



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

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www.agronomyjournals.com

2025; 8(1): 986-992

Received: 02-10-2024

Accepted: 05-11-2024

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Correlation and Path Coefficient Analysis for Yield and Yield Components in Dolichos Bean (*Lablab purpureus* L.)

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DOI: <https://doi.org/10.33545/2618060X.2025.v8.i1i.4701>

Abstract

The present investigation was carried out to assess the correlation and path coefficient analysis for yield and yield components in dolichos bean (*Lablab purpureus* L.). The experiment was conducted during Rabi 2021-2022 at the PG Research Block, College of Horticulture, Mojerla, Telangana, using 45 genotypes laid out in a Randomized Block Design with two replications. Observations were recorded on sixteen yield, yield-attributing and quality traits and phenotypic and genotypic correlation coefficients were estimated.

Correlation studies revealed that pod yield per plant showed positive and significant correlation with vine length (0.3446 P, 0.3606 G), number of primary branches per plant (0.3642 P, 0.3881 G), number of pods per plant (0.6909 P, 0.7243 G) and 100-seed dry weight (0.4433 P, 0.4974 G). At the phenotypic level, pod yield also exhibited significant positive association with 100-seed fresh weight (0.2460), seed width (0.2276) and protein content (0.2812). In general, genotypic correlation coefficients were higher than phenotypic correlations, indicating predominant genetic control over trait associations.

Path coefficient analysis revealed that vine length exerted a positive direct effect on pod yield at both phenotypic (0.2330) and genotypic (0.2261) levels. Number of primary branches per plant showed low positive direct effect at phenotypic level (0.1673) and high positive direct effect at genotypic level (0.3302). Traits such as days to 50% flowering, pod length, pod width, number of seeds per pod, seed length, seed width and 100-seed dry weight also exhibited positive direct effects on pod yield at the genotypic level. Total sugars showed negligible direct effects on pod yield (−0.0544 P and 0.0387 G). The residual effects were low at phenotypic (0.304) and genotypic (0.233) levels, indicating adequate explanation of yield variability by the traits studied. The study identified key yield-contributing characters that can be effectively utilized in selection programmes for improving pod yield in dolichos bean.

Keywords: Dolichos bean (*Lablab purpureus* L.), Pod Yield, Correlation Coefficient Analysis and Path Coefficient Analysis

Introduction

Dolichos bean (*Lablab purpureus* L.), commonly known as Indian bean or hyacinth bean, is an important traditional legume vegetable widely cultivated in India. Archaeobotanical evidence from Iron Age sites in Karnataka and Andhra Pradesh confirms its Indian origin and long history of domestication (Fuller, 2003). The crop belongs to the tribe Phaseoleae and is valued for its tender green pods, dry seeds, fodder and soil-enriching ability through biological nitrogen fixation.

The crop is nutritionally rich, with pods containing substantial amounts of carbohydrates, proteins, fibre and essential minerals such as calcium, phosphorus and iron, along with vitamins like vitamin C and thiamine (Naeem *et al.*, 2009) ^[11]. Dolichos bean also exhibits medicinal properties and is well adapted to arid and semi-arid regions due to its drought tolerance and ability to perform under low rainfall conditions. It is grown in diverse forms ranging from bushy to climbing types and is utilized as a vegetable, pulse, fodder and green manure crop (Bose *et al.*, 1993) ^[4].

Despite its nutritional and agronomic importance, dolichos bean remains underexploited due to low productivity, long duration, photosensitivity and indeterminate growth habit. In Telangana, cultivation is largely confined to local landraces and farmer-selected varieties, resulting in wide

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variability in pod yield and quality traits. Improvement in yield potential through effective utilization of indigenous and exotic germplasm has been emphasized for developing compact, early and photo-insensitive genotypes (Shivashankar *et al.*, 1993) ^[16]. Pod yield in dolichos bean is a complex quantitative trait influenced by several yield-contributing and quality characters, each governed by polygenic inheritance and affected by environmental factors. Therefore, assessment of genetic variability, heritability and genetic advance is essential for understanding the scope of improvement through selection (Savitha *et al.*, 2008 and Parmar *et al.*, 2013) ^[15, 12]. The success of any crop improvement programme largely depends on the availability of genetic diversity and the magnitude of association among yield and its component traits.

Correlation analysis provides information on the nature and degree of association between yield and its contributing characters, whereas path coefficient analysis further partitions these correlations into direct and indirect effects, thereby identifying the actual contribution of individual traits towards yield (Al-Jibouri *et al.*, 1958) ^[1]. Such information is crucial for formulating efficient selection strategies, particularly when multiple traits influence yield simultaneously. Moreover, understanding genetic divergence among genotypes aids in identifying diverse and promising parents for use in breeding programmes (Ismunadji and Arsyad, 1990) ^[9].

