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GENETIC VARIABILITY AND ASSOCIATION STUDIES IN COWPEA [*VIGNA UNGUICULATA* (L.) WALP] FOR SEED YIELD AND RELATED TRAITS

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SUMMARY

Fourteen genotypes of cowpea (*Vigna unguiculata* (L.) Walp) were evaluated for character association during *kharif* 2017. The genotypes were analyzed for genetic variability, correlation and path coefficients. The genotypes were found significantly different for all the characters, which indicated scope for further genetic studies. High heritability along with high genetic advance was recorded in seed yield per plot, days to 50% flowering and plant height indicating predominance of additive effects in the inheritance of these characters. The phenotypic coefficient of variation (PCV) estimates was invariably higher than their corresponding genotypic coefficient of variation (GCV) values. This suggests the environmental influence. High GCV and PCV were observed for seed yield per plot, days to 50% flowering, days to maturity and plant height suggesting that selection based on these characters would facilitate successful isolation of desirable types. Number of seeds per pod had positive and significant correlation at genotypic level with seed yield per plot. The traits like number of seeds per pod, number branches per plant and days to maturity showed direct effect on seed yield per plot. Two genotypes *viz.* GC 3 and PTBCP 4 were found resistant against Cowpea Yellow Mosaic Virus (CYMV) disease.

Key words : Cowpea, Genetic advance, GCV, PCV, Heritability

Cowpea [*Vigna unguiculata* (L.) Walp.] is an annual, self pollinated legume belonging to family Leguminaceae with a diploid chromosome number of 2n=2x=22. It is native to India but tropical and Central Africa is considered as secondary centre of origin. In India cowpea is cultivated for food, vegetables, and fodder purpose (Arya *et al.,* 2019). This crop has tremendous adaptability for various conditions and therefore it is cultivated from north Jammu& Kashmir to south Tamil Nadu. Cowpea has been referred to as "Poor man's meat" because of its high protein content (20- 25%) (Sabale *et al*., 2018). It is considered as one of the oldest legume used as protein source for humans and livestock. It is being used as pulse in form of dry seed, immature pod and green leaf and growing twig can be utilized as vegetable. It is an important source of green as well as dry fodder. Cowpea is cultivated for both grain and fodder in all tropical and sub-tropical regions among fodder legumes (Nguyen *et al.*, 2017). It is drought hardy crop and responds well under irrigated conditions. In Haryana, cowpea is grown as intercrop with fodder sorghum, maize or pearl millet to improve the quality of fodder (Phogat *et al.,* 2017). The crops like cowpea can also became a valuable component in cereal based farming system as it restores soil fertility for succeeding crop. It fixes about 240kg/ha atmospheric nitrogen and leaves about 60 to 70 kg nitrogen for succeeding crop (Kumar, 2020). Therefore, being a pulse crop, it is useful to improve soil fertility (Nguyen *et al.,* 2016). There is need to develop varieties suitable for a specific region and use. Low and variable grain yield, seed quality and susceptibility to diseases & pests are the main constraints in cowpea production. Under such conditions genetic diversity is of great importance and plays a crucial role in focusing crop improvement. Genetic variability of yield and yield contributing characters and correlation between them is basic to plan out future improvement programme in any crop.

TABLE 1
List of genotypes of Grain Cowpea used in study along with their source and pedigree

S. No.	Genotype	Source	Pedigree
1.	RC 101(Ch)	Rajasthan	-
2.	GC 3 (Ch)	SKDAU, S.K. Nagar, Gujarat	-
3.	Pant Lobia-3(Ch)	Pantnagar	-
4.	Pant Lobia-4(Ch)	Pantnagar	-
5.	CPD-249	RARI, Durgapura, Rajasthan	RC 101 X RC 19
6.	PTBCP-4	ARS, Pattambi	Anaswara X Bhagyalakshmi
7.	Phule PCP 1123	ARS, Pandharpur	RC 101 X Phule Vithai 7-1-4
8.	Phule PCP 1129	ARS, Pandharpur	(VCM 8 TC 701) X (TC 701)-15-2-9-3
9.	VCP 13-001	NPRC, Vamban	CO (CP) 7 X Vamban 1
10.	TC 172	BARC, Trombay, Maharashtra	-
11.	GC 1506	SKDAU, S.K. Nagar, Gujarat	GC 2 X GC 703
12.	CPD 221	RARI, Durgapura, Rajasthan	RC 19 X GC 3
13.	GC 1501	SKDAU, S.K. Nagar, Gujarat	GC 2 X PGCP 1
14.	VCP 12-005	NPRC, Vamban	Vamban 1 X VCP 23

