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GENETIC VARIABILITY, HERITABILITY AND PATH ANALYSIS OF GROWTH ATTRIBUTES AND YIELD COMPONENTS OF ADVANCE BLACKGRAM GENOTYPES UNDER LATE *KHARIF* CONDITION IN RED AND LATERITE ZONE OF WEST BENGAL

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ABSTRACT

An experiment was conducted to evaluate 17 blackgram genotypes at Regional Research Sub Station (RRSS), Bidhan Chandra Krishi Viswavidyalaya, Raghunathpur, Purulia, West Bengal, India under late *kharif* situation of 2021. The analysis of variance showed highly significant differences among 17 genotypes of black gram for 12 plant characters. The high heritability (H^2) coupled with high genetic advance (GA) as percent of mean was recorded for seed yield (H^2 = 95.1%, GA= 0.40, GA as % mean= 24.84%), pods/plant (H^2= 85.9%, GA= 10.31, GA as % mean= 49.12%), test weight (H^2 = 95.1%, GA= 9.01, GA as % mean= 18.85%), and dry matter accumulation (H^2= 96.4%, GA= 1.26, GA as % mean= 46.84%), which indicated the possibility of improvement through direct selection. The seed yield showed significant positive genotypic correlations with stover yield (r= 0.946), pods/plant (r= 0.817), test weight (r= 0.756), plant height (r= 0.645), and branches/plant (r= 0.667). Path coefficient analysis revealed high direct effects of harvest index (0.382) and stover yield (0.175) on seed yield. Genotypes KU 16-77, KU 17-25 and KU 17-63 exhibited superior performance across multiple traits, and can be recommended as promising parents for developing high-yielding blackgram cultivars adapted to red laterite soil condition in late *kharif* season of West Bengal.

***Keywords* :** Blackgram, genetic variability, heritability, path analysis, seed yield.

Introduction

Blackgram (*Vigna mungo* L.) is a tropical erect or sub-erect, self-pollinated, annual herb of Fabaceae family. It contains 62-65% carbohydrate, 25-28% protein, 3.5-4.5% fibre, 4.5-5.5% ash and 0.5-1.5% oil on dry weight basis, and also contains sulphur containing amino acids, methionine, cysteine and lysine (Rana *et al.*, 2019). The present production of blackgram is quite low in India (22.30 lakh tonnes) mainly due to lack of suitable varieties, poor management practices, lack of awareness and minimal amount of genetic diversity among the present genetic materials.

The success of any crop improvement programme largely depends on the extent of genetic variability present in the germplasm and in depth understanding of the genetic architecture of key agronomic traits. The estimation of genetic parameters such as genotypic and phenotypic coefficients of variation (GCV, PCV), heritability, and genetic advance provides valuable insights into the nature and extent of trait inheritance, thereby guiding effective selection strategies for yield enhancement. Moreover, correlation studies between growth and yield components help in identifying key traits that directly or indirectly influence grain yield, and which can be targeted in breeding programme. The assessment of genetic divergence or similarity among genotypes further aids in the identification of promising parents that can be used in breeding programme. The yield attributes are often interrelated and influenced by various morphological and developmental traits. The magnitude and direction of such associations can be effectively assessed through correlation analysis, which in turn helps the breeders to formulate sound breeding strategies for improving productivity. Additionally, comprehensive knowledge of genetic variability, heritability, genetic advance, and trait associations is essential for selecting suitable parents and adopting appropriate breeding methods for the genetic improvement of blackgram.

In West Bengal, blackgram is cultivated on uplands during *kharif* season by broadcasting method only to utilize the fallow lands. It frequently fails to compete with high-yielding varieties and hybrids of non-legumes produced during this season due to lack of proper management practices, lack of high yielding disease-pest tolerant varieties and heavy disease-pest infestation. Keeping in view, the present experiment was conducted to evaluate some balckgram genotypes for nine quantitative traits, and to study genetic variability along with association of characters for selecting superior genotypes and formulating effective breeding strategies for yield enhancement in blackgram at red lateritic zones of West Bengal.