In view of the above, the present investigation was undertaken to study the correlation and path coefficient analysis for yield and yield components in dolichos bean (*Lablab purpureus* L.), with the objective of identifying key yield-contributing characters that can be effectively utilized for genetic improvement of the crop.

Materials and Methods

The present investigation was conducted during Rabi season, 2021-2022 at the PG Research Block, College of Horticulture, Mojerla, Wanaparthy, Telangana, to study the correlation and path coefficient analysis for yield and yield components in dolichos bean (*Lablab purpureus* L.). The experimental material comprised 45 genotypes of dolichos bean, including the released variety Arka Adarsh used as a standard check. The genotypes were obtained from the National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Hyderabad.

The experiment was laid out in a Randomized Block Design (RBD) with two replications. Each genotype was represented by eight plants per replication, spaced at 2.0 m × 0.5 m and the crop was trained on a pandal system following recommended agronomic practices to ensure uniform growth and development. Observations were recorded on sixteen yield, yield-attributing and quality traits, including vine length, number of primary branches per plant, days to 50% flowering, days to first harvest, pod length, pod width, number of pods per plant, number of seeds per pod, 100-seed fresh weight, 100-seed dry weight, seed length, seed width, protein content, reducing sugars, total sugars and pod yield per plant. Data were recorded on a plant basis and mean values were used for statistical analysis.

Phenotypic and genotypic correlation coefficients among the characters were computed to assess the nature and magnitude of association between pod yield per plant and its component traits. Path coefficient analysis was carried out to partition correlation coefficients into direct and indirect effects of different traits on pod yield per plant, following the method proposed by Wright (1921) ^[19] and subsequently elaborated by Dewey and Lu (1959)

^[6]. The residual effect was calculated to determine the adequacy of the characters included in explaining variability in pod yield per plant. Phenotypic and genotypic correlation coefficients were estimated to determine the degree and direction of association between pod yield per plant and its component characters. These coefficients helped in identifying traits that were positively or negatively associated with yield at both phenotypic and genotypic levels. To further elucidate the nature of these associations, path coefficient analysis was performed by partitioning the correlation coefficients into direct and indirect effects of the independent characters on pod yield per plant, considered as the dependent variable. Path analysis was carried out following the procedure suggested by Wright (1921) ^[19] and later elaborated by Dewey and Lu (1959) ^[6].

The direct effects indicated the true contribution of each character towards pod yield, while indirect effects revealed the influence exerted through other interrelated traits. The residual effect was computed to assess the extent to which the selected characters collectively explained the variability in pod yield per plant. A low residual value indicated that most of the variation in yield was accounted for by the traits included in the analysis, thereby confirming the adequacy of the model used. This approach facilitated the identification of key yield-contributing traits that can be effectively utilized as selection criteria for yield improvement in dolichos bean.

Results and Discussion

Correlation coefficients studies

The phenotypic (P) and genotypic (G) coefficients were worked out for sixteen characters and the results are depicted in Table 1 and Table 2.

Vine length (cm)

Vine length showed positive and significant correlations both in phenotypic and genotypic level with pod length (0.2174 P, 0.2989 G) but at phenotypic level, it showed positive and significant correlation with 100-seed dry weight (0.2117 P) and seed width (0.2123 P). The results of vine length exhibited positive significant correlation are similar for pod length by Pawar and Prajapathi, Chandran *et al.* and Singh *et al.* (2015), Reddy *et al.* (2018) ^[17, 13] in dolichos bean.

Number of primary branches per plant

Number of branches per plant registered positive and significant correlation in phenotypic and genotypic level with number of pods per plant (0.3221 P, 0.3695 G), days to first harvest (0.4037 P, 0.4326 G), days to 50% flowering (0.2860 P, 0.3304 G), but it showed positive and significant correlation with 100-seed fresh weight (0.2150 P), protein content (0.0896 P) at phenotypic level. Negative and significant correlation was noticed with total sugars (-0.1810 G) at genotypic level. similar results of number of primary branches per plant with number of pods per plant were reported by Geetha *et al.* in dolichos bean.

Days to 50% flowering

Days to 50% flowering registered positive significant correlation with number of primary branches per plant (0.2860 P, 0.3304 G), number of seeds per pod (0.2899 P, 0.3561 G) and days to first harvest (0.8471 P, 0.8801 G) both in phenotypic and genotypic level. While, at phenotypic level, positive a significant correlation with seed length (0.2212 P) was observed. The results of days to 50% flowering exhibited positive significant

correlation are similar findings for days to first harvest Singh *et al.* (2015) ^[17]; for number of seeds per pod by Chaitanya *et al.* (2013) ^[5] and Singh *et al.* (2015) ^[17] and Reddy *et al.* (2018) ^[13] in dolichos bean.

