Vegetable Science (2024) 51(1): 142-147
doi: 10.61180/vegsci.2024.v51.i1.19
ISSN- 0970-6585 (Print), ISSN- 2455-7552 (Online)
www.isvsvegsci.in

RESEARCH ARTICLE

Variability in horticultural and biochemical traits of dolichos bean (*Lablab purpureus* L.) landraces from Bundelkhand region of Uttar Pradesh

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Abstract

The present experiment of Dolichos bean (*Lablab purpureus* L.) was laid out during *Kharif* 2020 at Vegetable Research Farm, RLBCAU, Jhansi, Bundelkhand region of Uttar Pradesh. In this investigation, a total of 21 genotypes of Dolichos bean were sown in a randomized block design with two replications to estimate genetic variability, heritability and genetic advance analysis among genotypes. Observations were recorded on 21 quantitative and qualitative characters. Analysis of variance and mean performance for pod yield and its components revealed significant differences among all the genotypes for all the genotypes for all characters except days to first pod harvesting and dry matter content, indicating the presence of a wide range of variability in studied genotypes. Phenotypic coefficient variation values were slightly greater than genotypic coefficient variation, which revealed little influence of environment on their expression. High estimates of the genotypic and phenotypic coefficient of variation were observed for the characters *viz.*, inflorescence length, number of flowers per inflorescence, number of pods per inflorescence, pod length, vitamin C content, pod yield per plot and 10 pod weights. High heritability coupled with genetic advance as percent of mean was observed for leaf length, flower attributes and pod attributes, except days to first pod harvest, pod width, a width of leaf, days to 50% flowering, number of pod per inflorescence, pod length and chlorophyll content. Based on yield performance, the genotypes, namely RLBDL- S-8 and RLBDL- S-14 were found to be promising genotypes for productive and biochemical traits of Dolichos bean in the Bundelkhand region of Uttar Pradesh.

Keywords: Dolichos bean, Heritability, Genetic advance, quality.

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Citation: Singh, A., Pandey, M., Pandey, A.K., Dubey, R.K., Sharma, G., Kumar, V., Shivam. and Pandey, P. (2024). Variability in horticultural and biochemical traits of dolichos bean (*Lablab purpureus* L.) landraces from Bundelkhand region of Uttar Pradesh. Vegetable Science, 51(1), 142-147.

Source of support: Nil

Conflict of interest: None.

Received: 25/02/2024 **Revised:** 15/05/2024 **Accepted:** 30/05/2024

Introduction

Dolichos bean, botanically known as (*Lablab purpureus* L.) with chromosome number 22 and belongs to the family *Fabaceae*. It is one of the most ancient crops known for its food and fodder value and is grown throughout the country. It is also known as poor man's bean (Ismunandji and Arsyad, 1990) and originated in India. It is a perennial herbaceous crop but cultivated as an annual bushy and pole erect or climbing type. Wild species is mostly perennial in nature. Fruit is a legume pod; variable in shape, size, and color and primarily grown for green pods used for vegetable purposes. It is a rich source of protein, minerals, vitamins, carbohydrates and fiber. Protein content is found approximately 4% in green pods and 20 to 25% in dry pods (Ibrahim et al., 2008). Among vitamins and minerals, it contains vitamin C 5 mg, vitamin B_1 0.1 mg, vitamin A 312 IU and carbohydrate content is 6.7 g per 100 g, whereas potassium 262 mg, calcium 210 mg and iron 1.7 mg per 100 g edible part (Gopalan et al., 1996). Dolichos bean is of two types- one is vegetable type (*D. lablab* var. typicus) and another one pulse type of Dolichos bean (*D. lablab* var.

lignosus). It is photo- sensitive and short- and long-day plant and crop grown throughout the country and distributed in Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu and North Eastern states. Karnataka state is the highest producer and shares around 92%. This crop has not gained the desired attention from geneticists and breeders even though a wide genetic base exists for the breeding program (Magalingam et al., 2013), (Upadhayay and Mehta, 2012). Despite of being originated in India, very little work has been done in the field of yield and quality aspects of Dolichos bean. Augmenting the current low on farm productivity (0.5 t ha^{-1}) to a potential level (2.0 t ha^{-1}) (Shivashankar and Kulkarni, 1989) suggested broadening the genetic base of Dolichos bean cultivars through enhanced use of diverse germplasm accessions. The yield level of the Dolichos bean is low, which is mainly due to the non-availability of desirable high-yielding, disease and insect-resistant varieties and poor management practices. Hence, the high yield potential and quality are the main targets for an effective breeding program in this crop. For any crop improvement program, it is essential that sufficient variability exist for economically important traits in germplasm. Many workers have repeatedly emphasized the importance of genetic variability and the selection of parents for recombination breeding in crops. Genetic variability, heritability and genetic advance are prerequisites for the improvement of crops for selection of superior genotypes and improvement of traits. Moreover, estimates of heritability indicate the extent of transmissibility of a character in advanced generations which helps in selection-base improvement. In India, large numbers of indigenous strains are available throughout the country but very little work has been done for the genetic improvement of yield and quality. Keeping in view the mentioned facts, the present study was therefore aimed to study variability, heritability and genetic advance among 21 genotypes of Dolichos bean for variability in productive and biochemical traits.

