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CORRELATION AND PATH ANALYSIS FOR YIELD AND ITS RELATED TRAITS IN F_3 GENERATION OF BLACKGRAM [*Vigna mungo* (L.) Hepper]

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ABSTRACT

The present investigation on correlation and path coefficient analysis for yield and yield contributing characters in F_3 population of 21 families developed by crossing 12 parents with three testers, ascertain the genetic and phenotypic correlation and contribution of these traits towards the yield directly and indirectly in blackgram. The results showed that seed yield per plant exhibited significant and positive correlation with biological yield per plant (r=0.730), harvest index (r=0.522), seeds per pod (r=0.466), pods per plant (r=0.428) and pod length (r=0.332). Path coefficient analysis depicted that biological yield per plant (0.719) and harvest index (0.485) had a direct influence on seed yield in positive direction. This predicted that while designing a breeding strategy for the improvement of blackgram these traits should be kept in mind to enhance seed yield of urdbean in the future breeding programs.

INTRODUCTION

Blackgram (*Vigna mungo* (L.) Hepper) is one of the important pulse crops, popularly known as mash or urdbean. It is an important short duration and self pollinated *Kharif* legume crop belonging to the family Fabaceae and subfamily Faboideae. It has been domesticated from *Vigna mungo* var. *silvestris* and reported to be originated in India with its secondary centre of origin in central Asia. Urdbean occupies an important position due to its high seed protein (25-26%, carbohydrates (60%), fibre (3.5-4.5%), fat (1.5%), minerals, aminoacids and vitamins and ability to restore the soil fertility through symbiotic nitrogen fixation (Malik 1994). It is consumed in the form of split pulse as well as whole pulse, which is an essential supplement of vegetarian based diet. India is the largest producer as well as consumer of urdbean and produces about 1.5 million tonnes annually from about 3.25 million hectare of area with an average productivity of 400 kg per hectare (Anonymous 2016). In India, Madhya Pradesh is the leading producer of blackgram, cultivated in an area of 0.602mha with production 0.226mt and average productivity of 376kg/ha Arya *et al*. (2017). In Himachal Pradesh blackgram cultivation is confined to low and mid hills.

In any crop breeding, selection of promising plant is important. An association study gives information about the contribution of different characters towards seed yield. Seed yield is the result of the expression and association of several plant growth components. It is very complex trait which is controlled by polygenes and interlinked with other yield components, hence it is very difficult to improve yield directly. It can be achieved by improving closely related traits and giving selection pressure on these traits. The study of correlation coefficient gives a measure of the relationship between traits and provides the degree to which various characters are associated with seed yield, which ultimately leads to improvement of yield in a short time. Its estimation enables to eliminate the characters with little or no importance during selection. When there is positive correlation between major yield components, breeding strategies would be very effective but on the reverse, selection becomes very difficult. Earlier, Parveen *et al*. (2011) reported positive and significant correlation of clusters per plant, pods per plant, days to maturity, days to 50 per cent flowering, pods per cluster and 100-seed weight with seed yield in F_1 generation.

The correlation values provided only nature and degree of relationship of yield contributing characters on seed yield. Path coefficient analysis is a statistical technique to split the observed correlation coefficients into direct and indirect effects of independent variables on the dependent variable. Rajasekhar *et al*. (2017) observed that primary branches per plant, pods per plant, plant height, biological yield and harvest index showing the direct positive effect on seed yield.

The correlations due to direct effects reflect true and perfect relationship and such characters can be directly subjected for improving yield. The major constraints in achieving higher yield of blackgram are lack of exploitable genetic variability, absence of suitable ideotype for different cropping system, poor harvest index, disease susceptibility and planting in marginal areas of farming. Keeping this, in view the present investigation was proposed with an aim to identify the important traits for development of superior/ high yielding blackgram genotypes.