Days to first harvest

Days to first harvest showed positive significant correlation with number of primary branches per plant (0.4037 P, 0.4326 G), 100-seed fresh weight (0.3460 P, 0.3629 G) and days to 50% flowering (0.8471 P, 0.8801 G) both in phenotypic and genotypic level. At phenotypic level, it was positive significant correlation with number of seeds per pod (0.2081 P), 100-seed dry weight (0.2713 P) were also noticed and at genotypic level, 100-seed dry weight (0.3286 G) showed positive correlation. The results of days to first harvest exhibited positive significant correlation with days to 50% flowering by Sharma *et al.*, Chaitanya *et al.* (2013) ^[5] and Reddy *et al.* (2018) ^[13] in dolichos bean.

Number of pods per plant

Number of pods per plant exhibited positive and significant correlations in both phenotypic and genotypic level with number of primary branches per plant (0.3221 P, 0.3695 G), number of seeds per pod (0.3028 P, 0.4023 G), 100-seed dry weight (0.4036 P, 0.4287 G). At phenotypic level, it was positive and significant correlations with seed width (0.0141 P) were also registered.

Pod length (cm)

Positive and significant correlation were registered by pod length with vine length (0.2174 P, 0.2989 G) and number of seeds per pod (0.4138 P, 0.4485 G) in both phenotypic and genotypic level. The results of pod length exhibited positive significant correlation with similar findings for vine length by Pawar and Prajapathi and Reddy *et al.* (2018) ^[13] in dolichos bean.

Pod width (cm)

Pod width recorded negative and significant correlation with reducing sugars (-0.2400 P) at phenotypic level. Negative and significant correlation with number of seeds per pod (-0.3155 P, -0.4786 G) and 100-seed fresh weight (-0.3565 P, -0.4042 G) were also registered. The results of pod width exhibited negative significant correlation is in similar finding for number of seeds per pod reported by Reddy *et al.* (2018) ^[13] in dolichos bean.

Number of seeds per pod

Number of seeds per pod showed positive and significant correlations with number of pods per plant (0.3028 P, 0.4023 G), 100-seed fresh weight (0.3370 P, 0.4550 G), pod length (0.4138 P, 0.4485 G), days to 50% flowering (0.2899 P, 0.3561 G) both in phenotypic and genotypic level, but at phenotypic level, positive significant correlation with days to first harvest (0.2081 P). Negative significant correlation with pod width (-0.3155 P, -0.4786 G) both in phenotypic and genotypic level, while negative significant correlation with seed length (-0.2147 P) in phenotypic level were also registered. Similar results of positive correlation with days to 50% flowering, 100-seed fresh weight were reported by Reddy *et al.* (2018) ^[13], for pod length Kiran *et al.* (2014) ^[10] in dolichos bean.

Seed length (cm)

Seed length showed positive and significant correlation with seed width (0.8477 P, 0.8767 G) both in phenotypic and genotypic level, while it was positive and significant correlation

with 100-seed fresh weight (0.2486 P), 100-seed dry weight (0.2527 P) and days to 50% flowering (0.2212 P) at phenotypic level. The negative significant correlation with number of seeds per pod (-0.2147 P), reducing sugars (-0.2467 P) at phenotypic level were observed. Similar results of positive correlation were reported by Singh *et al.* and Reddy *et al.* (2018) ^[13] for seed width in dolichos bean.

Seed width (cm)

Seed width registered positive significant correlation with 100-seed fresh weight (0.3968 P, 0.4266 G), 100-seed dry weight (0.3672 P, 0.4630 G) and seed length (0.8477 P, 0.8767 G) both in phenotypic and genotypic level. While at phenotypic level positive significant correlation with vine length (0.2123 P) and number of pods per plant (0.0141 P) were also recorded. Similar results of positive correlation were reported by Reddy *et al.* (2018) ^[13] for 100-seed fresh weight, seed length in dolichos bean.

100-seed fresh weight (g)

100-seed fresh weight showed positive and significant correlation with number of seeds per pod (0.3370 P, 0.4550 G), 100-seed dry weight (0.2921 P, 0.3371 G), seed width (0.3968 P, 0.4266 G), but at phenotypic level, positive significant correlation with number of primary branches per plant (0.2150 P), seed length (0.2486 P), days to first harvest (0.3460 P) were recorded. At genotypic level it showed positive and significant correlation with days to first harvest (0.3629 G). The negative and significant correlations with pod width (-0.3565P, -0.4042 G) both in phenotypic and genotypic level was also recorded. The results of positive correlation with number of seeds per pod, 100-seed dry weight, seed width were reported by Chaitanya *et al.* (2013) ^[5] and Reddy *et al.* (2018) ^[13] in dolichos bean.