Materials and Methods

The experiment was conducted at a Vegetable research farm, RLBCAU, Jhansi, Bundelkhand, Uttar Pradesh during 2020-2021. The experimental site is situated at 25.31° N latitude and 78.33°E longitude at an altitude of 227 m above mean sea level. The experimental material comprised 21 germplasm of Dolichos bean. All the landraces are locally collected from different regions of the Bundelkhand and Sultanpur districts of UP (Table 1). The soil of the experimental plot was sandy loam, having pH 6.7, which depicts the acidic nature of the experimental soil. The organic carbon content of soil was 2.03 g/kg of soil and electrical conductivity was 0.4dS/m. The genotypes were sown to different sub-plots in each replication randomly following the principle of RBD. Each genotype was sown by dibbling method and two to three seeds were sown per hill at a distance 100 × 75 cm (row to plant) and subplot diameter 4 × 2 m (length x width), which contain 10 to 11 plants per plot. The plots were irrigated immediately after sowing. After a span of 25 days, weak and non-vigorous seedlings were thinned out and one good seedling was left per hill. Throughout the raising of a crop, it became observed that aphids and pod borers are the primary pests of the Dolichos bean. The observations were recorded from 5 randomly selected plants from each genotype in each replication. The data recorded on 16 quantitative and 5 quality characters *viz*., leaves length (cm), a width of leaves (cm), days to first flowering, days to 50% flowering, length of inflorescence (cm), number of flowers per inflorescence, number of pods per inflorescence, pod length (cm), pod width (cm), days to first pod harvesting, duration of picking, pod per cluster, 10 pod weight (cm), number of seed per pod, pod yield per plant (kg), pod yield per plot (kg) total soluble solid (^{0}Brix), dry matter content, chlorophyll content (mg/100g), vitamin C content (mg/100g) and protein content (%).

Results and Discussion

The current study indicated that there were wide variations in morphological characters (leaves shape, leaves color, flower color, fresh pod curvature and pod color, etc.), quantitative characters (days to 50% flowering, days to first flowering, number of flowers per inflorescence, number of pods per inflorescence, pod length and 10 pod weight, etc.), quality traits (total soluble solid, vitamin C content, dry matter content, chlorophyll content and protein content) and yield among Dolichos bean genotypes.The data recorded on 21 genotypes in the experiment was subjected to analysis of variance. The mean sum squares are given in Table 2 for different characters. The highly significant mean sum of squares was recorded in the traits *viz.,* length of leaf, the width of leaf, days to 50% flowering, length of inflorescence, number of flowers per inflorescence, number of pod per inflorescence, pod width, pod length, duration of picking, number of pod per cluster, ten pod weight, number of seed per pod, total soluble solid, dry matter content (%), vitamin C content, protein content, pod yield per plant, pod yield per plot, days to first pod harvesting and chlorophyll content. It indicated significant differences with respect to all traits, showing sufficient genetic variations among all genotypes of the Dolichos bean under study. Moreover, (Peer et al., 2018) and (Reddy et al., 2019) also reported significant variability among Indian bean genotypes and their findings corroborate with the results obtained in the study. The phenotypic coefficient of variation was found to be higher than the genotypic coefficient of variation for all 21 quantitative characters in the present investigation, indicating that the apparent variation was not only due to genotype but also to favorable