Materials and Methods

A field experiment was conducted at Regional Research Sub-Station, Red and Laterite Zone (23°54'N, 86°67'E and 240 m), Bidhan Chandra Krishi Viswavidyalaya, Raghunathpur, Purulia, West Bengal during late *kharif* season of 2021 with 17 blackgram genotypes replicate thrice which were randomly allocated in 4m × 3m plots within each replication in a randomized block design (R.B.D.). The recommended agronomic practices were followed to conduct the experiment. The Rhizobium inoculated seeds of 17 blackgram genotypes (*viz.* V_1: Bidhan Kalai, V_2: Uttara, V_3: NUL 242, V_4: PU 10, V_5: KU 15-07, V_6: KU 15-98, V_7: KU 15-99, V_8: KU 15-102, V_9: KU 15-104, V_{10}: KU 16-76, V_{11}: KU 16-77, V_{12}: KU 16-79, V_{13}: KU 16-80, V_{14}: KU 16-81, V_{15}: KU 17-25, V_{16}: KU 17-63, V_{17}: KU 17-70) were sown @ 25 kg/ha at a spacing of 25 cm × 10 cm. The uniform fertilizer dose of 20:40:40 kg/ha of N: P_2O_5: K_2O was given to each experimental unit as basal. Thinning and weeding was done at 15 DAS and 30 DAS, respectively. All 17 blackgram genotypes were manually harvested at 80% pod maturity stage, and subsequently threshing and winnowing were done to separate the grains from pods. The data on all growth and yield parameters were collected following the standard procedures.

The data collected as described earlier were subjected to statistical analysis by analysis of variance (ANOVA) method suitable for RBD in the experiment (Gomez and Gomez, 1984) using online OPSTAT software. Correlation studies were made to reveal the association between dependant and predictor set of variables in the experiment. Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (H^2) and genetic advance (GA) were estimated using IBM SPSS software.

Results and Discussion

The different growth and yield parameters are shown in Table 1. The plant height was varied significantly among genotypes, ranging from 51.63 cm (KU 15-07) to 66.03 cm (KU 16-77). The tallest plant was recorded with KU 16-77 (66.03 cm), followed by PU 10 (62.4 cm) and KU 16-79 (58.37 cm). However, Baisakh *et al. (*2014) reported lower plant height (21.63-40.86 cm) in blackgram during *kharif* season at OUAT, India. The number of branches/plant was varied between 4.17 (NUL 242) to 6.05 (KU 16-77), but lower number of branches/plant of blackgram ranging between 3.60-4.80 at harvest was noted during *kharif* season of 2015 at Ajmer, Rajasthan by Choudhary *et al*., (2017). The accumulated dry matter (DM) was lowest in 1.86 g (KU 15-07) and highest in 3.68 g (KU 16-77). The higher dry matter in KU 16-77, KU 16-79, and PU 10 reflects superior growth performance, likely due to more efficient photosynthesis and source-sink balance. LAI followed a similar trend, with maximum values observed in KU 16-76 (2.27), KU 15-104 (2.23), and KU 16-81 (2.22). The pods/plant were ranged from 15.13 (KU 16-80) to 36.47 (KU 17-63), while pod length from 4.36 cm (KU 15-07) to 5.03 cm (KU 16-79), with non-significant variation among them. The seeds/pod were varied from 6.13 (KU 17-70) to 6.8 (PU 10) with most genotypes maintaining a consistent range (6.23-6.6 seeds/pod), which indicates stable performance across genotypes for this trait. Contrary to this, significant variation in number of seeds/pod of blackgram genotypes was reported by Jadhav *et al.* (2014) during *kharif* season of 2012-13 at MKV, Parbhani, Maharashtra. The minimum test weight (41.93 g) was recorded in NUL 242, while the maximum (56.9 g) was observed in KU 16-79. The seed yield/plant was ranged from 1.29 g (KU 15-104) to 1.95 g (KU 17-63), where the superior performance of KU 17-63, KU 17-25, and PU 10 highlights their yield potential (Fig 1). The stover yield/plant was varied from 3.39 g (NUL 242) to 4.64 g (PU 10) and that could be supported by the fact that PU 10, KU 16-77, KU 16-76 and KU 17-63 produced the taller plants, better branching habit, more LAI, higher aerial dry matter accumulation compared to other genotypes. The harvest index was lowest in KU 15-104 (27.17%) and highest in KU 17-25 (30.93%).