MATERIALS AND METHODS

The experimental material used for present investigation consisted of F_3 population of 21 families which were developed by crossing 12 parents i.e. COBG-653, DU-1, HPBU-124, HPBU-126, IPU-02-33, IPU-05-13, KU-223, KU-553, KUG-216, KUG-540, TU-17-4 and TU-94-2 with three testers *viz.*, Palampur-93, Him Mash-1, HPBU-111. Phenotypically superior high yielding transgressive segregants were selected from F_2 population during *kharif* 2015 and their F_3 progenies were studied during *kharif* 2016 in Compact Family Block Design (CFBD) with three replications at Experimental Farm of the Department of Crop Improvement, CSK HPKV, Palampur. Twenty-one main plots were randomized in each replication and six progenies were grown side by side in each plot. Each progeny was grown in two rows of 1.5 m with a spacing of 30cm x 10cm. The observations were recorded on ten randomly competitive plants for 12 agro-morphometric traits *viz*., plant height, branches per plant, pods per plant, pod length, seeds per pod, biological yield per plant, harvest index, 100-seed weight and seed yield per plant on plant basis, whereas days to flower initiation, days to 50% flowering and days to 75% maturity on plot basis. The data on these traits is then subjected to statistical analysis. Data recorded for all the families and were analyzed according to Compact Family Block Design analysis as per the procedure given by Chandel (1970) (ANOVA) for comparison between families. Phenotypic and genotypic coefficients of correlation were worked out by the procedure of Al- Jibouri *et al*. (1958) and Dewey and Lu (1959). Direct and indirect effects of component characters on seed yield were computed using appropriate correlation coefficient of different component characters as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance (ANOVA) (Table 1) showed highly significant differences ($P < 0.05$) among the families for all the traits studied except days to 50% flowering, indicating presence of genetic variability among the genotypes. Similar findings were also reported by earlier workers *viz*., Mehandi *et al*. (2013), Punia *et al*. (2014), Hadimani *et al*. (2015) and Ozukum and Sharma (2017).

Relationship between yield and yield contributing traits

The association among yield and yield contributing characters provide reliable information on nature, extent and direction of selection. Grafiaus (1959) suggested that the knowledge of magnitude and direction of association among different characters is of paramount importance to a plant breeder as characters genetically related to each other tend to move in the same direction under selection. Correlation studies are quite helpful in determining the components of a complex trait like seed yield per plant, for which direct selection is not much effective. Hence, it is indispensable to measure the correlations both at the genotypic and phenotypic levels. Genotypic correlations reflect genetic correlations when the heritability is high for the concerned characters. Phenotypic correlation of coefficient involves environmental effect and it showed masking effect on character.

The genotypic and phenotypic correlation coefficients were computed among 12 characters (table 2). Correlation among yield and its related traits indicated that, in general genotypic correlation coefficients were greater than phenotypic correlation coefficients for all agro-morphometric traits. Similarly, Sharma (2015) also reported genotypic correlation coefficients were greater than phenotypic correlation coefficients for most of the traits. This revealed that all the traits were genetically associated with each other and inter-relationships were inherent. In the present investigation, seed yield per plant exhibited highly significant and positive correlation with biological yield per plant (r=0.603**,0.730**), harvest index (r=0.323**,0.522**), seeds per pod (r=0.340**,0.466**), pods per plant (r=0.367**,0.428**), pod length (r=0.293**,0.332**), plant height (r=0.116**,0.187**), 100-seed weight

Table 1: Analysis of variance among all 21 families

S.No.	Traits		Mean sum of squares	
		Replication	Genotypes	Error
		2	20	40
1	Days to flower initiation	1.82	17.94*	2.31
2	Day to 50 per cent flowering	0.29	31.12	21.46
3	Days to 75 per cent maturity	3.57	41.21*	4.87
4	Plant height (cm)	58.52	1436.36*	88.92
5	Branches per plant	0.03	4.02*	0.09
6	Pods per plant	0.49	102.25*	2.23
7	Pod length (cm)	0.01	0.62*	0.02
8	Seeds per pod	0.01	2.28*	0.13
9	Biological yield per plant (g)	0.27	527.75*	23.11
10	100-seed weight (g)	0.12	1.32*	0.17
11	Harvest index (%)	9.71	417.91*	24.45
12	Seed yield per plant (g)	0.01	13.79*	1.01

* Significant at $P \leq 0.05$

Table 2: Estimates of correlation coefficient of phenotypic (P) and genotypic (G) levels among different traits

