plant (175.16%), pod length (59.08%), pod girth (26.39%), pod weight (68.53%) and pod yield/plant (171.35%), indicating that these characters are controlled by additive gene action. Thus, selection for these characters will improve the yield. The similar results were reported by Chaudary *et al.* (2017), Gangadhara *et al.*(2018),Tripathi *et al.*(2018) and Singh *et al.* (2023).

The estimates of phenotypic and genotypic correlation coefficients among different characters of dolichos bean genotypes are presented in (Table 2). The Plant height exerted positive and highly significant

Table 1: Estimates of genetic parameters for various characters in dolichos bean

Character	Range		Mean	GCV	PCV	h^2	GA	GAM
	Min.	Max.						
Plant height(m)	2.72	4.88	3.90	10.34	11.14	86.1	0.77	20.17
Primary branches/plant	3.02	6.85	4.31	20.51	21.13	94.1	1.76	40.99
Number of pods/plant	59.91	1550.00	206.42	85.62	86.21	98.6	325.45	175.16
Pod length(cm)	5.43	17.50	11.05	28.86	29.05	98.7	6.53	59.08
Pod girth(cm)	3.30	6.13	4.36	13.61	14.46	88.6	1.15	26.39
Pod weight(g)	3.73	15.20	7.63	33.61	33.96	97.9	5.24	68.53
Days to first flowering	69.82	87.57	80.56	5.26	5.28	99	8.67	10.77
Days to first harvest	90.21	111.35	100.23	4.30	4.36	97	8.73	8.72
Pod yield/plant(kg)	1.02	9.80	2.72	83.66	84.15	98.8	2.29	171.35

GCV- Genotypic co-efficient of variation, **PCV**- Phenotypic co-efficient of variation,

h^2- Heritability (broad sense), **GA**- Genetic advance, **GAM-** Genetic advance as % mean

Table 2: Genotypic and phenotypic correlation (association) for growth and yield characters in dolichos bean

Character	Plant height(m)	Number of branches	Number of pods/plant	Pod length(cm)	Pod girth(cm)	Pod weight(g)	Days to first flowering	Days to first harvest	Pod yield/ plant(kg)
Plant height(m)	**1**	0.5622**	0.0541	0.0868	0.1102	0.0813	0.2210**	0.2130**	0.1194
Number of branches	0.5173**	**1**	0.4775**	0.3171**	0.2666**	0.2959**	0.0991	0.0413	0.5489**
Number of pods/plant	0.0477	0.4630**	**1**	0.1729*	0.2118**	0.1642*	0.0033	-0.1037	0.9443**
Pod length (cm)	0.0799	0.3073**	0.1693*	**1**	0.2009	0.8522**	0.1622*	0.1331	0.4196**
Pod girth (cm)	0.0899	0.2437**	0.1971**	0.1884*	**1**	0.4253**	0.2383**	0.1126	0.3333**
Pod weight (g)	0.0774	0.2905**	0.1615*	0.8388**	0.3944**	**1**	0.2401**	0.1600*	0.4408**
Days to first flowering	0.2093**	0.0980	0.0030	0.1590*	0.2224*	0.2362**	**1**	0.8581**	0.0808
Days to first harvest	0.2058**	0.0463	-0.1017	0.1293	0.0953	0.1588*	0.8498**	**1**	-0.0211
Pod yield/ plant(kg)	0.1145	0.5359**	0.9351**	0.4149**	0.3069**	0.4401**	0.0794	-0.0201	**1**

Above diagonal indicates genotypic correlations below phenotypic correlations. **Significant at 5% and * Significant at 1%

correlation with number of branches (r_g= 0.5422 and r_p= 0.5173), days to first flowering (r_g= 0.2210 and r_p= 0.2093), days to first harvesting (r_g= 0.2130 and r_p= 0.2058) at both genotypic and phenotypic level. Number of branches showed highly significant and positive association with number of pods/ plant (r_g= 0.4775 and r_p= 0.4630), pod length (r_g= 0.3171 and r_p= 0.3073), pod girth (r_g= 0.2666 and r_p= 0.2437), pod weight (r_g= 0.2959 and r_p= 0.2905) and pod yield/plant (r_g= 0.5489 and r_p= 0.5359) at both genotypic and phenotypic levels (Table 2). Number of pods/plant had positive and highly significant with pod girth (r_g= 0.2118 and r_p= 0.1971) and pod yield/plant (r_g= 0.9443 and r_p= 0.9351) at genotypic and phenotypic levels, whereas, it showed positive and significant correlation with pod length (r_g= 0.1729 and r_p= 0.1693) and pod weight (r_g= 0.1642 and r_p= 0.1615) at both levels. Pod length showed highly significant and positive correlation with pod weight (r_g= 0.8522 and r_p= 0.8388), pod yield/ plant (r_g= 0.4196 and r_p= 0.4149) at both levels while, it showed highly significant and positive correlation with pod girth (r_g= 0.2009 and r_p= 0.1884) at genotypic level only but significant and positive correlation at phenotypic level whereas, it had positive and significant correlation with days to first flowering (r_g= 0.1622 and r_p= 0.1590) at both levels. Pod girth recorded highly significant and positive association with pod weight (r_g= 0.4253 and r_p= 0.3944), days to first flowering (r_g= 0.2383 and r_p= 0.2224), pod yield/plant (r_g= 0.3333 and r_p= 0.3069) at genotypic and phenotypic level. Pod weight exhibited positive and highly significant correlation with, days to first flowering (r_g= 0.2401 and r_p= 0.2362), pod yield/ plant (r_g= 0.4408 and r_p= 0.4401) at genotypic and phenotypic level. Positive and significant correlation was recorded with days to first harvesting (r_g= 0.1600 and r_p= 0.1588) at both the level. Hence pod weight should be considered as important selection criteria for the improvement of pod yield/plant. Days to first flowering showed highly significant and positive correlation with days to harvesting (r_g= 0.8581 and r_p= 0.8498) at genotypic and phenotypic level. Days to first harvest recorded negative and non significant correlation with pod yield/plant (r_g= -0.0211 and r_p= -0.0201) at genotypic and phenotypic level which indicates the earliness.