Table 1: Genotypes of Dolichos bean and their sources of collection

S. No.	*Genotype*	*Location of collection*	*Village*	*S. No.*	*Genotype*	*Location of collection*	*Village*
1	RLBDL-S-1	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Brasin Kudwar	12	RLBDL-S-9	Sultanpur Latitude:26.1412203″N Longitude:82.2469606″E	Hanumatnagar
2	RLBDL- S-1-1	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Parsipur Kudwar	13	RLBDL-S-10	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Utmanpur
3	RLBDL-S-1-2	Sultanpur Latitude:26.4133^{0}N Longitude:82.1272^0	Jamkhuri Lambhuwa	14	RLBDL-S-11	Sultanpur Latitude:26.1412203″N Longitude:82.2469606″E	Dhanaudhee
4	RLBDL-S-2	Sultanpur Latitude:26.4133^{0}N Longitude:82.1272^0	Badshada Lambhua	15	RLBDL-S-12	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Kevtli
5	RLBDL-S-3	Sultanpur Latitude:26.1412203″N Longitude:82.2469606″E	Koluhamau Belhari	16	RLBDL-S-13	Sultanpur Latitude:26.1412203″N Longitude:82.2469606″E	Jaysinghpur
6	RLBDL-S-4	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Bansi Kudwar	17	RLBDL-S-14	Sultanpur Latitude:26^{0}25′59.99″N Longitude:82^{0}06′60.00″E	Katka
7	RLBDL-S-4-5	Sultanpur Latitude:26^{0}10′12.00″N Longitude:82^{0}22′48.00″E	Utmanpur Kudwar	18	RLBDL-J-1	Jhansi Latitude:25.444128″N Longitude78.567597:″E	Bhojla
8	RLBDL-S-5	Sultanpur Latitude:26.1412203″N Longitude:82.2469606″E	Belhari	19	RLBDL-J-2	Jhansi Latitude:25.444128″N Longitude:78.567597″E	Simradha
9	RLBDL-S-6	Sultanpur Latitude:26^{0}25′59.99″N Longitude:82^{0}06′60.00″E	Bhartipur	20	RLBDL-J-3	Jhansi Latitude:25.5015″N Longitude:79.31959″E	Lakara
10	RLBDL-S-7	Sultanpur Latitude:26^{0}25′59.99″N Longitude:82^{0}06′60.00″E	Babuganj	21	RLBDL-J-4	Jhansi Latitude:25.45205″N Longitude:78.51605″E	Karari
11	RLBDL-S-8	Sultanpur Latitude:26.4133^{0}N Longitude:82.1272^0	Gopalpur				

Table 2: ANOVA analysis of Dolichos bean genotypes for different horticultural traits

Characters	*Source of variation*		
	Replications Mean sum of Squares	*Treatments Mean sum of Squares*	*Error*
D. F.	1	20	20
Leaf length	0.128	10.496**	0.140
Width of leaf	0.009	0.255**	0.080
Days of first flowering	262.5	702.67**	58.45
Days to 50% flowering	421.166	488.680**	124.066
Length of inflorescence	34.634	85.594**	15.103
Number of flower per inflorescence	21.143	108.486**	9.529
Number of pod per inflorescence	355.543	19.313**	13.985
Pod length	11.005	21.139**	1.917
Pod width	0.001	0.223*	0.094
Days to first pod harvesting	106.881	532.873	277.130
Duration of picking	0.214	4.280**	1.114

Number of pod per cluster	0.125	4.537**	0.471
10 Pod weight	365.151	440.517**	36.895
Number of seed per pod	0.011	0.928**	0.070
Total Soluble Solid	0.005	1.717**	0.045
Dry matter content	0.003	21.951**	0.009
Chlorophyll content	29.316	45.447	30.137
Vitamin C content	0.044	176.384**	0.090
Protein content	0.005	4.119**	0.275
Pod yield per plant	0.009	0.495**	0.083
Pod yield per plot	0.020	6.205**	0.382

Table 3: Components of genetic variability for different horticultural traits in Dolichos bean genotypes