100-seed dry weight (g)

100-seed dry weight showed positive and significant correlation with number of pods per plant (0.4036 P, 0.4287 G), seed width (0.3672 P, 0.4630 G) and 100-seed fresh weight (0.2921 P, 0.3371 G) both in phenotypic and genotypic level, whereas at phenotypic level 100-seed dry weight showed positive and significant correlation with vine length (0.2117 P), seed length (0.2527 P) and days to first harvest (0.2713 P) were observed. And at genotypic level, it was positive significant correlation with number of seeds per pod (0.3182 G) and days to first harvest (0.3286 G) and negative significant correlations with reducing sugars (-0.2093 P) at phenotypic level were registered. Similar results of positive correlation for number of pods per plant and number of seeds per pod were reported by Chaitanya *et al.* (2013) ^[5] and Reddy *et al.* (2018) ^[13] in dolichos bean.

Protein content (%)

Protein content found positive significant correlation with number of primary branches per plant (0.0896 P) at phenotypic level. Similar results were given by Chaitanya *et al.* (2013) ^[5].

Reducing sugars (%)

This trait recorded positive and significant correlations with total sugars (0.5079 G) at genotypic level and negative significant correlation with 100-seed dry weight (-0.2093 P), pod width (-0.2400 P), seed length (-0.2467 P) and protein content (-0.2307 P) at phenotypic level. The findings for pod width are similar to that reported by Patel *et al.* in cowpea.

Total sugars (%)

Total sugars noticed positive and significant correlation with reducing sugars (0.4858 P, 0.5079 G) both in phenotypic and genotypic level. At genotypic level it was negative significant correlation with number of primary branches per plant (-0.1810 G) was observed as reported by Patel *et al.* in cowpea.

Pod yield per plant (g)

This trait exhibited positive and significant correlation with vine length (0.3446 P, 0.3606 G), number of primary branches per plant (0.3642 P, 0.3881 G), number of pods per plant (0.6909 P, 0.7243 G) and 100-seed dry weight (0.4433 P, 0.4974 G). At the phenotypic level, positive and significant association was also observed with 100-seed fresh weight (0.2460), seed width (0.2276) and protein content (0.2812). Similar results, especially for number of pods per plant, were reported by Chaitanya *et al.* (2013) [5], Singh *et al.* (2015) [17], Kiran *et al.* (2014) [10], Attar *et al.* (2022) [2] and Reddy *et al.* (2018) [13]. Higher genotypic correlations than phenotypic correlations indicated predominant genetic control, suggesting that vine length, primary branches, pods per plant and 100-seed dry weight are important selection criteria for yield improvement.

Path coefficient analysis

Path coefficient is the ratio of standard deviation of the effect due to a given cause (independent variable) to the total standard deviation of the effect (dependant variable). This technique, which aims to improve a dependent character like yield when the independent characters have a significant relation in desirable direction and positive direct or indirect effect through other component traits on the dependent characters, it is used in plant breeding programs.

Path analysis was carried out at phenotypic and genotypic level considering pod yield per plant as dependent variable and its attributes viz., vine length (cm), number of primary branches per plant, number of pods per plant, number of seeds per pod, 100-seed fresh weight (g), 100-seed dry weight (g), pod length (cm), pod width (cm), seed length (cm), seed width (cm), days to 50% flowering, days to first harvest, protein content (%), reducing sugars (%) and total sugars (%) as independent variables.

Each component has two path actions viz., direct effect on yield and indirect effect through components which are not revealed by correlation studies. The results of phenotypic path coefficient are presented in Table 3 and genotypic coefficient in Table 4.

Vine length (cm)

At both phenotypic level and genotypic level, vine length showed moderate direct positive effect (0.2330 P, 0.2261 G) on pod yield per plant respectively. The results in dolichos bean are similar with that of Attar *et al.* (2022) [2] in dolichos bean.

Number of primary branches per plant

This trait showed low direct positive effect on pod yield per plant at phenotypic level (0.1673 P) and high positive direct effect at genotypic level (0.3302 G). The findings are according to Attar *et al.* (2022) [2] in dolichos bean.

Days to 50% flowering

At phenotypic level, days to 50% flowering manifested moderate negative direct effect (-0.2105) on pod yield per plant. At genotypic level, very high positive direct effect was exhibited (1.5679) on pod yield per plant. Similar results were recorded by Singh *et al.* (2015) [17] and Chattopadhyay and Dutta dolichos bean.

Days to first harvest

Days to first harvest had negligible positive direct effect on pod yield per plant (0.0083) at phenotypic level. At genotypic level, this character showed very high negative direct effect (-3.2847) on pod yield per plant. The findings are similarly obtained as reported by Noorjahan *et al.* and Attar *et al.* (2022) [2] in dolichos bean.

Number of pods per plant

Number of pods per plant exhibited high positive direct effect (0.5279 P) on pod yield per plant at phenotypic level. At genotypic level, this trait exhibited very high negative direct effect (-1.3519 G) on pod yield per plant. Findings are similar to that reported by Attar *et al.* (2022) [2] and Chaitanya *et al.* (2013) [5] in dolichos bean.

Pod length (cm)

At phenotypic level, pod length showed negligible negative direct effect (0.056 P) on pod yield per plant. At genotypic level, this character exhibited very high direct positive effect (1.8025 G) on pod yield per plant. Similar findings are reported in dolichos bean by Kyada *et al.* dolichos bean.

