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Gentic Variablity, Correlation and Path Analysis in Greengram *(Vigna radiata)*

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ABSTRACT

Genetic parameters along with association and effect of yield attributing traits on seed yield have been studied to identify a set of characters for effective selection during breeding programme. All the traits studied showed significant variation except pod length and best donors for each traits was identified. Moderate to high values for genetic parameters were recorded for plant height, pod number, cluster number, 100 seed weight, plant dry weight and harvest index. Pods per plant, plant dry weight and harvest index were found to have positive association with seed yield at both genotypic as well as phenotypic levels. Path analysis revealed plant height, number of clusters, 100-seed weight, plant dry weight and harvest index at phenotypic and genotypic level, displayed positive and direct effect on seed yield. On basis of moderate to high values for genetic parameters, positive association and direct contribution towards seed yield has been observed for cluster number, pod number, plant height, 100 seed weight, plant dry weight and harvest index. Selection for these traits in combination may enhance the seed yield in greengram effectively.

Key words : Correlation coefficient, Greengram, Path analysis, Variability

Greengram [*Vigna radiata* (L.) Wilczek syn. *Phaseolus aureus* Roxb] is an important legume crop with good nutritional value, cultivated widely in India for its dietary high protein (24%) seeds. Greengram is one of the crops widely grown in India. It is unequivocal fact that the realized seed yield in greengram is so far too low compared to the potential yield. Genetic characterization of cultivars paves the way for evaluation of genetic variation that forms the basis of selection of genotypes for direct use and also identification of base materials for further genetic improvement. As only genetic variability is heritable, to get an idea about expected gain in next generation, it has to be considered in conjunction with genetic advance. At the same time strong association between key yield attributing characters along with their possible direct effect on yield have to be also taken into consideration while selecting yield attributing characters to enhance the yield of the crop. The expression of quantitative characters is likely to vary with the genotypes used and agro climatic conditions. This report included genotypes, which were not evaluated previously in Allahabad agro ecosystem. Therefore, the component approach of selection for any specific agroecosystem needs to be established before starting a comprehensive genetic programme.

MATERIAL AND METHODS

A total of twenty diverse greengram genotypes, were selected for this study. These include twelve germplasm lines, seven released varieties and one exotic advance breeding line. These were grown at the Field Experimentation Center of Department of Genetics and Plant Breeding, Allahabad Agricultural Institute, Allahabad during kharif 2003 in randomized block design with three replications, each plot measured 3m^2 size. The row-to-row spacing was 30 cm and plant-to-plant distance was 10 cm. In each plot, data were recorded for plant height, number of primary branches per plant, number of cluster per plant, number of pods per plant, pod length, number of seeds per pod, 100-seed weight, plant dry weight, harvest index and seed yield per plant on 10 randomly selected competitive plants. The genetic variability, genetic advance, correlations and path analysis were estimated as per the methods given by Burton (1952), Lush (1949), Al-jibouri *et al.* (1958), Robinson *et al.* (1951) and Dewey and Lu (1959) respectively.

RESULTS AND DISCUSSION

The genetic variability is a prerequisite for any effective selection scheme. In the present study, except pod length, all other traits exhibited

