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ASSOCIATION AND GENETIC DIVERSITY STUDIES IN GREENGRAM (*Vigna radiata* (L.) Wilczek)

C. NATARAJAN[1], K. THIYAGARAJAN[2], and R. RATHNASWAMY[3]

Genetic association and diversity studies among forty five genotypes of diverse origin of greengram were carried out for eight characters. The seed yield, pod number and plant height showed high genotypic coefficient of variation. High heritability estimates were observed for 100 seed weight, days to flowering, plant height and pod length. The seed yield showed highest genetic advance followed by plant height. The correlation study revealed that the seed was positively and significantly correlated with plant height, clusters and pods per plant and seeds per pod. Pods per plant showed a high positive direct effect on seed yield followed by seeds per pod. By application of D^2 analysis, the forty five genotypes were grouped into four clusters. The types chosen from the same eco-geographic region were found scattered in different clusters. The clustering together of types from the same eco-geographic region into one cluster was also observed. Maximum intercluster distance was observed between cluster III and IV indicating that highly divergent types existed in these clusters. In the selected materials, seed weight contributed maximum towards the genetic divergence.

The seed yield in greengram (*Vigna radiata* (L.) Wilczek) as in other crops is a complex character that is highly subjected to environmental variations. Selection, therefore, based on seed yield alone is not likely to be efficient. Indeed, a knowledge of the genotypic correlations of yield and yield components and the relative contribution of component characters towards yield indicate those components upon which greater emphasis should be placed for the purpose of selection.

The success of hybridisation in self pollinated crops is mainly dependent on the genetic diversity of the parents involved. Selection of parents a suitable criterian. As this assu ption is only an inferential criteri the importance of genetic diversi has long been appreciated by pla breeders. Such an analysis will eve tually help to choose desi parents for hybridisation and evo superior genotypes. Hence it necessary to evaluate the availa genetic resources. With these asp the study was carried out.

MATERIAL AND METHODS

A total of forty five genotypes greengram of diverse origin from t germplasm was chosen and stud during kharif 1985 at National Pu Research Centre, Puddukkottai, Ta in a single row of 3 m length spaced 30 cm apart and 10 cm between plants. Five plants were randomly selected in each type and observations were recorded on eight characters. Genetic and phenotypic co-efficient of variation (Burton, 1952), heritability in broad sense (Lush, 1940), genetic advance and correlation co-efficients (genotypic and phenotypic) (Johnson *et al.*, 1955) were calculated. Path analysis was done as suggested by Dewey and Lu (1959). Mahalanobis, D^2 analysis was used for estimating the genetic divergence among the genotypes.

RESULTS AND DISCUSSION

Mean, range, phenotypic and genotypic co-efficients of variation (PCV and GCV), heritability and genetic advance are presented in Table 1.

The genotypes showed significant differences in respect of all the characters studied. The seed yie pod number and plant height show high G C V indicating that th characters are highly amenable selection. Pod length and days flowering showed minimum variabil as evidenced from the low values GCV. Similar results were reported Paramasivam and Rajasekaran (198 and Boomikumaran (1980). Heritabil estimates give the best picture of t extent of advance to be expected selection. High heritability estimat (broad sense) were observed for 1 seeds weight, days to flowering, pl height and pod length, as repor earlier by Sulaiman (1976) a Boomikumaran (1980) in greengram.

The genetic gain that can be e pected by selection for a character given by the estimates of gene advance for the characters Gene advance expressed as per cent of me was the highest for seed yield follow by plant height, seed weight and po per plant.