The genotypes KU 17-25, KU 17-63, and KU 16-81 exhibited higher HI (>30%), which suggests better partitioning efficiency of assimilates towards economic yield. There was significant variation in protein content ranged from 16.7% (KU 16-80) to 22.74% (KU 15-07). KU 15-07, KU 16-77, and KU 17-25 recorded higher protein content, which indicates their nutritional superiority. Soris *et al.* (2010) reported higher protein content (>24%) in seeds of *kharif* sown blackgram genotypes at Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

The analysis of variance shows significant variation in different traits among blackgram genotypes tested in the study (Table 2). The coefficient of variation (CV) less than 10% for most of the traits suggests that there was less genotype × environment interaction. The grand mean was varied notably among the traits. The wide phenotypic ranges were observed in such pods/plant (15.13-36.47), test weight (41.93-56.90 g), and harvest index (27.17-30.93%), which indicates substantial inherent variability. High GCV and PCV were reported for dry matter accumulation (23.12% and 23.54%, respectively), pods/plant (25.73% and 27.77%), and seed yield/plant (12.36% and 12.67%), which suggests that these traits are under strong genetic control with minimal environmental influence. This is further supported by their high heritability (>85%) and high genetic advance as a percentage of the mean, particularly for pods/plant (49.12%), dry matter (46.84%), and seed yield/plant (24.84%). These traits exhibit a high proportion of additive gene action, making them promising targets for improvement through simple phenotypic selection. Moderate genetic variability was noted in traits such as plant height, stover yield/plant, leaf area index (LAI), and protein content, where heritability was varied from 62.3% to 89.2%, and GA as percent of mean was ranged from 12.95% to 20.94%. These traits may respond moderately to selection, and can be improved further under replicated and multi-environment trials. On the other hand, traits such as pod length (4.69 cm), seeds/pod (6.43), and harvest index (29.23%) exhibited low heritability (19.8%-51.2%) and low genetic advance as a percent of the mean (<5%), which reflects stronger environmental influence. These traits are less effective for direct selection, and may require alternative strategies like hybridization or marker-assisted breeding. Gill *et al.* (2012) reported high heritability for number of branches/plant (87.39%), moderate heritability for pod length (69.79%), number of seeds/pod (41.42%) and 100-seed weight (37.14%), and low heritability for number of pods/plant (23.15%) and plant height (4.09%) at Punjab Agricultural University, Ludhiana.