Table 1. Genetic parameters and best donors for different traits in greengram

S.No	Traits	MSS	GCV	PCV	GA(%mean)	H	Donor genotypes
1	Plant height	233.82	17.66	18.78	34.18	88	Pusa 93-32, AKM-8802, BDYR-2, HUM-2, AKM-9243 2
2	Primary branches plant^{-1}	0.649	11.45	13.58	19.93	71	ML-955, T-44, IPRM-10, BHUM-93-94
3	Clusters plant^{-1}	21.88	17.72	20.9	30.97	71	MUM-1-1, T-44, BHUM-93-94, HUM-2, IPRM-10
4	Pods plant^{-1}	377.38	22.37	29.54	34.86	57	UPM-83-1, WGG-2, T-44, ML-955, MUM-1-1
5	Pod length	0.68	4.51	9.44	4.41	22	BDYR-2,NARP-280, AKM 8802, HUM-8, ML-955
6	Seed pod^{-1}	1.082	4.08	6.4	5.38	4	HUM-8, BDYR-2,IPRM-10,MUM-1-1,WGG-2
7	100 seed weight	0.812	14.16	15.25	27.09	86	BDYR-2,AKM 8802,NARP 280, ML 406, T 44, HUM 2
8	Plant dry weight	551.2	28.12	34.34	47.41	67	WGG-2, AKM 8802, MUM 1-1, T 44
9	HI	0.212	29.9	34.03	55.97	77	AKM 9243, UPM 83-1, BHUM-GP-17, T 44, BDYR 2
10	Seed yield plant^{-1}	34.33	25.59	35.75	3.77	51	T 44, AKM 8802, WGG 2, AKM 9243

significant variation, included plant height, primary branches per plant, clusters per plant, pods per plant, seeds per pod, 100-seed weight, plant dry weight, harvest index and seed yield. Number of workers reported previously sufficient variability for plant height, primary branches per plant, pods per plant, clusters per plant and seed yield (Han and Li, 1998, Loganathan *et al* 2001, Pandey *et al* 2007) and lowest variability for pod length (Reddy *et al* 1993, Upadhyay *et a*l 1993). Hence, high variability presence for these traits may be exploited in breeding programme.

T-44 recorded highest seed yield among the evaluated set of germplasm followed by AKM-8802, WGG-2 and AKM-9243. High yield in T-44 was due to many primary branches (4-5), clusters (17-18) and heavy seeds (3.7 g). Best donors for yield attributing traits have been identified among the present set of germplasm (Table 1) and may be utilized as a base material in breeding programme for enhancement of seed yield.

The genetic parameters are also required to be considered for an effective breeding programme. The genotypic (GCV) and phenotypic (PCV) variation for seed yield per plant, harvest index, plant dry weight, number of pods per plant, number of clusters per plant and plant height were found moderate to high. These results are inconformity with the results of Loganathan (2001), Venkateswarlu (2001) and Pandey *et. al*. (2007). High heritability (H) was noticed for plant height, primary branches per plant, clusters per plant, 100-seed weight, plant dry weight and harvest index, similar findings were also reported by Sinha *et.al.* (1998) and Pandey *et. al* .(2007). High estimates of genetic advance (% of mean) for plant height, number of clusters per plant, pods per plant, plant dry weight, harvest index and seed yield per plant (Table1). Many workers have reported high GA for above traits (Vikas *et al* 1998; Islam *et al,* 2000, Vekateswarlu (2001) and Pandey *et al* (2007)). Seeds per pod and pod length showed low values for genetic parameters (GCV, PCV, GA and heritability), hence selection of these traits may result in poor yield while pods per plant registered high PCV, GCV, GA and moderate heritability. The results indicated that selection for tall plant with many primary branches, clusters, pods and heavy seeds, good biomass will favour high yield.

In the present investigation, the genotypic and phenotypic correlation coefficients showed positive and significant correlations with seed yield for number of pods per plant, plant dry weight and harvest index. Such associations were also reported

Table 2. Correlation coefficient values for different traits at phenotypic, genotypic and environmental levels in greengram