Table 1. Mean, variability, heritability and genetic advance of yield and seven economic charact in greengram

Characters	Mean	GCV	PCV	Heritability	Genetic advance	Genetic advance as % of mean
Yield	2.78	30.14	39.99	54.79	1.33	46.83
Plant height	44.37	21.60	25.17	73.65	16.66	38.22
No. of cluster/plan	4.42	17.10	37.74	20.54	0.77	15.98
No. of pods/plant	10.55	21.88	32 90	44.26	3.49	30.10
Pod length (cm)	7.31	12.24	14.67	69.66	1.52	21.07
No. of seeds/pod	11.24	5.71	10.45	29.86	0.72	6.43

ɔ 2. Phenotypic (values in parenthesis) and genotypic correlation coefficients of yield and yield components

acters	No. of clusters per plant	No. of pods per plant	Pod length	No. of seeds	100 seed weight	Days to 50% flowering	Yield
t height	0.3391*	0.5794**	0.2469	0.7494*	—0.0504	0.0913	0.7452**
	(0.1835)	(0.3765)	(0.1859)	(0.3879)	(—0.0580)	(0.0961	(0.4296)
ɔf clusters per plant		0.6104**	-0.1336	0.2226	—0.3445**	—0.1393	0.5612**
		(0.5795)	(0.0431)	(0.0964)	(—0.1523)	(—0.6331)	(0.3222)
ɔf pods per plant			0.0086	0.4583**	—0.3168*	0.1391	0.8061**
			(0.0712)	(0.1958)	(—0.2231)	(0.1019)	(0.5824)
length				0.2614	0.2295	—0.0405	0.1321
				(0.3190)	(0.1889)	(—0.0238)	(0.1381)
f seeds per pod					—0.0868	—0.1567	0.7375**
					(—0.0559)	(—0.0616)	(0.2741)
seed weight						—0.0690	—0.1342
						(—0.0684)	(—0.1050)
to 50% flowering							—0.0249
							(0.0053)

**, * indicate significance at one and five per cent levels respectively

The correlation analysis (Table 2) revealed that seed yield was significantly and positively correlated with plant height, clusters per plant,pods per plant and seeds per pod. This indicates that selection based on these characters may result in improving the yield. Similar results were reported by Boomikumaran and Rathinam (1981) and Singh and Sharma (1981). A significant positive correlation has also been reported by Shamuzzaman *et al.*, (1981) for pods per plant and seeds per pod and at AVRDC (1983) for plant height and pods per plant. Plant height, clusters per plant and pods per plant showed significant positive correlation with seed yield but comparatively low at genotypic level. This might be due to the modifying effect of the environment in the expression of the genetic component of these characters. The inter-correlations estimated for the yield components showed that plant height, clusters per plant and pods per plant were significantly and positively correlated among themselves. It indicates that simultaneous improvement of these characters can be effected by selection. 100 seed weight showed significant negative correlation with clusters per plant and pods per plant.

The high positive correlation values obtained for plant height, clusters per plant and pods per plant with seed yield and the significant inter correlations existing among themselves, genotypically and phenotypically revealed that these characters may be considered for improvement of yield.

positive direct effect on seed yiel followed by seeds per pod. The indirect effects of other characters lik clusters per plant, plant height and po length through pods per plant and seed per pod were also much appreciabl indicating that these characters playe an important role in determining yield In contrast to these results, Boomikumaran and Rathinam (1981) reporte negative direct effects for pods pe plant and seeds per pod on seed yield It is noticeable here that pods per plan and seeds per pod showed high magnitudes of positive genotypic correlations with seed yield.

The residual effect observed in the path analysis was low (0.3802) indicating that the characters not included in the present study exert insignificant effect on seed yield.

By application of D^2 analysis, the forty five genotypes were grouped into four different clusters (Table4). Among the clusters, cluster I contained 32 genotypes while cluster IV contained only one genotype namely Rasipuram, a local collection. The cluster III consisted types from the same geographical region, showing similar genetic architecture among the types of the cluster. Such a parallelism was also reported by Boomikumaran (1980) and Shanmugam and Sree Rangasamy (1982) in greengram. Clusters I and II contained types from different geographical regions, indicating that the geographic diversity though important may not be the only