Traits		DTF	DTM	PH	BPP	PPP	PL	SPP	BYP	HSW	HI	Correlation with seed yield per plant(g)
DFI	P	0.417**	0.615**	0.120*	-0.02	-0.099	0.072	-0.095	0.023	0.028	-0.012	-0.025
	G	0.986**	0.804**	0.147**	-0.115	-0.238	0.098	-0.239	0.049	0.088	-0.168	-0.09
DTF	P		0.546**	0.189**	0.057	-0.139**	-0.015	-0.077	-0.021	0.055	0.025	-0.02
	G		1.135**	0.426**	0.160**	-0.280**	-0.067	-0.22	-0.028	0.142	-0.003	-0.026
DTM	P			0.299**	0.100*	-0.140**	0.004	-0.101*	-0.004	0.002	-0.069	-0.068
	G			0.521**	0.161*	-0.281	-0.014	-0.283**	0.007	0.034	-0.176	-0.117*
PH	P				0.199**	0.052	0.015	-0.051	0.05	0.228**	0.122*	0.116*
	G				0.223**	0.038	0.017	-0.039	0.079	0.480**	0.197**	0.187**
BPP	P					0.072	-0.088	0.145**	0.236**	0.013	-0.152**	0.05
	G					0.094	-0.097	0.164**	0.289**	0.071	-0.214**	0.094
PPP	P						0.234**	0.278**	0.157**	0.076	0.229**	0.367**
	G						0.255**	0.355**	0.158**	0.105	0.407**	0.428**
PL	P							0.249**	0.208**	0.015	0.065	0.293**
	G							0.281**	0.233**	0.018	0.105	0.332**
SPP	P								0.367**	-0.019	0.032	0.340**
	G								0.446**	-0.083	0.108	0.466**
BYP	P									-0.003	-0.294**	0.603**
	G									-0.023	-0.220**	0.730**
HSW	P										0.134**	0.115*
	G										0.403**	0.173**
HI	P											0.323**
	G											0.522**

*Significant at P≤ 0.05, ** Significant at P ≤ 0.01
DFI-days to flower initiation, DTF- Days to 50 % flowering; DTM-Days to 75% maturity; PH-Plant height (cm); BPP-Branches per plant; PPP-Pods per plant; PL-Pod length(cm); SPP-Seeds per pod; BYP-Biological yield per plant(g); HSW-100-seed weight(g) and HI-Harvest index(%)

Table 3: Estimates of direct and indirect phenotypic (P) and genotypic (G) effects of different traits on seed yield per plant

Traits		DFI	DTF	DTM	PH	BPP	PPP	PL	SPP	BYP	HSW	HI	SYP
DFI	P	-0.04	-0.017	-0.024	-0.005	0.001	0.004	-0.003	0.004	-0.001	-0.001	0.001	-0.025
	G	-0.007	-0.033	0.027	0.001	-0.002	0.006	0.006	0.011	0.045	-0.012	-0.133	-0.09
DTF	P	0.006	0.014	0.008	0.003	0.001	-0.002	0	-0.001	0	0.001	0	-0.02
	G	-0.008	-0.034	0.039	0.005	0.004	0.008	-0.004	0.01	-0.026	-0.019	-0.003	-0.026
DTM	P	0.002	0.002	0.004	0.001	0	-0.001	0	0	0	0	0	-0.068
	G	-0.006	-0.038	0.034	0.006	0.003	0.007	-0.001	0.012	0.006	-0.004	-0.139	-0.117*
PH	P	0.002	0.003	0.005	0.018	0.004	0.001	0	-0.001	0.001	0.004	0.002	0.116*
	G	-0.001	-0.014	0.01	0.011	0.005	-0.001	0.001	0.002	0.072	-0.062	0.156	0.187**
BPP	P	0.001	-0.003	-0.006	-0.011	-0.056	-0.004	0.005	-0.008	-0.013	-0.001	0.009	0.05
	G	0.001	-0.005	0.005	0.002	0.024	-0.002	-0.005	-0.007	0.262	-0.009	-0.17	0.094
PPP	P	-0.012	-0.017	-0.017	0.006	0.009	0.119	0.028	0.033	0.019	0.009	0.027	0.367**
	G	0.002	0.009	-0.009	0.001	0.002	-0.027	0.015	-0.016	0.143	-0.013	0.322	0.428**
PL	P	0.006	-0.001	0	0.001	-0.007	0.018	0.077	0.019	0.016	0.001	0.005	0.293**
	G	-0.001	0.002	-0.001	0.001	-0.002	-0.007	0.06	-0.012	0.211	-0.002	0.083	0.332**
SPP	P	-0.002	-0.001	-0.002	-0.001	0.002	0.005	0.004	0.016	0.006	0	0.001	0.340**
	G	0.001	0.007	-0.009	-0.001	0.003	-0.009	0.017	-0.045	0.405	0.01	0.085	0.466**
BYP	P	0.016	-0.015	-0.003	0.036	0.17	0.113	0.15	0.264	0.719	-0.003	-0.211	0.603**
	G	-0.001	0.001	0.001	0.001	0.007	-0.004	0.014	-0.02	0.907	0.003	-0.174	0.734**
HSW	P	0.001	0.002	0	0.009	0.001	0.003	0.001	-0.001	0	0.04	0.005	0.115*
	G	-0.001	-0.004	0.001	0.005	0.001	-0.002	0.001	0.003	-0.02	-0.13	0.319	0.173**
HI	P	-0.006	0.012	-0.034	0.059	-0.074	0.111	0.031	0.015	-0.142	0.065	0.485	0.323
	G	0.001	0.001	-0.006	0.002	-0.005	-0.011	0.006	-0.004	-0.199	-0.052	0.791	0.522**