The analysis revealed substantial differences between genotypic and phenotypic correlations for many traits which indicate the role of environmental factors influencing trait expressions (Table 3). Genotypic correlations were higher in magnitude compared to phenotypic correlations which signifies that these associations were largely influenced by genetic factors and less affected by the environment. Plant height had significant positive genotypic (r= 0.645**) and phenotypic (r= 0.589**) correlations with seed yield. Similarly, number of branches/plant was positively and significantly correlated with seed yield both genotypically and phenotypically, which signifies that taller plants with more branches tend to support greater number of pods and hence higher yield potential. There was strong positive genotypic (r=0.732**) and phenotypic (r=0.694**) correlations between seed yield, accumulated DM and which reveals that efficient dry matter production and accumulation is vital for better seed development and yield performance likely due to improved source-sink relationships. In contrast to other traits, LAI showed non-significant correlations with seed yield at both genotypic and phenotypic levels. This suggests that under the conditions of the current study, LAI had limited direct contribution to yield, possibly due to sub-optimal leaf retention or inefficient light interception during critical reproductive stages. The pods/plant exhibited highly significant positive correlations with seed yield (r= 0.817** for GCV and r= 0.748** for PCV), which identifies this trait as one of the primary contributors to the yield of blackgram. Similar kind of positive correlation between number pods/plant with seed yield was reported by Venkatesan *et al.* (2004). The pods/plant also showed positive genotypic correlations with branches/plant (r= 0.605*) and stover yield/plant (r= 0.698**), while pod length and seeds/pod showed moderate to weak correlations with seed yield/plant. At the genotypic level, seeds/pod had positive but non-significant correlation (r= 0.405), whereas pod length showed an even weaker correlation (r= 0.479). These results suggest that these two traits, though important, may have smaller impact on overall yield. Test weight showed strong positive correlations with seed yield at both genotypic (r= 0.756**) and phenotypic (r= 0.704**) levels, which indicates that heavier seeds contribute significantly to yield improvement. Protein content exhibited weak to moderate positive correlations with seed yield, with genotypic correlation (r= 0.405) being slightly higher than phenotypic correlation (r= 0.365**). This indicates that higher seed protein content is not strongly linked to yield performance, a pattern commonly reported in legumes due to often negative association between yield and protein concentration when partitioning of assimilates is biased towards either growth or quality. Harvest index showed moderate positive correlations with seed yield (r= 0.633**, r= 0.5194** for GCV and PCV, respectively), which implies that genotypes with better efficiency of assimilate partitioning towards grain are favourable for yield enhancement. Yadav and Gangwar (2020) also found similar kind of variation among genotypic and phenotypic characters in blackgram at Jhansi, Uttar Pradesh during *kharif* season of 2018-19.

The path coefficient analysis was conducted to partition the correlation coefficients into direct and indirect effects, with seed yield as the dependent (Table 4). At the genotypic level, plant height (0.121), dry matter accumulation (0.122), pods/plant (0.109), stover yield/plant (0.175), and harvest index (HI) (0.382) exhibited positive direct effects on seed yield, which shows their importance in determining yield performance. The strongest direct contributor was HI (0.382) followed by stover yield (0.175), which indicates their central role in yield determination. On the other hand, traits such as branches/plant (-0.036), LAI (-0.008), pod length (-0.027), and protein content (-0.032) showed small negative direct effects. Seeds/pod (0.007) and test weight (0.013) had small, but positive direct effects on seed yield. Among indirect effects, the largest contributions were mediated through stover yield which emphasizes its key role in influencing seed yield via multiple pathways. At the phenotypic level, a similar trend was observed, with stover yield (0.829) and HI (0.462) showing large positive direct effects on seed yield. The traits such as plant height (0.002), LAI (0.010), pod length (0.005), seeds/pod (0.001), test weight (0.001), and protein content (0.006) exhibited small positive direct effects, while number of branches (-0.004) and dry matter accumulation (-0.001) had small negative direct effects. Similar kind of findings was observed by Rajasekhar *et al.* (2017) in blackgram at Allahabad, Uttar Pradesh during *kharif* season of 2016.

Conclusion

The present study reveals substantial genetic variability among 17 blackgram genotypes evaluated under late *kharif* condition in the Red and Laterite Zone of West Bengal. The high heritability and genetic advance were observed for seed yield/plant (H^2= 95.1%, GA= 0.40), pods/plant (H^2= 85.9%, GA= 10.31), test weight (H^2= 95.1%, GA= 9.01), and dry matter accumulation (H^2= 96.4%, GA= 1.26) indicating the potential for genetic improvement through direct selection. The significant positive genotypic correlations of seed yield/plant with stover yield/plant (r= 0.946), pods/plant (r= 0.817), test weight (r= 0.756), plant height (r= 0.645), and branches/plant (r= 0.667) suggest that these traits are key contributors to yield enhancement. Path analysis further highlighted harvest index (direct effect, 0.382) and stover yield/plant (direct effect, 0.175) as the most influential traits directly affecting seed yield. The superior genotypes such as KU 16-77, KU 17-25, KU 17-63, KU 16-79**,** and PU 10 demonstrated excellent performance and hold promise as potential parents for breeding high-yielding blackgram cultivars suited to red and laterite soil regions in West Bengal.