Pod width (cm)

At phenotypic level, pod width revealed negligible negative direct effect (-0.0057 P) on pod yield per plant. At genotypic level, this trait recorded high positive direct effect (0.5211 G) on pod yield per plant. Similar results are obtained in dolichos bean by Bansod *et al.* (2021) [3] and Attar *et al.* (2022) [2] in dolichos bean.

Number of seeds per pod

Number of seeds per pod was recorded to have negligible negative direct effect (-0.030 P) on pod yield per plant at phenotypic level. At genotypic level, this trait showed high positive direct effect (0.3474 G) on pod yield per plant. The present observation is in concurrence with Bansod *et al.* (2021) [3] in dolichos bean.

Seed length (cm)

Seed length exhibited negligible negative direct effect (-0.0217) on pod yield per plant at phenotypic level. At genotypic level, this trait exhibited very high direct positive effect (4.3849) on pod yield per plant. Similar results are obtained by Reddy *et al.* (2018) [13] in dolichos bean.

Seed width (cm)

This character noticed negligible positive direct effect on pod yield per plant (0.0681) at phenotypic level. At genotypic level, this trait found very high direct positive effect (4.3666) on pod yield per plant.

100-seed fresh weight (g)

At phenotypic level, 100-seed fresh weight revealed that low positive direct effect (0.1636 P) on pod yield per plant. At genotypic level recorded high negative direct effect (-0.506 G).

100-seed dry weight (g)

100-seed dry weight expressed a very low positive direct effect (0.1309 P) on pod yield per plant at phenotypic level. At genotypic level, this character exhibited very high direct positive effect (1.3021 G) on pod yield per plant. The results are similar with that of Salim *et al.* (2013) [14] in dolichos bean.

Protein content (%)

Protein content manifested low positive direct effect on pod yield per plant (0.1266) at phenotypic level. At genotypic level, this character showed high negative direct effect (-0.4998) on pod yield per plant.

Reducing sugars (%)

This character observed negligible positive direct effect on pod yield per plant (0.0065) at phenotypic level. At genotypic level, this character recorded high negative direct effect (-0.7508) on pod yield per plant.

Total sugars (%)

Total sugars showed a negligible negative direct effect on pod yield per plant at the phenotypic level (-0.0544), while a negligible positive direct effect (0.0387) was observed at the genotypic level. Path analysis, which partitions correlation into direct and indirect effects, revealed that vine length exerted a positive direct effect on pod yield and also showed positive correlation, indicating its importance as a selection criterion. The residual effects were low in magnitude (0.304 at genotypic and 0.233 at phenotypic levels), suggesting that the selected traits adequately explained variability in pod yield. Overall, vine length, number of primary branches per plant, days to 50% flowering, 100-seed dry weight, pod length, pod width, number

of seeds per pod, seed length and seed width exhibited positive direct effects on pod yield per plant and were identified as key yield-contributing traits for improvement of dolichos bean.

Conclusion

The present study clearly establishes that pod yield in dolichos bean (*Lablab purpureus* L.) is predominantly governed by genetically controlled yield components. Strong and consistent positive associations of pod yield with vine length, number of primary branches per plant, number of pods per plant and 100-seed dry weight at both phenotypic and genotypic levels, coupled with their positive direct effects in path analysis, confirm these traits as primary determinants of yield. The higher magnitude of genotypic correlations over phenotypic correlations underscores minimal environmental interference and reinforces the reliability of these traits for selection. Low residual effects further validate that the major sources of yield variation were effectively captured in the analysis. Collectively, the findings provide robust evidence that selection focused on vine vigour, branching ability, pod number and seed weight will lead to substantial improvement in pod yield and the superior genotypes identified for these traits constitute valuable genetic resources for future dolichos bean breeding programmes.

Table 1: Phenotypic (P) correlation coefficients of yield and yield attributes in forty five genotypes of dolichos bean

