

Investigating the variability in dolichos bean (*Lablab purpureus*) yield and yield-contributing attributes using a character association and route analysis method

Suresh. G, Sulochana, Subhadra. H

Department of Rural Development and Agricultural Extension, Debre Markos University,
Debre Markos, Ethiopia

Article Info

Received: 29-12-2024 Revised: 15-01-2025 Accepted: 18-01-2025 Published: 21-01-2025

ABSTRACT

In order to assess the degree of diversity in dolichos bean [*Lablab purpureus* (L.) Sweet] genotypes for significant horticultural variables and their correlations, an experiment was carried out in 2019–20 and 2020–21 at the ICAR-Central Institute for Subtropical Horticulture, Lucknow, Uttar Pradesh. Significant genetic variety among the genotypes was evidenced by the observed range and mean variations of the variables under study. Environmental influences have little to no effect on the phenotypic expression of these characteristics, as seen by the little difference between the genotypic (GCV) and phenotypic coefficient of variation (PCV) for defined characters. Pod yield, days to first flowering, pod weight, plant height, and pod breadth were among the variables that had positive GCV, suggesting the existence of additive gene activity. High heritability and modest genetic advance were seen in variables including pod weight, days to first flowering, and pod breadth. This suggests that the high heritability of these traits is caused by the effects of additive genes and that genetic gain may be anticipated via phenotypic selection. An innate relationship between the qualities was shown by the stronger genotypic correlations. Consequently, the strong character link between plant height, number of pods/cluster, pod width, and pod weight provided the basis for the selection criteria for high yield. The greatest direct beneficial impact on yield was seen in the number of pods per plant, followed by the number of clusters per plant. Therefore, choosing heavier pods, more clusters per plant, and more pods per cluster may all boost pod output.

Keywords: Correlation, Genetic advance, Heritability, Path analysis

Introduction

One well-known leguminous crop is the dolichos bean [*Lablab purpureus* (L.) Sweet]. It thrives all around the country because of its wide climate adaptation, strong drought tolerance, and widespread consumer acceptance. It is noted for its high protein, mineral, and vitamin content. Nutri-gardeners and commercial vegetable producers in the northern plains cultivate it for green pods, immature fresh seeds as veggies, and dried seeds as pulses. The protein composition of seeds is 15–25%, but that of pods is 10–19%. One source of medicinal components used in medicine is the dolichos bean (Morris 2009). By fixing atmospheric nitrogen in the soil, it contributes significantly to the sustainability of agriculture. Due to its lengthy gestation time and poor production, this significant leguminous crop remained underutilized. Based on the data that is now available, India is thought to be one of the main origins of dolichos beans, which have a wide range of plant and pod traits. To optimize the advantages of

IIICAR: Central Institute for Subtropical Horticulture, Uttar Pradesh, Lucknow. *The author's email address is srajparmar@gmail.com.

To boost production and close the gap between potential and actual output, genetic restructuring of dolichos beans is required. Additionally, consumers' preferences for different pod sizes, shapes, colors, and scents should be considered while making improvements. However, since it depends on a number of variables, the horticultural requirements for dolichos beans restrict the potential for production enhancement. As a result, selection based on yield performance will be useless, and throughout the improvement program, the breeder should take into account other features that contribute to yield. Achieving improvement in the proper direction requires prior understanding of the kind and degree of correlation between yield and other yield-contributing factors. The amount of genetic variety in the germplasm determines how successful a crop improvement effort is. The strength of the association between independent and dependent features may be evaluated using correlation coefficients. The direct effect of one variable on another is measured via path coefficient analysis. Finding certain features for crop development is made feasible by breaking down the correlation coefficients into direct and indirect impacts. Our goal in this research was to look at the genetic characteristics that cause variability and to determine the key traits for yield and quality improvement in the collected genotypes.

MATERIALS AND METHODS

The current research was conducted in 2019–20 and 2020–21 at the ICAR-Central Institute for Subtropical Horticulture in Lucknow, Uttar Pradesh (26° 45' to 27° 10' N, 80° 30' to 80° 5' E, and 123 m amsl). The experiment comprised 20 diverse genotypes of pole type dolichos bean, viz. CISH-DC-1, CISH-DC-2, CISH-DC-3, CISH-DC-4, CISH-DC-5, CISH-DC-6,

CISH-DC-7, CISH-DC-8, CISH-DC-9, CISH-DC-10, CISH-DC-11, CISH-DC-12, CISH-DC-13, CISH-DC-14, CISH-DC-15, CISH-DC-16, CISH-DC-17, CISH-DC-18, CISH-DC-19, CISH-DC-20 collected from different growing regions of Uttar Pradesh. A randomized block design (RBD) with three replications was used to set up the study. In order to accommodate 10 plants/line of each genotype in each replication, the seeds were directly sowed in the first week of July of each experimental year at a distance of 1.20 m × 0.90 m between and within rows. The bower training technique was used to train and stake the plants.