Table 1: Mean performance of blackgram genotypes

Genotypes	Plant height (cm)	Branch/plant	DM	LAI	Pods/plant	Pod length (cm)	Seeds/ pod	Test weight	Seed yield (g/plant)	Stover yield (g/plant)	HI (%)	Protein (%)
V_1: Bidhan Kalai	52.3^{ef}	5.08^{bcd}	2.52^{d}	1.87^{bcde}	23.33^{bcd}	4.53^{ab}	6.43^{ab}	43.43^{ef}	1.65^{de}	3.9^{cd}	29.71^{ab}	21.44^{abc}
V_2: Uttara	54.97^{cdef}	4.48^{cd}	2.61^{d}	1.84^{bcdef}	15.6^{f}	4.67^{ab}	6.33^{ab}	48.53^{d}	1.62^{ef}	3.91^{cd}	29.34^{ab}	21.56^{abc}
V_3: NUL 242	53.73^{def}	4.17^{d}	2.02^{f}	1.62^{f}	16.2^{f}	4.73^{ab}	6.37^{ab}	41.93^{f}	1.42^{ghi}	3.39^{e}	29.55^{ab}	19.3^{abcd}
V_4: PU 10	62.4^{b}	5.23^{abc}	3.53^{ab}	2.23^{a}	24.47^{b}	4.72^{ab}	6.8^{a}	51.8^{bc}	1.94^{a}	4.64^{a}	29.45^{ab}	18.21^{cd}
V_5: KU 15-07	51.63^{f}	4.78^{bcd}	1.86^{f}	1.74^{cdef}	20.67^{bcdef}	4.36^{b}	6.5^{ab}	42.2^{f}	1.47^{gh}	3.55^{de}	29.34^{ab}	22.74^{a}
V_6: KU 15-98	53.07^{def}	4.22^{d}	3.1^{c}	1.76^{cdef}	16.73^{ef}	4.63^{ab}	6.3^{ab}	50.5^{bcd}	1.45^{gh}	3.62^{de}	28.54^{ab}	19.51^{abcd}
V_7: KU 15-99	54.17^{def}	5.3^{abc}	2.03^{f}	1.85^{bcdef}	15.5^{f}	4.71^{ab}	6.4^{ab}	42.67^{f}	1.52^{fg}	3.65^{cde}	29.36^{ab}	18.93^{abcd}
V_8: KU 15-102	55.53^{cdef}	5.5^{ab}	2.13^{ef}	1.94^{bc}	22.47^{bcde}	4.6^{ab}	6.53^{ab}	45.57^{e}	1.52^{fg}	3.83^{cde}	28.39^{ab}	16.89^{d}
V_9: KU 15-104	54.4^{def}	4.45^{cd}	2.45^{d}	2.23^{a}	18.13^{cdef}	4.77^{ab}	6.27^{ab}	43.4^{ef}	1.29^{i}	3.47^{e}	27.17^{b}	19.65^{abcd}
V_{10}: KU 16-76	54.27^{def}	4.4^{cd}	3.39^{abc}	2.27^{a}	17.87^{def}	4.78^{ab}	6.32^{ab}	50.03^{cd}	1.53^{fg}	4.04^{bc}	27.43^{b}	19.23^{abcd}
V_{11}: KU 16-77	66.03^{a}	6.05^{a}	3.68^{a}	1.9^{bcde}	24.1^{bc}	4.6^{ab}	6.57^{ab}	53.17^{b}	1.87^{ab}	4.58^{a}	28.98^{ab}	22.4^{ab}
V_{12}: KU 16-79	58.37^{c}	5.22^{abc}	3.32^{bc}	1.7^{def}	24.33^{b}	5.03^{a}	6.6^{ab}	56.9^{a}	1.81^{bc}	4.4^{ab}	29.2^{ab}	21.36^{abc}
V_{13}: KU 16-80	55.67^{cde}	4.97^{bcd}	2.09^{ef}	1.92^{bcd}	15.13^{f}	4.68^{ab}	6.23^{ab}	44.1^{ef}	1.44^{gh}	3.46^{e}	29.38^{ab}	16.7^{d}
V_{14}: KU 16-81	56.3^{cd}	4.98^{bcd}	2.39^{de}	2.22^{a}	23.13^{bcd}	4.54^{ab}	6.38^{ab}	51.63^{bc}	1.68^{de}	3.82^{cde}	30.57^{a}	21.63^{abc}
V_{15}: KU 17-25	52.4^{ef}	5.63^{ab}	3.38^{abc}	2.02^{b}	26.6^{b}	4.85^{ab}	6.47^{ab}	49.47^{cd}	1.75^{cd}	3.9^{cd}	30.93^{a}	21.9^{abc}
V_{16}: KU 17-63	55.23^{cdef}	5.17^{abc}	3.19^{c}	1.7^{def}	36.47^{a}	4.88^{ab}	6.6^{ab}	51.7^{bc}	1.95^{a}	4.36^{ab}	30.85^{a}	20.8^{abc}
V_{17}: KU 17-70	52.27^{ef}	4.73^{bcd}	2.08^{ef}	1.69^{ef}	16.13^{f}	4.72^{ab}	6.13^{b}	45.53^{e}	1.38^{hi}	3.41^{e}	28.71^{ab}	18.79^{bcd}
SEm (±)	0.741	0.188	0.069	0.045	1.265	0.114	0.124	0.591	0.026	0.083	0.501	0.755
CD (p=0.05)	2.134	0.541	0.200	0.130	3.643	NS	NS	1.702	0.075	0.240	1.450	2.174