Sno.	Characters		(X_1)	(X_2)	(X_3)	(X_4)	(X_5)	(X_6)	(X_7)	(X_8)	(X_9)	(X_{10})
1	Plant height (X_1)	rg	1.000	0.191	0.381	0.233	-0.084	0.77**	-0.225	0.07	0.056	0.037
		rp	1.000	0.189	0.352	0.168	0.071	0.430	-0.171	0.108	0.022	0.134
		re	1.000	0.206	0.271	0.008	**0.362**	0.222	0.200	0.276	0.427*	0.459*
2	Primary branches plant^{-1} (X_2)	rg		1.000	0.710	0.208	0.566**	-0.307	-0.296	0.456*	0.492*	0.060
		rp		1.000	0.548*	0.259	0.236	-0.153	-0.240	0.457*	0.393	0.160
		re		1.000	0.142	0.360	0.017	0.029	-0.042	0.462*	0.107	0.329
3	Clusters plant^{-1} (X_3)	rg			1.000	0.197	0.916**	0.043	0.452*	0.139	0.660**	0.306
		rp			1.000	0.153	0.348	0.090	-0.368	0.275	0.517*	0.126
		re			1.000	0.078	0.048	0.163	-0.172	0.176	0.093	0.162
4	Pods plant^{-1} (X_4)	rg				1.000	0.465*	0.113	-0.352	0.448*	0.336	0.720**
		rp				1.000	0.077	0.030	-0.195	0.541	0.131	0.609**
		re				1.000	0.159	0.049	0.215	0.720	0.304	0.480**
5	Pod length (X_5)	rg					1.000	0.290	0.192**	0.306	0.184	0.122
		rp					1.000	0.016	0.359	0.064	0.202	0.092
		re					1.000	0.106	-0.138	0.110	0.299	0.218
6	Seeds plant^{-1} (X6)	rg						1.000	0.263	0.026	0.175	0.123
		rp						1.000	0.247	0.073	0.147	0.152
		re						1.000	0.318	0.136	0.134	0.177
7	100-seed weight (X_7)	rg							1.000	0.037	0.075	0.106
		rp							1.000	0.060	0.089	0.135
		re							1.000	0.153	0.158	0.249
8	Plant Dry weight (X_8)	rg								1.000	0.457*	0.473*
		rp								1.000	0.369	0.576**
		re								1.000	0.143	0.745**
9	Harvest index (X_9)	rg									1.000	0.558*
		rp									1.000	0.508*
		re									1.000	0.474*
10	Seed yield plant^{-1} (X_{10})	rg										1.000
		rp										1.000
		re										1.000

Table 3. Path coefficient values of different traits at genotypic and phenotypic level.

Characters		X1	X2	X3	X4	X5	X6	X7	X8	X9	Positive indirect effect	Negative indirect effect	Total indirect effect	Realised effect	Correlation with yield
Plant height (X1)	P	**0.021**	0.016	0.029	0.004	0.001	0.028	0.015	0.089	0.02	0.159	0.043	0.116	0.137	0.134
	G	**0.445**	0.013	0.041	0.050	0.01	0.335	0.067	0.074	0.072	0.129	0.537	0.408	0.037	0.037
Primary branch	P	0.004	**0.083**	0.045	0.007	0	0.01	0.021	0.377	0.349	0.447	0.370	0.077	0.16	0.16
plant $^{-1}$ (X2)	G	0.085	**0.070**	0.077	0.045	0.1	0.145	0.089	0.486	0.625	0.889	0.759	0.13	0.06	0.06
Clusters plant^{-1} (X3)	P	0.007	0.045	**0.082**	0.004	0.01	0.006	0.032	0.227	0.459	0.289	0.497	0.208	0.126	0.126
	G	0.169	0.050	**0.108**	0.042	0.16	0.020	0.127	0.34	0.839	0.664	1.078	0.414	0.306	0.306
Pods plant^{-1} (X4)	P	0.004	0.021	0.013	**0.026**	0	0.002	0.017	0.446	0.116	0.601	0.019	0.582	0.608	0.609**
	G	0.104	-0.015	0.021	**-0.216**	0.08	-0.054	-0.105	0.478	0.428	1.11	-0.174	0.936	0.72	0.720**
Pod length (X5)	P	0.002	0.019	0.029	0.002	**0.016**	0.001	0.031	0.053	0.179	0.212	0.104	0.108	0.092	0.092
	G	-0.037	0.04	-0.1	0.1	**-0.17**	-0.137	0.273	-0.327	0.234	0.647	-0.6	0.047	-0.122	-0.122
Seeds pods^{-1} (X6)	P	0.009	0.013	0.007	0.001	0.0	**0.066**	0.021	0.061	0.131	0.23	0.013	0.217	0.151	0.152
	G	0.315	0.022	0.005	-0.024	-0.05	**-0.473**	0.079	0.027	0.223	0.671	-0.073	0.598	0.123	0.125
100-seed weight (X7)	P	0.004	0.020	0.030	0.005	0.006	0.016	**0.087**	0.05	0.079	0.129	0.081	0.048	0.135	0.135
	G	-0.1	0.021	-0.05	0.076	-0.15	-0.124	**0.299**	0.039	0.095	0.231	-0.424	-0.193	0.106	0.16
Plant dry weight (X8)	P	0.002	0.038	0.023	0.014	0.0	0.005	0.005	**0.825**	0.328	0.083	0.333	0.25	0.575	0.576**
	G	0.037	-0.032	0.035	-0.097	0.05	-0.012	0.011	**1.067**	-0.582	0.129	-0.723	-0.594	0.473	0.473*
Harvest index (X9)	P	0	0.032	0.042	0.003	0.003	0.010	0.008	0.304	**0.889**	0.011	0.391	0.38	0.509	0.508*
	G	-0.025	0.034	0.071	-0.073	-0.03	-0.083	0.022	-0.488	**1.272**	0.056	-0.771	-0.715	0.557	0.558*