	Vine length (cm)	Number of primary branches per plant	Days to 50% flowering	Days to first harvest	Number of pods per plant	Pod length (cm)	Pod width (cm)	Number of seeds per pod	Seed length (cm)	Seed width (cm)	100-seed fresh weight (g)	100-seed dry weight (g)	Protein content (%)	Reducing sugars (%)	Total sugars (%)	Pod yield per plant (g)
VL	1.0000	-0.0405	0.1174	0.1077	0.1587	0.2174*	0.0570	0.1300	0.0145	0.2123*	0.1368	0.2117*	0.0760	0.0743	-0.0084	0.3446**
NPB		1.0000	0.2860**	0.4037**	0.3221**	-0.1161	0.0355	0.0803	0.0018	0.1676	0.2150*	0.1778	0.0896	-0.1992	-0.1722	0.3642**
DF			1.0000	0.8471**	0.0651	0.0270	-0.0864	0.2899**	-0.2212*	-0.0474	0.1530	0.1676	-0.0911	-0.0464	0.1824	-0.0768
DFH				1.0000	0.0640	-0.1159	0.0081	0.2081*	-0.1338	0.0665	0.3460**	0.2713**	-0.1481	-0.1099	0.0515	0.0339
NPPP					1.0000	0.1087	-0.0269	0.3028**	-0.2347*	0.0141	0.0256	0.4036**	0.2276*	-0.0636	0.0610	0.6909**
PL						1.0000	0.1018	0.4138**	0.0804	0.1786	0.0340	0.1177	-0.0972	0.0373	0.0035	-0.0827
PW							1.0000	-0.3155**	0.1666	0.1528	-0.3565**	0.1614	-0.1572	-0.2400*	-0.1580	-0.0218
NS								1.0000	-0.2147*	-0.0106	0.3370**	0.2067	-0.0224	0.1189	0.1170	0.1706
SL									1.0000	0.8477**	0.2486*	0.2527*	-0.1738	-0.2467*	-0.0280	0.0140
SW										1.0000	0.3968**	0.3672**	-0.1488	-0.1824	0.0011	0.2276*
SFW											1.0000	0.2921**	-0.1373	-0.0284	0.0372	0.2460*
SDW												1.0000	0.0296	-0.2093*	0.0504	0.4433**
PC													1.0000	-0.2307*	-0.0590	0.2812**
RS														1.0000	0.4858**	-0.1333
TS															1.0000	-0.0847
PYPP																1.0000

*Significant at 5 per cent level; ** Significant at 1 per cent level

VL=vine length(cm);NBP= Primary branches per plant; DF = Days to 50% flowering;DFH= Days to first harvest; NPPP= Number of pods per plant; PL= Pod length (cm); PW=Pod width (cm);NSP=Number of seeds per pod; SL=Seed length (cm); SB=seed breadth (cm); SFW= 100-seed fresh weight; SDW= 100-seed dry weight; PC= Protein content (%); RS= Reducing sugars (%); TS= Total sugars (%); PYPP= Pod yield per plant (g).

Table 2: Genotypic (G) correlation coefficients of yield and yield attributes in forty five genotypes of dolichos bean

	Vine length (cm)	Number of primary branches per plant	Days to 50% flowering	Days to first harvest	Number of pods per plant	Pod length (cm)	Pod width (cm)	Number of seeds per pod	Seed length (cm)	Seed width (cm)	100-seed fresh weight (g)	100-seed dry weight (g)	Protein content (%)	Reducing sugars (%)	Total sugars (%)	Pod yield per plant (g)
VL	1.0000**	-0.0776	0.1259	0.1137	0.1724	0.2989*	0.0999	0.1735	0.0651	0.2853	0.1768	0.2599	0.0729	0.0974	-0.0025	0.3606*
NPB		1.0000**	0.3304*	0.4326**	0.3695*	-0.1370	0.0442	0.1784	-0.0152	0.1943	0.2483	0.2229	0.0897	-0.2183	-0.1810**	0.3881**
DF			1.0000**	0.8801**	0.0620	0.0267	-0.0801	0.3561*	-0.2327	-0.0368	0.1638	0.1589	-0.0799	-0.0507	0.1881	-0.0831
DFH				1.0000**	0.0662	-0.1547	-0.0032	0.2477	-0.1344	0.1137	0.3629*	0.3286*	-0.1519	-0.1153	0.0519	0.0353
NPPP					1.0000	-0.1195	-0.0612	0.4023**	-0.2448	0.0206	0.0313	0.4287**	0.2291	-0.0734	0.0573	0.7243**
PL						1.0000**	0.0264	0.4485**	0.1043	0.2379	0.0226	0.1644	-0.1178	0.0414	0.0165	-0.1145
PW							1.0000**	-0.4786**	0.1743	0.1700	-0.4042**	0.1578	-0.1892	-0.2725	-0.1748	-0.0496
NS								1.0000	-0.2821	-0.0443	0.4550**	0.3182*	-0.0371	0.1496	0.1444	0.2268

SL										1.0000**	0.8767**	0.2500	0.2909	-0.1753	-0.2573	-0.0302	0.0158
SW											1.0000**	0.4266**	0.4630**	-0.1566	-0.1934	0.0006	0.2692
SFW												1.0000**	0.3371*	-0.1460	-0.0147	0.0396	0.2570
SDW													1.0000**	0.0196	-0.2329	0.0076	0.4974**
PC														1.0000**	-0.2586	-0.0708	0.2839
RS															1.0000**	0.5079**	-0.1465
TS																1.0000**	-0.0841
PYPP																	1.0000