Residual effect : Phenotypic- 0.577, Genotypic: 0.046; DFI-days to flower initiation, DTF- Days to 50 % flowering; DTM-Days to 75% maturity; PH-Plant height (cm); BPP-Branches per plant; PPP-Pods per plant; PL-Pod length(cm); SPP-Seeds per pod; BYP-Biological yield per plant(g); HSW-100-seed weight(g); HI-Harvest index(%) and SYP-Seed yield per plant

(r = 0.115**,0.173**) at phenotypic and genotypic level respectively, and significant negative correlation with days to 75% maturity at genotypic level. Thus, these traits emerged as important traits for the improvement in seed yield per plant. These findings are in agreement with Kamleshwar *et al*. (2013) and Sharma *et al*. (2013) for pods per plant, Sahu *et al*. (2014) for plant height, Mathivathana *et al*. (2015) and Singh *et al*. (2016) for plant height, pods per plant, seeds per pods, 100-seed weight, Sohel *et al*. (2016) for pods per plant, pod length harvest index and 100-seed weight, Duddukur *et al*. (2017) and Dhoot *et al*. (2017) for pods per plant and harvest index.

In spite of correlation with seed yield per plant, association among other various yield components is also important to carry out effective selection for seed yield. The results showed that, plant height was significantly and positively correlated with biological yield per plant, 100-seed weight and harvest index which indicates that selection of the plants with higher plant height could result in increasing biological yield with more seed weight. Patidar and Sharma (2017) also recorded significantly and positively correlation between plant height and biological yield per plant. Pods per plant were significantly and positively correlated with pod length, seeds per pod, harvest index and biological yield per plant. Suresh and Malathi (2016) also reported similar results that pod per plant are positively correlated with pod length, seeds per pod and harvest index. Pod length was significantly and positively correlated with seeds per pod and biological yield per plant. Seeds per pod significantly and positively correlated with biological yield per plant. This was supported by Hemalatha *et al.* (2017). Biological yield per plant was significantly and negatively correlated with harvest index indicating improved biological yield always may not result in similar improvement in fodder weight and seed weight. This was in confirmation with the findings of bharti *et al.* (2014). 100-seed weight was significantly and positively correlated with harvest index. It suggested that selection of progeny with higher seed weight improves harvest index associated with it. More or less observations were observed by Kumar *et al.* (2014), Patel *et al.* (2014), Kumar *et al.* (2015) and Mehra *et al.* (2016).

Hence, selection should be based on traits like biological yield per plant, pods per plant, seeds per pod, harvest index, pod length, plant height and 100-seed weight for improving seed yield in blackgram.