Table 2: Genetic variability, heritability and genetic advance of blackgram genotypes

Traits	Grand Mean	Range	GCV	PCV	$h^2_{(bs)}$	GA	GA as % of mean
Plant height (cm)	55.46	51.63-66.03	6.65	7.04	89.20	7.18	12.95
Branch/plant	4.96	4.17-6.05	9.74	11.74	68.90	0.83	16.73
DM	2.69	1.86-3.68	23.12	23.54	96.40	1.26	46.84
LAI	1.91	1.62-2.27	10.79	11.50	88.00	0.40	20.94
Pods/plant	20.99	15.13-36.47	25.73	27.77	85.90	10.31	49.12
Pod length(cm)	4.69	4.36-5.03	2.13	4.72	20.40	0.09	1.92
Seeds/pod	6.43	6.13-6.80	1.65	3.72	19.80	0.10	1.56
Test weight	47.80	41.93-56.90	9.38	9.63	95.10	9.01	18.85
Protein (%)	20.06	1.29-1.95	8.38	10.61	62.30	2.73	13.61
Stover yield/plant	3.88	3.39-4.64	10.25	10.90	88.40	0.77	19.85
Harvest Index	29.23	27.17-30.93	3.04	4.25	51.20	1.31	4.48
Seed yield/plant	1.61	16.70-22.74	12.36	12.67	95.10	0.40	24.84