by several workers (Vikas *et al* 1998, Islam *et al,* 2000, Loganathan *et al* 2001). Plant height also revealed the positive and significant correlation with seed yield but only at environmental level hence should not be considered for selection (Table2).

At genotypic level, the positive and significant correlation was found between plant height and seeds per pod; primary branches and plant dry weight; pods per plant and plant dry weight and pod length with 100-seed weight. Whereas at phenotypic level, number of primary branches with clusters per plant and plant dry weight and pods per plant with plant dry weight revealed the positive and significant correlation. The positive and significant correlations of pods per plant, plant dry weight and harvest index with seed yield and significant inter-association among these traits at phenotypic and genotypic level could enhance augmentation of seed yield.

Conceptually correlation coefficient value between a component character and yield does not reflect the actual contribution, so the correlation value is untangled into direct effect of the character and its indirect effect via other characters, i.e. correlation of a character with seed yield is the resultant of its direct as well as indirect effect, employing path coefficient analysis. In the present study, correlation values computed at phenotypic and genotypic levels for nine agronomic characters were compartmentalized into direct and indirect effect on seed yield. At genotypic and phenotypic level, harvest index, plant dry weight, plant height, 100-seed weight and number of clusters per plant registered positive direct effect on seed yield. Harvest index showed very high positive direct effect on seed yield also with highly significant positive correlation with yield. Pod length and seeds per pod showed negative direct effect at both genotypic and phenotypic level.Negative direct effect of pod number and seed number on seed yield has also been reported by Bhumikumaran and Rathinam (1981), Yaqoob *et al* (1997) and Pandey *et al* (2007). Similar observations were reported by Rajan *et al. (2000)* and Venkateshwarlu, (2001). Finally the path analysis revealed the importance of harvest index, plant dry weight, plant height and 100-seed weight for their direct effect while number of primary branches, clusters per plant, pod length and seeds per pod for their indirect effect on seed yield and hence during selection these traits should be given utmost attention for developing high yielding greengram varieties.

The present study vividly indicated that due to higher HI, plant dry weight, plant height, more clusters, number pods and heavy seeds may be achieved resulting in high yield. High biological yield of a plant would conceptually pave the way for higher photosynthetic efficiency as well as sink capacity leading to higher net assimilation rate. While on the basis of high genetic variability, genetic parameters, association and positive direct effect, it may be concluded that plant height, number of clusters, number of pods, plant dry weight, 100-seed weight and harvest index considered to be the major yield attributing characters and proper consideration should be given to these traits for the enhancement of yield in greengram.

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