Trait	*Range*	*Mean*	*Vp*	*Vg*	*PCV (%)*	*GCV (%)*	*Heritability bs (%)*	*Genetic Advance*	*GA as % of mean*
LL	6.64-15.55	10.97	5.31	5.17	21.01	20.74	97.40	5.92	54.02
WL	0.88-2.08	1.52	0.16	0.088	26.94	19.42	52.00	0.56	36.97
DFF	76.50-133.00	104.80	380.56	322.11	18.58	17.09	84.60	43.59	43.59
50 DF	106.00-158.50	127.74	306.37	182.30	13.70	10.57	59.50	27.49	21.52
LI	5.70-31.25	12.88	50.34	35.24	55.08	46.08	70.00	13.11	101.79
NFI	6.70-37.30	15.01	59.00	49.47	51.16	46.84	83.85	17.00	113.25
NPI	5.90-16.80	10.05	16.64	2.66	40.59	16.23	16.00	1.72	17.14
PL	5.90-15.62	9.73	11.52	9.61	34.89	31.86	83.33	7.47	76.80
PW	0.87-2.08	1.53	0.15	0.06	26.12	16.60	40.39	0.42	27.85
DFPH	119.50-181.50	154.02	405.00	127.87	13.06	7.34	31.57	16.77	10.89
DP	11.00-17.50	14.74	2.69	1.58	11.14	8.53	58.69	2.54	17.26
PPC	3.50-8.50	6.02	2.50	2.03	26.30	23.69	81.16	3.39	56.35
10 PW	35.00-80.00	62.13	238.70	201.81	24.86	22.86	84.54	34.48	55.50
NSPP	3.30-5.40	4.16	0.49	0.42	16.96	15.72	85.94	1.60	38.49
TSS	5.75-9.90	7.80	0.88	0.83	12.03	11.71	94.84	2.35	30.13
DMC	7.48-21.16	13.28	10.18	10.97	24.95	24.94	99.91	8.74	65.83
CC	29.74-49.22	39.96	37.79	7.65	15.38	6.92	20.26	3.28	8.22
VCC	3.08-39.68	15.75	88.23	88.14	59.64	59.61	99.99	24.77	157.30
PC	20.73-25.84	24.11	2.19	1.92	6.14	5.75	87.48	3.42	14.20
PYPP1	1.55-3.35	2.31	0.28	0.20	23.26	19.61	71.07	1.01	43.64
PYPP2	4.50-11.05	6.76	3.29	2.91	26.85	25.24	88.38	4.23	62.65

LL: Leaf length, WL: Width of leaf, DFF: Days of first flowering, 50 DF: Days to 50% flowering, LI: Length of inflorescence, NFI: Number of flower per inflorescence, NPI: Number of pod per inflorescence PL: Pod length PW: Pod width, DFPH: Days to first pod harvesting, DP: Duration of picking, PPC: Number of pod per cluster 10PW: 10 Pod weight, NSPP: Number of seed per pod, TSS: Total Soluble Solid, DM: Dry matter content, CC: Chlorophyll content, VCC: Vitamin C content, PC: Protein content, PYPP1: Pod yield per plant, PYPP2: Pod yield per plot

environmental influences and that genotyping based on these traits can be misleading at times. This environmental influence could be due to heterogeneity in soil fertility and other uncontrollable factors. All of the characters had PCV values slightly higher than GCV, indicating that the environment had very little influence on their expression. These findings are in confirmation with the earlier results (Ganesh, 2005; Upadhyay and Mehta, 2011; Magalingam et al., 2013; Mohan et al., 2014). High estimates of GCV and PCV (>30%) were recorded for pod yield per plant, length of

inflorescence, number of flowers per inflorescence, number of pod per inflorescence, 10 pod weight and pod length but GCV was moderate for a number of pod per inflorescence and pod yield per plant (Table 3). The findings of the present experiment were in agreement of Savitha (2008), Rai et al. (2009), Islam et al. (2011) and Upadhayay and Mehta (2011) who also have recorded high GCV and PCV for pod yield per plant, pod yield per plot, number of flower per inflorescence, number of pod per cluster, length of inflorescence and number of pod per inflorescence. Results in respect to 10 pod weight and pod length were in conformity with observations of Magalingam et al. (2013), Mohan et al. (2014), Verma et al. (2015), Choudhary et al. (2016), Ali et al. (2005) and Raj et al. (2021) who obtained the similar result. The very high estimates of variability recorded in the following traits *viz.,* pod yield per plant, pod yield per plot and inflorescence length, indicated sufficient scope for selection. GCV and PCV values were moderate (10–20%) for the parameter pod width (PCV high for pod width), days to first flowering, days to 50% flowering and the number of seeds per pod. These findings corroborate the results of Ingle et al. (2020), Rai et al. (2008), Upadhayay and Mehta (2011), Mohan et al. (2014), Sharma et al. (2014) and Savitha (2008). In the current study, low estimates of variability (0–10%) for days prior to the first pod harvest were found. That result was also proved by Peer et al. (2018) and Kambal et al. (2016), who expressed the view of a limited range of selection. Because the given heritability estimates were made in a wide sense, the total genetic variance may include dominance and epistatic components that are not available for selection. Because heredity is a single numerical expression based on the ratio of two variances, selection based only on heritability estimates may not lead to success. As a result, high heritability in combination with a high genetic advance as a percentage of the mean, proved to be more useful in forecasting the effect of selection (Johnson et al., 1955). High heritability (>60%) and genetic advance as of mean% (>30%) were recorded for the days to first flowering, number of flowers per inflorescence, number of pods per cluster, pod length, pod width, pod yield per plant, number of seed per pod, 10 pod weight, pod yield per plot and protein content. Similar results were found by Rai et al. (2008), and Upadhyay and Mehta (2011). Furthermore, Sharma et al. (2014) for pod yield per plant and Verma et al. (2015) for all the characteristics except days to first harvest, number of pod per inflorescence, days to 50% flowering and pod width recorded for high genetic advance as of mean%. Bendale et al. (2004) and Verma et al. (2015) revealed similar results in the Dolichos bean, indicating the role of non-additive gene action and a significant influence of environment on the expression of these characteristics. In the hybridization program, these quality traits could be utilized through the manifestation of dominance and epistatic components.