3. Direct and indirect effects of seven characters on yield in greengram

Characters	Plant height	No. of clusters per plant	No. of pods per plant	Pod length	No. of seeds per pod	100 seed weight	Days to 50% flowering	Genotypic correlation coefficients with yield
height	*0.1048*	0.0596	0.2853	—0.0014	0.3038	—0.0062	—0.0051	0.7452
f clusters per plant	0.0355	*0.1757*	0.3006	0.0008	0.0902	—0.0426	0.0009	0.5612
f pods per plant	0.0607	0.1073	*0.4924*	—0.0000	0.1858	—0.0392	0.0009	0.8061
length	0.0259	—0.0235	0.0009	*0.0058*	0.1060	0.0284	0.0003	0.1321
f seeds per pod	0.0785	0.0391	0.2257	0.0015	*0.4054*	—0.0107	0.0010	0.7355
eed weight	—0.0053	—0.0605	—0.1560	—0.0013	—0.0352	*0.1237*	0.0005	—0.1342
to 50% flowering	0.0096	—0.0244	0.0685	0.0002	—0.0035	—0.0085	*—0.0067*	—0.0249

Figures in italics are direct effect ; Residual effect : *0.3802*

Table 4. Composition of D^2 values

Clusters	No. of types	Origin	Genotypes
I	32	Delhi	PIMS 2 and PIMS 3
		Philippines	MG 44 and H 70-16
		Punjab	PLS 284, PLS 287, PLS 319, PLS 330, PLS 337, LM LM 32, LM 38, LM 216, LM 232, LM 244, LM 265, LM 294, HL 4, ML 103 and ML 2
		Taiwan	AC 156, AC 157, AC 56, AC 2, AC 2549, 2106, 22 2273, 3096 and 3156
		TamilNadu	Perambalore
		Gujarat	G.1
II	10	Delhi	PS 16
		Philippines	MG 131
		Punjab	ML 1 and PLS 304
		Taiwan	1944, 2007, 2184, 2984 and 2268
		Uttar Pradesh	T 44
III	2	Punjab	LM 69 and LM 103
IV		Tamilnadu	Rasipuram

Table 5. Average intra and intercluster D^2 values and intra and intercluster distance (D) (Figu in parenthesis) Values

Clusters	I	II	III	IV
I	79.82 (8.93)	140.96 (11.87)	188.61 (13.73)	530.79 (23.
II		58.69 (7.67)	238.43 (15.44)	215.69 (14.
III			125.89 (11.22)	606.77 (24
IV				—

the differential grouping of the variteies. The clustering pattern failed to indicate any relationship between genetic divergence and geographic distribution.

Twenty types from Punjab were found scattered in three clusters indicatin the presence of wide genetic

the inter cluster distance between and IV was maximum followed by distance between I and IV (Table The types in these clusters may se as potential parents and crossing b ween the types may result in heter expression for yield compon. Wilcox and Wilsie (1964)

Table 6. Cluster mean

Cluster	Cluster mean							
	Yield/plant	Plant height	No. of clusters per plant	No. of pods/plant	Pod length	No. of seeds	100 seed weight	Days t· 50% floweri
I	2.775	42.02	4.91	11.91	7.57	11.54	3.51	36.91
II	3.214	48.70	4.60	11.27	6.01	11.40	4.11	35.9:
III	2.435	43.58	4.17	10.67	6.15	11.00	3.57	44.5
IV	2.000	43.70	4.00	8.38	9.50	11.00	5.43	35.0

the genetic diversity of the germplasm. However, the possibility of exploiting heterosis in greengram is ruled out in the near future because of the absence of male sterility.

Cluster I had increased mean values for clusters per plant, pods per plant and seeds per pod. Cluster II recorderd high mean values of plant height and yield. cluster IV recorded high mean values for pod length and 100 seed weight (Table 6). Intercrossing the types from these clusters might result in wide array of variability for exercising effective selection.

The relative contribution of different plant characters to the total genetic divergence can be estimat by utilizing D^2 statistics. In Mah lanobis' D^2, the relative contributi of variable characters to the to genetic divergence is given by respective rank totals (Murthy, 196 The character with the highest ra total contributes the maximum total genetic divergence. Utilizing t technique in the present study, t percentage contribution of each ch acter to the total divergence w assessed. The present study reveal that seed weight made greatest co tribution (57.87 per cent) follow by days to flowering (27.67 per cen

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