MATERIALS AND METHODS

A breeding trial of cowpea was conducted during *kharif* 2017, at CCSHAU, Hisar containing fourteen genotypes of cowpea. The experimental material was grown in a randomized block design (RBD) with three replications. The weather conditions and rainfall received during *kharif* 2017 presented in figure 1. Each genotype was planted in four rows of 4 m length with row-to-row distance of 45 cm and plant to plant distance of 10 cm. All the recommended cultural practices were followed throughout the crop seasons to raise a good crop. Observations from five randomly selected plants of each genotype in each replication were recorded on seven quantitative traits *viz*., days to 50 % flowering, days to maturity, plant height (cm), number of branches per plant, number of pods per plant, number of seeds per pod and seed yield per plot (kg/ha). Analysis of variance was performed using method described by Panse and Sukhatme (1967). Phenotypic coefficient of variance and genotypic coefficient of variability were calculated by the method explained by Singh and Chaudhary (1985). Heritability in broad sense and genetic advance were calculated by method given by (Burton and Devane, 1953). Correlation coefficient and path analysis was worked out as per the method suggested by Dewey and Lu (1959).

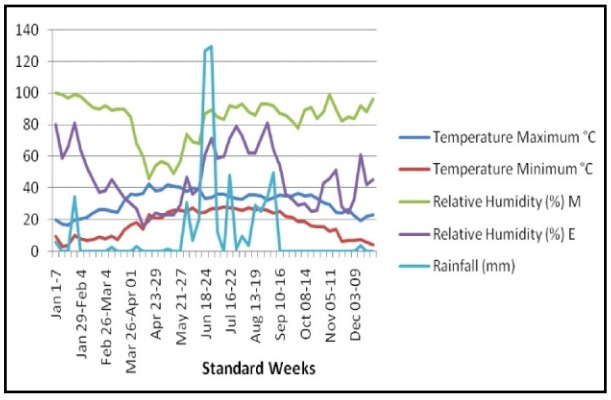

Fig. 1. Weekly weather data during *kharif* 2017.

RESULTS AND DISCUSSIONS

The genotypes were found significantly different for all the characters, which indicated scope for further genetic studies. The phenotypic coefficient of variation (PCV) estimates was invariably higher than their corresponding genotypic coefficient of variation (GCV) values. This suggests the environmental influence over these characters. High GCV and PCV were observed for seed yield per plot, days to 50% flowering, days to maturity and plant height suggesting that selection based on these characters would facilitate successful isolation of desirable types. Similar results were found by Nguyen *et al.* 2019 for days to 50% flowering, days to maturity and plant height, Om Vir and Singh, 2019 for all traits by Sharma *et al.,* 2017 for plant height and by Sharma *et al.,* 2019, Sabale *et al.,* 2018 and Shanko *et al.,* 2014 for seed yield per plant. High heritability along with high genetic advance was recorded in seed yield per plot, days to 50% flowering and plant height indicating predominance of additive effects in the inheritance of these characters (Table 2). Similar results were found by Nguyen *et al.,* 2019 for plant height, seed yield per plant and days to 50% flowering, Sharma *et al.,* 2019, Om Vir and Singh, 2019, Sabale

TABLE 2
Genetic parameters of different characters in grain cowpea

Characters	Mean ±SE(m)	C. D. (5%)	Range	Coefficient of variation		Heritability (%)	Genetic advance as % of mean
				GCV	PCV		
Days to 50% flowering	43.67±0.83	2.43	27.00-62.00	31.547	31.720	98.92	64.635
Days to maturity	80.48±0.89	2.61	59.33-118.33	28.575	34.194	69.84	49.193
Plant height (cm)	110.74±1.98	5.81	79.00-169.00	30.724	30.880	98.98	62.970
No. of branches/ plant	6.93±0.75	2.19	5.00-10.67	23.970	30.417	62.10	38.913
No. of pods per plant	25.24±1.61	4.70	17.33-39.00	21.555	24.213	79.25	39.529
No. of seeds per pod	11.67±1.02	NA	9.33-13.67	6.833	16.609	16.93	5.791
Seed yield per Plot (g)	396.64±12.57	36.75	63.33-95.67	70.424	70.638	99.396	144.636

TABLE 3
Phenotypic and genotypic correlations among yield component traits in grain cowpea. Above diagonal indicates phenotypic, below diagonal and bold are genotypic correlation coefficients.