*Significant at 5 per cent level; ** Significant at 1 per cent level VL=vine length(cm);NBP= Primary branches per plant; DF = Days to 50% flowering;DFH= Days to first harvest; NPPP= Number of pods per plant; PL= Pod length (cm); PW=Pod width (cm);NSP=Number of seeds per pod; SL=Seed length (cm); SB=seed breadth (cm); SFW= 100-seed fresh weight; SDW= 100-seed dry weight; PC= Protein content (%); RS= Reducing sugars (%); TS= Total sugars (%); PYPP= Pod yield per plant (g)

Table 3: Phenotypic (P) path coefficients indicating direct and indirect effects of components characters on pod yield in forty five genotypes of dolichos bean

Characters	Vine length (cm)	Number of primary branches per plant	Days to 50% flowering	Days to first harvest	Number of pods per plant	Pod length (cm)	Pod width (cm)	Number of seeds per pod	Seed length (cm)	Seed width (cm)	100-seed fresh weight (g)	100-seed dry weight (g)	Protein content (%)	Reducing sugars (%)	Total sugars (%)
VL	0.2330	-0.0094	0.0273	0.0251	0.0370	0.0506	0.0134	0.0303	0.0034	0.0495	0.0319	0.0493	0.0177	0.0173	-0.0020
NPB	-0.0068	0.1673	0.0479	0.0675	0.0539	-0.0194	0.0059	0.0134	0.0003	0.0280	0.0360	0.0297	0.0150	-0.0333	-0.0288
DF	-0.0247	-0.0602	-0.2105	-0.1783	-0.0137	-0.0057	0.0182	-0.061	0.0466	0.0100	-0.0322	-0.0353	0.0192	0.0098	-0.0384
DFH	0.0009	0.0034	0.0071	0.0083	0.0005	-0.001	0.0001	0.0017	-0.0011	0.0006	0.0029	0.0023	-0.0012	-0.0009	0.0004
NPPP	0.0838	0.1701	0.0344	0.0338	0.5279	-0.0574	-0.0142	0.1599	-0.1239	0.0075	0.0135	0.2131	0.1202	-0.0336	0.0322
PL	-0.0122	0.0065	-0.0015	0.0065	0.0061	-0.056	-0.0057	-0.0232	-0.0045	-0.0100	-0.0019	-0.0066	0.0054	-0.0021	-0.0002
PW	-0.0003	-0.0002	0.0005	0	0.0002	-0.0006	-0.0057	0.0018	-0.0009	-0.0009	0.0020	-0.0009	0.0009	0.0014	0.0009
NS	-0.0039	-0.0024	-0.0087	-0.0062	-0.0091	-0.0124	0.0095	-0.03	0.0064	0.0003	-0.0101	-0.0062	0.0007	-0.0036	-0.0035
SL	-0.0003	0	0.0048	0.0029	0.0051	-0.0017	-0.0036	0.0047	-0.0217	-0.0184	-0.0054	-0.0055	0.0038	0.0053	0.0006
SW	0.0145	0.0114	-0.0032	0.0045	0.0010	0.0122	0.0104	-0.0007	0.0577	0.0681	0.0270	0.0250	-0.0101	-0.0124	0.0001
SFW	0.0224	0.0352	0.0250	0.0566	0.0042	0.0056	-0.0583	0.0551	0.0407	0.0649	0.1636	0.0478	-0.0225	-0.0046	0.0061
SDW	0.0277	0.0233	0.0219	0.0355	0.0529	0.0154	0.0211	0.0271	0.0331	0.0481	0.0382	0.1309	0.0039	-0.0274	0.0066
PC	0.0096	0.0113	-0.0115	-0.0188	0.0288	-0.0123	-0.0199	-0.0028	-0.0220	-0.0188	-0.0174	0.0037	0.1266	-0.0292	-0.0075
RS	0.0005	-0.0013	-0.0003	-0.0007	-0.0004	0.0002	-0.0016	0.0008	-0.0016	-0.0012	-0.0002	-0.0014	-0.0015	0.0065	0.0032
TS	0.0005	0.0094	-0.0099	-0.0028	-0.0033	-0.0002	0.0086	-0.0064	0.0015	-0.0001	-0.0020	-0.0027	0.0032	-0.0264	-0.0544
PYPP	0.3446	0.3642	-0.0768	0.0339	0.6909	-0.0827	-0.0218	0.1706	0.0140	0.2276	0.2460	0.4433	0.2812	-0.1333	-0.0847
Partial R ²	0.0803	0.0609	0.0162	0.0003	0.3648	0.0046	0.0001	-0.0051	-0.0003	0.0155	0.0403	0.0580	0.0356	-0.0009	0.0046

Phenotypic Residual effect =0.304; Diagonal (under lined) values indicate direct effect.

VL=vine length(cm);NBP= Primary branches per plant; DF = Days to 50% flowering;DFH= Days to first harvest; NPPP= Number of pods per plant; PL= Pod length (cm); PW=Pod width (cm);NSP=Number of seeds per pod; SL=Seed length (cm); SB=seed breadth (cm); SFW= 100-seed fresh weight; SWD= 100-seed dry weight; PC= Protein content (%); RS= Reducing sugars (%); TS= Total sugars (%); PYPP= Pod yield per plant (g).