Direct and indirect effects on yield and its components

The knowledge of correlation between yield and its component characters is helpful in selection of superior plant types. Correlation gives only the relation between two variables but when more number of characters is included in correlation study, the direct and indirect contribution of each component is necessary. Therefore, in order to find out the direct and indirect contribution of different characters towards seed yield per plant the path coefficient analysis developed by Wright (1921) was done. It presents the better index for selection rather than mere correlation coefficients. The results showed highest positive direct effects of biological yield per plant (0.719) and harvest index (0.485) with seed yield per plant (Table 3). This indicated a true relationship between these traits with seed yield per plant and direct selection of these traits would be useful for yield improvement. Miah *et al.* (2016) and Arya *et al.* (2017) reported high positive direct effects of harvest index on seed yield per plant followed by biological yield per plant.

The perusal of overall results indicated that biological yield per plant and harvest index are important traits which has direct impact on seed yield per plant than any other traits affecting yield, although simultaneous selection of plant height, branches per plant and pod length will also be useful in bringing higher yield from segregating populations.

REFERENCES

Al-jibouri, H. A., Miller, P. A. and Robinson, H. P. 1958. Genotypic and environment variance and covariance in upland cotton cross of interspecific origin. *Agron. J.* **50:** 633-636.

Anonymous. 2016. ACRIP, MULLaRP. http://www. acripmullarp. res.in/ crop profile.html [4th Jaunuary, 2016]

Arya, P., Lal, G. M. and Lal, S. S. 2017. Correlation and path analysis for yield and yield components in blackgram (*Vigna mungo* (L.) hepper). *Int. J. Adv. Biol. Res.* **7:** 382-386.

Bharti, B., Kumar, R., Bind, H. N., Kumar, A. and Sharma, V. 2014. Correlation and path analysis for yield and yield components in blackgram (*Vigna mungo* (L.) Hepper). *Int. J. Plant Sci.* **9:** 410-413.

Chandel, R. S. 1970. Handbook of Agricultural statistics 4th edition. Achal Prakashan Mandir, Parmat, Kanpur-1. pp. 542-546.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path analysis of components of crested wheat grass seed production. *Agron J.* **51:** 513-518.

Dhoot, R., Modha, K. G., Kumar, D., Dhoot, M. and Ahirwar, C. 2017. Analysis of Correlations and Path on Yield and Its Components in F_2 Population of Mungbean (Vigna radiata (L.) Wilczek), *Int. J. Pure App. Biosci.* **5(3):** 803-808.

Duddukur, R., Sapna, L. and Gabrial, M. L. 2017. Character association and path analysis for seed yield & its components in black gram [vigna mungo (l.) hepper]. *Plant Arch.* **17(1):** 467-471.

Grafiaus, J. E. 1959. A geometry of plant breeding. *Crop Sci.* **4:** 241-246.

Hadimani, A., Konda, C. R., Patil, R. P., Guru, P. N., Hegde, V. K. and Vijaykumar, L. 2015. Assessment of genetic variability, heritability and genetic advance for yield and yield attributing traits in blackgram (Vigna *mungo* (L.) Hepper) genotypes. *Int. J. Trop. Agric.* **33(4):** 2473-2476.

Hemalatha, K., Lal, S. S. and Lal, G. M. 2017. Study on Genetic Variability and Correlation in Blackgram (Vigna mungo L. Hepper). *J .Pharmacogn Phytochem.* **6(4):** 674-676.

Kamleshwar, K., Yogendra, P., Mishra, S. B., Pandey, S. S. and Ravi, K. 2013. Study on genetic variability, correlation and path analysis with grain yield and yield attributing traits in green gram [Vignaradiata (L.) wilczek]. *The Bioscan.* **8(4):** 1551-1555.

Kumar, G. V., Vanaja, M., Sathish, P., Vagheera, P., Shishodia, S. S. and Razak, A. 2014. Correlation and path analysis of seed yield and yield contributing components of blackgram (*Vigna mungo* (L.) Hepper) under rainfed condition from Andhra Pradesh. *Int J Appl Biol Pharm.* **5:** 137-140.

Kumar, G. V., Vanaja, M., Sathish, P., Vagheera, P. and Lakhsmi, N.J. 2015. Correlation analysis for quantitative traits in blackgram (*Vigna mungo* (L.) Hepper) in different seasons. *Int. J. Sci. Res. Publ.* **5:** 1-3.