Pod yield/plant exhibited positive and highly significant correlation with, number of branches (r_g= 0.5489 and r_p= 0.5359), number of pods/plant (r_g= 0.9443 and r_p= 0.9351), pod length (r_g= 0.4196 and r_p= 0.4149), pod girth (r_g= 0.3333 and r_p= 0.3069), pod weight (r_g= 0.4408 and r_p= 0.4401) while, non-significant negative correlation was recorded for days to first harvesting (r_g= -0.0211 and r_p= -0.0201) at both genotypic and phenotypic level. These results are in accordance with (Gangadhara *et al.,* 2023a; Gangadhara *et al.,* 2023b; Gangadhara *et al.,* 2023d; Singh *et al.*, 2023).

Hence these traits should be considered as important selection criteria for the improvement of pod yield/plant. Thus, trait pairs recorded higher values of genotypic correlations than their corresponding phenotypic correlations. This indicated that there was high degree of association between two variables at genotypic level; its phenotypic expression was deflated by the influence of environmental factors. The results on correlation coefficients revealed that number of branches, number of pods/ plant, pod length, pod girth and pod weight were most important traits and may contribute considerably towards higher pod yield/plant. The interrelationship among pod yield/plant components traits would help in future breeding programmes for increasing the pod yield in dolichos bean.

Highly diverse lines of dolichos bean: Highly promising and productive lines were identified during 2018-2023 based on different horticultural traits indicating ideal for four locations *viz.,* CHES,Vejalpur, Godhra, Gujarat, KVK-Panchmahal, Gujarat, CIAH, Bikaner, Rajasthan and ICAR-KVK, Kalaburagi-II, Karnataka.

CHESDB-7 (Thar Kiran): It is a high yielding with purple red pods and anthocyanin rich (190 mg/100g) variety. The plants have purple pigmentation in their stems, petioles, flowers, leaf veins and pods. The number of pods/plant varies for 1100 to1600/plant with an average yield of 7-9 kg/plant. It is resistance to dolichos bean yellow mosaic virus (DYMV) disease under field conditions.

CHESDB-50 (Thar Ganga): This variety has attractive and shining long green pods. The pods are very long with pod length (17.5cm), pod girth (5.21cm) and pod weight (15.2g). The fresh pods are harvested 98-110 days after sowing. The number of pods/plant varies for 800 to 1200/plant with an average yield of 8-10 kg pods/plant. It is moderately resistance to dolichos bean yellow mosaic virus (DYMV) disease under field conditions.

CHESDB-31(IC-631578): This genotype has whitish green pod colour with slender pod shape with cluster pod bearing in nature and produces 12-15pods/ cluster and it has got whitish colour matured seeds. Pods are long with pod length (14.23cm), pod girth (4.21cm) and pod weight (8.50g). It takes 98-100 days for first flowering and fresh pods are harvested at 115 and 120 days after sowing. It gives 900-1250 pods with a yield potential of 6–7 kg/plant. The whole pods are rich in proteins (4.20g/100g), other vitamins and minerals. It is moderately tolerant to dolichos bean yellow mosaic virus (DYMV) disease under field conditions.

CHESDB-40(IC-631579): It is a pole type genotype having light purple red colour and sickle shaped pods which are rich in anthocyanins (180mg/100g) and highly field resistant to dolichos bean yellow mosaic virus disease. It has pod length of 15.50cm pod girth (4.0cm) and pod weight (7-7.5g). The fresh pods are harvested at 95-97 days after sowing. It gives 900-1400 fresh pods with yield potential of 7.0 to 8.0 kg/plant.

CHESDB-10 (IC-631577): This genotype has unique broad pod shape with 6.20cm of girth, pods are long and creamy whitish green in colour. It is a prolific pod bearer and moderately field resistant to dolichos bean yellow mosaic virus disease. The pods are broad and long with length (16.00cm), pod girth (6.20cm) and pod weight (11.50g). It takes 98-100 days for first flowering and fresh pods are harvested at 115-120 days after sowing. It bears 750-900 pod/plant with a yield of 7.0–7.8 kg/plant which are rich in proteins (5.0g/100g), other vitamins and minerals.

CHESDB-01(IC-631574): It is a pole type genotype having long flat and medium sized and green pods. It has average pod length of 14.50cm with girth of 5.50cm and pod weight of 10.60g. It takes 78 days for first flower and fresh green pods are harvested at 90-95 days after sowing. It produces 750-800 pods/plant with a yield of 5.5-6.5 kg/plant of fresh pods.

Conclusion

The characters recorded for high PCV and GCV indicated wide variability present in germplasm. High heritability coupled with high genetic advance as per cent mean was observed for most of the characters, indicating that these characters are controlled by additive gene action. Thus, selection for these characters will improve the yield. Pod yield/plant exhibited positive and highly significant correlation with, number of branches, number of pods/plant, pod length, pod girth, pod weight at both genotypic and phenotypic level. Hence these traits should be considered as important selection criteria for improvement of pod yield/plant.

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