Table 3: Association analysis of blackgram genotypes

Traits		Plant height (cm)	Branch/plant	DM	LAI	Pods /plant	Pod length	Seeds /pod	Test weight	Stover yield	HI	Protein (%)	Seed yield
Plant height (cm)	G	1											
	P	1											
Branch/plant	G	0.614**	1										
	P	0.460**	1										
DM	G	0.586*	0.364	1									
	P	0.551**	0.301*	1									
LAI	G	0.269	0.066	0.294	1								
	P	0.208	0.101	0.287*	1								
Pods/plant	G	0.276	0.605*	0.529*	0.001	1							
	P	0.266	0.463**	0.493**	0.018	1							
Pod length	G	0.258	0.204	0.696**	-0.099	0.402	1						
	P	0.031	-0.062	0.335*	-0.0	0.170	1						
Seeds/pod	G	0.942**	1.046**	0.759**	0.104	1.085**	-0.268	1					
	P	0.363**	0.292*	0.347*	0.057	0.465**	0.244	1					
Test weight	G	0.609**	0.364	0.84**	0.156	0.535*	0.754**	0.746**	1				
	P	0.565**	0.292*	0.809**	0.148	0.476**	0.284*	0.309*	1				
Stover yield	G	0.805**	0.646**	0.851**	0.213	0.698**	0.474	1.235**	0.818**	1			
	P	0.682**	0.487**	0.776**	0.204	0.615**	0.224	0.549**	0.740**	1			
HI	G	-0.035	0.404	0.078	-0.287	0.649**	0.21	0.657**	0.226	0.349	1		
	P	0.022	0.374**	0.058	-0.227	0.438**	-0.091	0.214	0.151	0.053	1		
Protein (%)	G	0.068	0.157	0.305	-0.153	0.419	-0.138	0.380	0.347	0.312	0.431	1	
	P	0.001	0.193	0.259	-0.117	0.3201*	-0.148	0.131	0.235	0.234	0.3403*	1	
Seed yield	G	0.645**	0.667**	0.732**	0.076	0.817**	0.479	1.244**	0.756**	0.946**	0.633**	0.405	1
	P	0.589**	0.587**	0.694**	0.067	0.748**	0.154	0.568**	0.704**	0.878**	0.519**	0.365**	1

G = Genotypic correlation coefficient. P = Phenotypic correlation coefficient. *Significant at 5% level, **Significant at 1% level.

Table 4: Path analysis of blackgram genotypes

Traits		Plant height	Branch /plant	DM	LAI	Pods/ plant	Pod length	Seeds/ pod	Test weight	Protein (%)	Stover yield	HI	y/p (Correlation value)
Plant height	G	0.121	-0.022	0.072	-0.002	0.030	-0.007	0.007	0.008	-0.002	0.455	-0.013	0.645
	P	0.002	-0.002	0.000	.002	0.010	0.000	0.000	0.001	0.000	0.566	0.010	0.589
Branches/plant	G	0.074	-0.036	0.044	-0.001	0.066	-0.006	0.007	0.005	-0.005	0.364	0.154	0.667
	P	0.001	-0.004	0.000	0.001	0.017	0.000	0.000	0.000	0.001	0.403	0.173	0.587
DM	G	0.071	-0.013	0.122	-0.002	0.058	-0.019	0.006	0.011	-0.010	0.480	0.030	0.732
	P	0.001	-0.001	-0.001	0.003	0.018	0.002	0.000	0.001	0.001	0.643	0.027	0.694
LAI	G	0.033	-0.002	0.036	-0.008	0.000	0.003	0.001	0.002	0.005	0.120	-0.110	0.076
	P	0.000	0.000	0.000	0.010	0.001	0.000	0.000	0.000	0.001	0.163	-0.104	0.067
Pods/ plant	G	0.033	-0.022	0.065	0.000	0.109	-0.011	0.008	0.007	-0.013	0.393	0.248	0.817
	P	0.000	-0.002	0.000	0.000	0.037	0.001	0.000	0.000	0.002	0.509	0.202	0.748
Pod length	G	0.031	-0.007	0.085	0.001	0.044	-0.027	-0.002	0.010	0.004	0.267	0.080	0.479
	P	0.000	0.000	0.000	0.000	0.006	0.005	0.000	0.000	-0.001	0.183	-0.043	0.154