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	No. of seeds/ pod	Seed yield (g)
Days to 50% Flowering	1.00	0.851**	0.489**	0.492**	-0.141^{NS}	-0.119^{NS}	-0.159^{NS}
Days to maturity	0.991**	1.00	0.421**	0.496**	-0.147^{NS}	-0.160^{NS}	-0.047^{NS}
Plant height (cm)	0.496**	0.505**	1.00	0.337*	-0.280^{NS}	-0.035^{NS}	-0.453**
No. of branches /plant	0.619**	0.771**	0.416**	1.00	0.013^{NS}	-0.087^{NS}	0.074^{NS}
No. of pods per plant	-0.171^{NS}	-0.289^{NS}	-0.322*	0.002^{NS}	1.00	0.340*	0.207^{NS}
No. of seeds per pod	-0.245^{NS}	-0.103^{NS}	-0.116^{NS}	-0.438**	0.769**	1.00	0.149^{NS}
Seed yield (g)	-0.162^{NS}	-0.057^{NS}	-0.456**	0.090^{NS}	0.250^{NS}	0.414**	1.00

TABLE 4
Direct and indirect effect of component traits on yield in grain cowpea. Residual effect= 0.6901

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	No. of seeds/ pod
Days to 50% Flowering	-0.252	0.253	-0.259	0.119	-0.001	-0.020
Days to maturity	-0.215	0.298	-0.222	0.120	-0.001	-0.027
Plant height (cm)	-0.123	0.125	-0.529	0.082	-0.002	-0.006
No. of branches per plant	-0.124	0.148	-0.178	0.243	0.000	-0.014
No. of pods per plant	0.036	-0.044	0.148	0.003	0.008	0.057
No. of seeds per pod	0.030	-0.048	0.018	-0.021	0.003	0.167

et al., 2018, Sharma *et al.,* 2017 for seed yield per plant and plant height. Number of seeds per pod had positive and significant correlation at genotypic level while, plant height has negative and significant correlation both at genotypic and phenotypic level with seed yield per plot. Traits like number of pods per plant and number of branches per plant had positive but non significant correlation with seed yield per plot both at genotypic and phenotypic level (Table 3). Similar results were found by Nguyen *et al.,* 2019 for number of seeds per pod, Om Vir and Singh, 2019, Sharma *et al.,* 2019, Walle *et al.,* 2018 for number of seeds per pod. The traits like number of seeds per pod, number branches per plant and days to maturity showed direct positive effect while, plant height has high direct negative effect on seed yield per plot followed by days to 50% flowering (Table 4). The genotypes were also evaluated against the Cowpea Yellow Mosaic Virus (CYMV) disease. Two genotypes *viz.* GC 3 and PTBCP 4 were found resistant against CYMV (Table 5).

CONCLUSION

At present, in India cowpea is consumed by people in the form of *daal* and vegetable. Cowpea

TABLE 5
Evaluation of cowpea genotypes against cowpea yellow mosaic virus during *Kharif* 2017

Name/ no of entry	Disease rating	Reaction
RC 101	5.20	Moderately Resistant
TPTC-29	5.00	Moderately Resistant
GC 3	3.20	Resistant
Pant Lobia-3	5.80	Susceptible
Pant Lobia-4	6.40	Susceptible
CPD-249	7.20	Susceptible
PTBCP-4	4.40	Resistant
Phule PCP 1123	5.00	Moderately Resistant
Phule PCP 1129	6.00	Susceptible
VCP 13-001	4.60	Moderately Resistant
TC-172	5.00	Moderately Resistant
GC 1506	5.80	Moderately Resistant
CPD-221	5.60	Moderately Resistant
GC-1501	6.40	Susceptible
VCP 12-005	6.00	Susceptible

variety with white colored grain, high protein content, good taste & cooking quality and without anti-nutritional factors like tannins and trypsin inhibiting factors is preferred by consumers. Animals are fed with its green leaves but the use of cowpea seed in animal feed as protein source can be a new option. Keeping in view the above factors breeding objectives can be made.

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