Table 4: Genotypic (G) path coefficients indicating direct and indirect effects of components characters on pod yield in forty five genotypes of dolichos bean

	Vine length (cm)	Number of primary branches per plant	Days to 50% flowering	Days to first harvest	Number of pods per plant	Pod length (cm)	Pod width (cm)	Number of seeds per pod	Seed length (cm)	Seed width (cm)	100-seed fresh weight (g)	100-seed dry weight (g)	Protein content (%)	Reducing sugars (%)	Total sugars (%)
VL	0.2261	-0.0175	0.0285	0.0257	0.0390	0.0676	0.0226	0.0392	0.0147	0.0645	0.0400	0.0588	0.0165	0.0220	-0.0006
NPB	-0.0256	0.3302	0.1091	0.1429	0.1220	-0.0452	0.0146	0.0589	-0.0050	0.0642	0.0820	0.0736	0.0296	-0.0721	-0.0598
DF	0.1974	0.518	1.5679	1.3800	0.0972	0.0418	-0.1256	0.5583	-0.3648	-0.0577	0.2568	0.2491	-0.1252	-0.0795	0.2949
DFH	-0.3734	-1.4211	-2.8910	-3.2847	-0.2175	0.5080	0.0104	-0.8136	0.4413	-0.3736	-1.1920	-1.0793	0.4989	0.3787	-0.1704
NPPP	-0.233	-0.4995	-0.0838	-0.0895	-1.3519	0.1616	0.0828	-0.5439	0.3309	-0.0279	-0.0423	-0.5795	-0.3098	0.0992	-0.0774
PL	-0.5388	0.2470	-0.0481	0.2788	0.2155	-1.8025	-0.0476	-0.8083	-0.1881	-0.4288	-0.0408	-0.2964	0.2124	-0.0747	-0.0298
PW	-0.0520	-0.0230	0.0417	0.0016	0.0319	-0.0138	-0.5211	0.2494	-0.0908	-0.0886	0.2106	-0.0822	0.0986	0.1420	0.0911
NS	0.0603	0.0620	0.1237	0.0861	0.1398	0.1558	-0.1663	0.3474	-0.0980	-0.0154	0.1581	0.1105	-0.0129	0.0520	0.0502
SL	-0.2855	0.0667	1.0203	0.5891	1.0733	-0.4575	-0.7643	1.2371	-4.3849	-3.8446	-1.0964	-1.2756	0.7686	1.1282	0.1324
SW	1.2458	0.8486	-0.1608	0.4967	0.0900	1.0387	0.7425	-0.1935	3.8286	4.3666	1.8626	2.0216	-0.6838	-0.8446	0.0027
SFW	-0.0895	-0.1256	-0.0829	-0.1836	-0.0158	-0.0115	0.2045	-0.2302	-0.1265	-0.2158	-0.5060	-0.1705	0.0739	0.0074	-0.0200
SDW	0.3384	0.2903	0.2069	0.4278	0.5582	0.2141	0.2055	0.4143	0.3788	0.6028	0.4389	1.3021	0.0255	-0.3033	0.0099
PC	-0.0364	-0.0448	0.0399	0.0759	-0.1145	0.0589	0.0946	0.0186	0.0876	0.0783	0.0730	-0.0098	-0.4998	0.1293	0.0354
RS	-0.0731	0.1639	0.0381	0.0866	0.0551	-0.0311	0.2046	-0.1123	0.1932	0.1452	0.0110	0.1749	0.1941	-0.7508	-0.3813
TS	-0.0001	-0.007	0.0073	0.0020	0.0022	0.0006	-0.0068	0.0056	-0.0012	0	0.0015	0.0003	-0.0027	0.0196	0.0387
PYPP	0.3606	0.3881	-0.0831	0.0353	0.7243	-0.1145	-0.0496	0.2268	0.0158	0.2692	0.2570	0.4974	0.2839	-0.1465	-0.0841
Partial R ²	0.0815	0.1281	-0.1303	-0.116	-0.9792	0.2064	0.0258	0.0788	-0.0692	1.1755	-0.1300	0.6477	-0.1419	0.1100	-0.0033

Genotypic Residual effect= 0.233; Diagonal (under lined) values indicate direct effect

VL=vine length(cm);NBP= Primary branches per plant; DF = Days to 50% flowering;DFH= Days to first harvest; NPPP= Number of pods per plant; PL= Pod length (cm); PW=Pod width (cm);NSP=Number of seeds per pod; SL=Seed length (cm); SB=seed breadth (cm); SFW= 100-seed fresh weight; SWD= 100-seed dry weight; PC= Protein content (%); RS= Reducing sugars (%); TS= Total sugars (%); PYPP= Pod yield per plant (g).

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