Standardized agronomic cultivation procedures were used in both research years to guaranty proper expression of phenotypic features. Plant height (m), primary branches/plant, date of first flowering, number of flowers/cluster, number of clusters/plant, pods/cluster, length of pod (cm), width of pod (cm), weight of pod (g), and yield of pod/plant (kg) were among the quantitative characteristics that were measured from five randomly chosen plants in each replication during the two study years. Using the methods suggested by Gomez and Gomez (1984), pooled mean data from two consecutive years were taken into consideration for statistical estimate. Allard's (1960) approach was used to determine the coefficient of variation and variance, whereas Johnson et al.'s (1955) method was used to calculate heritability in general and predicted genetic advancement. The formulas given by Al-Jibouri et al. (1955) were used to estimate the genotypic and phenotypic variation. Correlation and route analysis were determined using the techniques suggested by Miller et al. (1958) and Dewey and Lu (1959).

RESULTS AND DISCUSSION

All features were found to be significant at the 1 and 5% levels of significance in the mean sum of squares of the analysis of variance, with the exception of pod width and pod weight. It showed a great deal of variation in the genotypes that were assessed for pod yield and factors that contribute to yield. Days to first bloom, number of clusters/plant, number of flowers/cluster, number of pods/cluster, and yield (kg/plant) showed the most diversity. Significant genetic diversity indicates that selection might be a useful strategy for improving the dolichos bean's earliness and production. Character variability may be effectively measured using the range, mean, and genotypic coefficient of variations (Singh et al. 2020). The great degree of genetic variability is reflected in the broad range of mean values. The effects of genotype, environment, and their interplay are included in the expression values of characteristics. Determining the heritable and non-heritable components of total variability is thus a necessity for starting any crop development effort. The plants were between 1.70 and 5.90 meters tall. The genotype CISH-DC-18 recorded the lowest plant height (1.70 m), whereas genotype CISH-DC-16 recorded the highest plant height. The principal number of branches/plant varies between 5.67 (CISH-DC-5) and 11.00 (CISH-DC-13). The initial blooming time varied from 65.00 to 225 days. The genotype CISH-DC-20 required the most days to first blossom (225.00), whereas the genotype CISH-DC-1 required the fewest days. With a grand mean of 19.70, the number of flowers per cluster varied from 11.33 (CISH-DC-6) to 28.00 (CISH-DC-3). There were between 20.00 and 70.33 clusters per plant. Genotype CISH-DC-20 had the fewest clusters per plant (20.00), whereas genotype CISH-DC-15 had the most clusters per plant (70.33). The range of pods per cluster was 6.67–19.67. The genotype CISH-DC-11 had the maximum number of pods/cluster (19.67), whereas the genotype CISH-DC-2 had the lowest number (6.67). The pod's length varied from 8.40 to 16.80 cm. Genotype CISH-DC-13 had the longest pod (16.80 cm), whereas genotype CISH-DC-3 had the smallest pod (8.40 cm). Pod width varied from 1.03 cm for CISH-DC-3 to 2.25 cm for CISH-DC-13. The weight of the pods varied from 2.97 to 5.97 g. The genotype CISH-DC-1 had the lowest average pod weight, whereas genotype CISH-DC-6 had the greatest average pod weight. The range of pod output per plant was 1.90–10.17 kilogram. The genotype CISH-DC-3 had the maximum pod production per plant, whereas CISH-DC-2 had the lowest pod output per plant. The great diversity among the genotypes for significant features was shown by the broad range and mean values, indicating the possibility of enhancing dolichos beans by selective breeding. Chaitanya et al. (2011), Dhillon and Kumar (2015), Chauhan et al. (2021), and Singh et al. (2022) have all previously documented similar variability patterns in dolichos beans. The degree of variability shown by various qualities may be accurately measured using the genotypic and phenotypic coefficients of variation. All of the factors showed higher PCV than GCV, suggesting the influence of surroundings on character expression, but the differences were negligible. The small difference between the genotypic and phenotypic coefficients of variation suggests that genetic factors dominate trait expression. With equal probability of success, the choices made based on these characteristics are probably going to be successful. The yield of pod/plant (50.89 and 50.53), days to first flowering (44.39 and 44.38), pod weight (33.04 and 33.00), plant height (26.82 and 25.19), pod width (23.41 and 23.36), number of clusters/plant (25.80 and 25.20), and number of flowers/cluster (24.00 and 23.54) all showed good potential for improvement.