Conclusion

On the basis of mean performance and other genetic parameters, superior genotypes such as RLBDL-S-14, RLBDL-S-8, RLBDL-S-1-2, RLBDL-S-5, RLBDL-S-1-1, RLBDL-S-10, RLBDL-J-1, RLBDL-J-2 and RLBDL-S-1 may be used in breeding programs for the development of superior Dolichos bean varieties for commercial cultivation, through crop improvement program. In the present investigation, the PCV, GCV and heritability ranged from 6.14 to 59.64%, 5.75 to 59.61%, 16 to 99.99% and genetic advance as % of mean 8.22 to 157.30%, respectively. In future crop improvement programs, the promising genotypes viz., RLBDL-S-1-2, RLBDL-S-5, RLBDL-S-8, RLBDL-S-7, RLBDL-S-12, RLBDL-S-14, RLBDL-J-1 and RLBDL-J-2 would be more awarding for future, in order to commercial use in large area of Bundelkhand region of Uttar Pradesh.

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सारांश

सेम (लैब्लैब परप्यूरियस एल.) का वर्तमान प्रयोग उत्तर प्रदेश के बुंदेलखंड क्षेत्र के सब्जी अनुसंधान फार्म, आरएलबीसीएयू, झांसी में खरीफ 2020 के दौरान किया गया था। इस जांच में, जीनोटाइप के बीच आनुवंशिक परिवर्तनशीलता, आनुवंशिकता और आनुवंशिक अग्रिम विश्लेषण का अनुमान लगाने के लिए दो प्रतिकृति के साथ एक यादृच्छिक ब्लॉक डिजाइन में सेम के कुल 21 जीनोटाइप बोए गए थे। 21 मात्रात्मक और गुणात्मक वर्णों पर अवलोकन दर्ज किए गए। फली की उपज और उसके घटकों के लिए भिन्नता और माध्य प्रदर्शन के विश्लेषण से पता चला कि पहली फली की कटाई के दिनों और शुष्क पदार्थ की मात्रा को छोड़कर सभी जीनोटाइप के सभी लक्षणों के बीच महत्वपूर्ण अंतर था, जिससे अध्ययन किए गए जीनोटाइप में परिवर्तनशीलता की विस्तृत श्रृंखला की उपस्थिति का संकेत मिला। फेनोटाइपिक गुणांक भिन्नता मान जीनोटाइपिक गुणांक भिन्नता से थोड़ा अधिक थे, जिससे उनकी अभिव्यक्ति पर पर्यावरण का बहुत कम प्रभाव सामने आया। लक्षणों के लिए जीनोटाइपिक और फेनोटाइपिक भिन्नता के गुणांक (पीसीवी, जीसीवी) के उच्च अनुमान देखे गए, जैसे पुष्पक्रम की लंबाई, प्रति पुष्पक्रम में फूलों की संख्या, प्रति पुष्पक्रम में फली की संख्या, फली की लंबाई, विटामिन सी सामग्री, प्रति प्लॉट फली की उपज और 10 फली का वजन. पहली फली की कटाई के दिनों को छोड़कर, फली की चौड़ाई, पत्ती की चौड़ाई, 50% फूल आने के दिन, प्रति पुष्पक्रम में फली की संख्या, फली को छोड़कर, पत्ती की लंबाई, फूल की विशेषताओं और फली की विशेषताओं के लिए औसत प्रतिशत के रूप में आनुवंशिक प्रगति के साथ उच्च आनुवंशिकता देखी गई। लंबाई और क्लोरोफिल सामग्रीउपज प्रदर्शन के आधार पर, आरएलबीडीएल- एस-8 और आरएलबीडीएल- एस-14 जीनोटाइप उत्तर प्रदेश के बुंदेलखंड क्षेत्र में सेम की फलियों के उत्पादक और जैव रासायनिक लक्षणों के लिए आशाजनक जीनोटाइप पाए गए।