Malik, B. A. 1994. Grain legumes. In: Crop Production (Ed.): M.S.Nazir.p.301 National Book Foundation, Islamabad. 301.

Mathivathana, M. K., Shunmugavalli, N., Muthuswamy, A. and Harris, C. V. 2015. Correlation and path analysis in blackgram. *Agric. Sci. Digest.* **35:** 158-160.

Mehandi, S., Singh, C. M. and Kushwaha, V. K. 2013. Estimates of genetic variability and heritability for Yield and yield component traits in mungbean. *The Bioscan.* **8(4):** 1481-1484.

Mehra, R., Tickle, A. N., Saxena, A., Munjal, A., Rekhakhandia and Singh, M. 2016. Correlation, path coefficient and gentic diversity in blackgram (*Vigna mungo* (L.) Hepper). *Int. J. Plant Sci.* **7:** 001-011.

Miah, M. R., Rob, M. M., Habiba, U., Das, K. R. and Islam, M. S. 2016. Correlation and path coefficients analysis of blackgram (*Vigna mungo* (L.) Hepper). *Eur. Acad. Res.* **3:** 10906-10917.

Ozukum, C. and Sharma, M. B. 2017. Variability among Urdbean (*Vigna Mungo* L. Hepper) for Yield and Yield Components. *Int. J. Res. Innov. Appl. Sci.* **2(4):**2454-6194.

Parveen, S. I., Sekhar, M. R., Reddy, D. M. and Sudhakar, P. 2011. Correlation and path coefficient analysis for yield and related components in blackgram (*Vigna mungo* (L.) Hepper). *Int J Appl Biol Pharm.* **2:** 619-625.

Patel, R.V., Patil, S. S., Patel, S. R. and Jadhav, B. D. 2014. Genetic Variability and Character Association in Blackgram (*Vigna mungo* (L.) Hepper) during Summer. *Trends Bio.* **7:** 3795-3798.

Patidar, M. and Sharma, H. 2017. Correlation and path coefficient studies in Blackgram (*Vigna mungo* (L.) Hepper). *J Pharmacogn Phytochem.* **6(4):** 1626-1628.

Punia, S. S., Gautam, N. K., Ram, B., Verma. P., Dheer, M., Jain, N. K., Koli, N. R., Mahavar, R. and Jat, V. S. 2014. Genetic variability and correlation studies in urdbean (*Vigna mungo* (L.) Hepper). *Legume Res.* **37:** 580-584.

Rajasekhar, D., Lal, S. S. and Lal, G. M. 2017. Character association and Path analysis for seed yield & its components in blackgram [*Vigna Mungo* (L.)Hepper]. *Plant Arch***.** **17(1):** 467-471.

Sahu, H., Amadabade, J., Kumar, P., Sao, A. and Patel, R. K. 2014. Assessment of segregating generations for genetic variability and yield regulating traits in mungbean. *The Bioscan.* **9:** 1701-1706.

Sharma, H. K., Singh, D. P., Kumar, A. and Shrotria, P. K. 2013. Evaluation of F_4 progenies emanated from an interspecific hybridization of mungbean and blackgram. *Leg. Res.* 36: 191-199.

Sharma, R. M. 2015. Association analysis for yield and its components in Urd Bean (Vigna Mungo L.) genotypes. *The Bioscan.* **10(4):** 2121-2124.

Singh, M., Swarup, I., Billore, M. and Chaudhari, P. R. 2016. Association analysis of seed yield and its attributing traits in black gram [*Vigna mungo* (L.) Hepper]. *Agric. Sci. Digest.* **36(2):** p83-87.

Sohel, M. H., Miah, M. R., Mohiuddin, S.J., Islam, A. K. M.S., Rahman, M. M. and Haque, M. A. 2016. Correlation and path coefficient analysis of Blackgram (*Vigna mungo* (L.) Hepper). *J. Biosci. Agric. Res.* **7(2):** 621-629.

Suresh, S. and Malathi, D. 2016. Proportional contribution, trait association and path coefficient analysis for agronomic traits and its components in mungbean (*Vigna radiata* (l.)wilczek) genotypes. *The Bioscan.* **11(2):**1083-1087.

Wright, S. 1921. Correlation and causation. *J. Agric. Res.* **20:** 577-587