Table 1 Genotypic (G) and phenotypic (P) correlation coefficient estimation among the traits of dolichos genotypes

Trait		Plant height (m)	No. of primary branches/ plant	Days to first flowering	No. of flowers/ cluster	No. of clusters/ plant	No. of pods/ cluster	Pod length (cm)	Pod width (cm)	Pod weight (g)	Pod yield/ plant (kg)
Plant height (m)	G	1.000	0.156	0.089	0.451*	0.528*	0.444*	0.357	0.112	0.193	0.565**
	P	1.000	0.093	0.083	0.418*	0.497*	0.396*	0.328	0.106	0.185	0.527*
Number of primary branches/plant	G		1.000	-0.249	-0.012	0.067	0.105	-0.154	-0.203	-0.141	-0.044
	P		1.000	-0.223	-0.031	0.063	0.042	-0.145	-0.192	-0.127	-0.064
Days to first flowering	G			1.000	-0.238	-0.102	0.038	0.192	0.306	0.211	0.066
	P			1.000	-0.232	-0.102	0.038	0.191	0.306	0.211	0.067
No. of flowers/ cluster	G				1.000	-0.020	0.647**	0.061	-0.093	-0.087	0.316
	P				1.000	-0.022	0.648**	0.060	-0.090	-0.086	0.323
No. of clusters/plant	G					1.000	-0.028	-0.218	0.170	-0.253	0.309
	P					1.000	-0.030	-0.216	0.171	-0.250	0.307
No. of pods/cluster	G						1.000	0.187	0.151	0.221	0.678**
	P						1.000	0.185	0.150	0.210	0.676**
Pod length (cm)	G							1.000	0.227	0.769**	0.484
	P							1.000	0.228	0.765**	0.481
Pod width (cm)	G								1.000	0.571**	0.606**
	P								1.000	0.570**	0.602**
Pod weight (g)	G									1.000	0.664**
	P									1.000	0.658**
Pod yield/plant (kg)	G										1.000
	P										1.000

*Significant at 5% level; ** Significant at 1% level.

May 2024] YIELD AND YIELD CONTRIBUTING TRAITS VARIABILITY IN DOLICHOS BEAN

Table 2 Estimates of direct (bold) and indirect effect of significant traits on yield of dolichos bean

527

Character	Plant height (m)	No. of primary branches/ plant	Days to first flowering	No. of flowers/ cluster	No. of clusters/ plant	No. of pods/ cluster	Pod length (cm)	Pod width (cm)	Pod weight (g)	Pod yield/ plant (kg)
Plant height (m)	-0.2221	0.0021	-0.0001	0.0724	0.3277	0.2279	0.0144	0.006	0.1364	0.5648
Number of primary branches/plant	-0.0346	0.0135	0.0003	-0.002	0.0418	0.0537	-0.0062	-0.0109	-0.0996	-0.0346
Days to first flowering	-0.0197	-0.0034	-0.0012	-0.0382	-0.0634	0.0194	0.0078	0.0164	0.1487	0.0664
No. of flowers/cluster	-0.1002	-0.0002	0.0003	0.1605	-0.0126	0.3322	0.0024	-0.005	-0.0614	0.3161
No. of clusters/plant	-0.1172	0.0009	0.0001	-0.0033	0.6207	-0.0144	-0.0088	0.0091	-0.1781	-0.1172
Number of pods/cluster	-0.0986	0.0014	.0001	0.1038	-0.0174	0.5136	0.0076	0.0081	0.1557	0.6741
Pod length (cm)	-0.0794	-0.0021	-0.0002	0.0097	-0.135	0.0962	0.0404	0.0122	0.5423	0.4841
Pod width (cm)	-0.0249	-0.0028	-0.0004	-0.015	0.1057	0.0775	0.0092	0.0536	0.4028	-0.0249
Pod weight (g)	-0.043	-0.0019	-0.0003	-0.014	-0.1568	0.1134	0.0311	0.0306	0.7053	0.6644

Residual effect – 0.1293.