Seeds/ pod	G	0.114	-0.037	0.096	-0.001	0.119	0.006	0.007	0.010	-0.012	0.710	0.235	1.244
	P	0.001	-0.001	0.000	0.001	0.017	0.001	0.001	0.000	0.001	0.455	0.097	0.568
Test Weight	G	0.074	-0.013	0.103	-0.001	0.059	-0.021	0.005	0.013	-0.011	0.462	0.086	0.756
	P	0.001	-0.001	-0.001	0.001	0.018	0.001	0.000	0.001	0.001	0.613	0.070	0.704
Protein	G	0.008	-0.006	0.037	0.001	0.046	0.004	0.003	0.004	-0.032	0.175	0.165	0.946
	P	0.000	-0.001	0.000	-0.001	0.012	-0.001	0.000	0.000	0.006	0.193	0.167	0.878
Stover yield (%)	G	0.097	-0.023	0.104	-0.002	0.076	-0.013	0.009	0.011	-0.010	0.664	0.133	0.633
	P	0.001	-0.002	-0.001	0.002	0.023	0.001	0.001	0.001	0.001	0.829	0.024	0.519
HI	G	-0.004	-0.015	0.010	0.002	0.071	-0.006	0.004	0.003	-0.014	0.197	0.382	0.405
	P	0.000	-0.001	0.000	-0.002	0.016	0.000	0.000	0.000	0.002	0.043	0.462	0.365

Residual (Genotypic) =0.0004   Residual (Phenotypic) = 0.0016

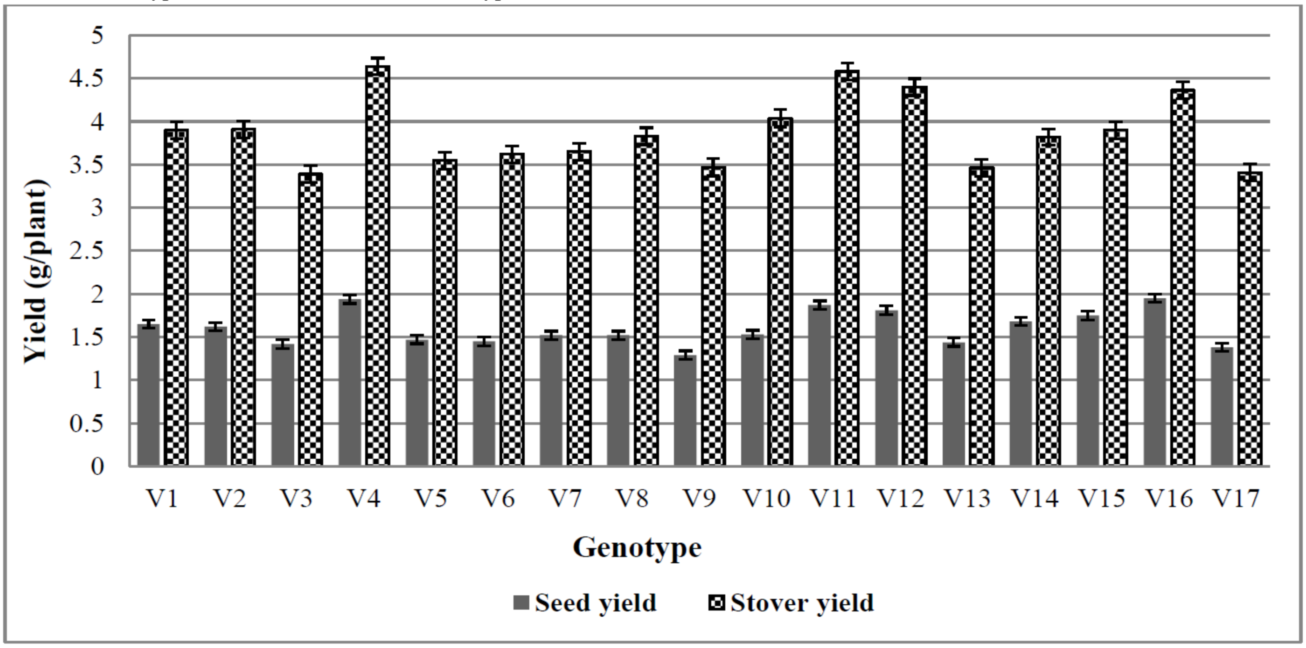

Fig. 1: Mean seed and stover yield (g/plant) of blackgram genotypes under late *kharif* situation in Red and Laterite Zone of West Bengal

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