Therefore, it's crucial to take into account a few other characteristics while choosing dolichos bean genotypes for increased yield in subtropical areas.

Therefore, it can be inferred from the results that dolichos bean genotypes vary significantly in terms of pod yield and yield-

related characteristics. While the number of primary branches/plant, days to first flowering, number of flowers/cluster, and pod width exhibited a positive connection with yield, the number of clusters/plant and the number of pods/plant had direct positive influence on production. Pod weight, cluster density, pod density, pods per plant, flowers per cluster, pod length, and pod breadth all directly and favorably affect yield and can be utilized in dolicho selective breeding.

REFERENCES

- Afsan N and Roy A K. 2020. Genetic variability, heritability and genetic advance of some yield contributing characters in lablab bean [*Lablab purpureus* (L.) Sweet]. *Journal of Bio-Science* **28**: 13–20.
- Al-Jibouri H A, Millar P A and Robinson H F. 1955. Genotypic, environmental variance and covariance in upland cotton cross of inter specific origin. *Agronomy Journal* **50**: 533–36.
- Allard R W. 1960. *Principles of Plant Breeding*, pp. 485, John Wiley and Sons London, England.
- Bendale V W, Topare S S, Bhav S G, Mehta J K and Madhav R R. 2004. Genetic analysis of yield and yield components in lablab bean [*Lablab purpureus* (L.) Sweet]. *Orissa Journal of Horticulture* **32**: 99–101.
- Chaitanya V, Reddy R V S K, Pandravada S R and Reddy P K. 2011. Evaluation of dolichos bean (*Dolichos lablab* L. var. typicus) germplasm for growth, flower pod and seed traits. *Haryana Journal of Horticultural Sciences* **40** (1–2): 93–97.
- Chauhan S and Kundu S. 2021. Estimation of genetic variability, heritability and genetic advance for yield and yield attributing traits in dolichos bean (*Dolichos lablab* L.). *International Journal of Environment Agriculture and Biotechnology* **6**: 88–95.
- Desai S B, Bendale V W, Bhav S G, Madav R R and Mehta J L. 2003. Heterosis of growth and development characters in lablab bean (*Lablab purpureus* L.). *Research on Crops* **4**(3): 366–72.
- Dewey D R and Lu K H. 1959. A correlation and path coefficient analysis of wheat gross production. *Agronomy Journal* **51**: 515–18.
- Dhillon T S and Kumar Ajay. 2015. Variability, heritability, correlation and genetic divergence studies in dolichos bean (*Lablab purpureus* L.). *Journal of Horticultural Science* **10**(2): 147–53.
- Gomez K A and Gomez A A. 1984. *Statistical Procedures for Agricultural Research*, 2nd edn. John Wiley and Sons Inc, New York.
- Johnson H W, Robinson H F and Comstock R E. 1955. Estimate of genetic and environmental variability in Soybean. *Agronomy Journal* **47**: 314–18.
- Magalingam V, Yassin M and Kumar S R. 2013. Genetic variability and character association in dolichos bean. *Journal of Agriculture* **11**(2): 161–71.
- Miller P A, Williams J C, Robinson, H F and Comstock R E. 1958. Estimate of genotypic and environment variance in upland cotton and the implications and selections. *Agronomy Journal* **50**: 126–31.
- Morris J B. 2009. Morphological and reproductive characterization in hyacinth bean (*Lablab purpureus* L.) germplasm chemically proven nutraceutical and pharmaceutical traits for use as a medical food. *Journal of Dietary Supplement* **6**(3): 263–79.
- Roy S K, Karim M A, Islam A K, Bari M N, Mian M A K and Hidayak T. 2006. Relationship between yield and its component characters of bush bean. *South Pacific Studies* **27**(2): 13–23.
- Singh R, Sharma D, Trivedi J and Nair S. 2022. Evaluation of dolichos bean (*Lablab purpureus* L.) for pod yield and its traits. *The Pharma Innovation* **11**(8): 293–98.
- Singh S R, Ahmed N, Kumar D, Trivedi A K, Singh A and Mir M. 2020. Assessment of genetic variability of chilli in western Himalayan region. *Journal of Environmental Biology* **41**: 266–73.