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Genetic Variability, Trait Association and Path Analysis of Yield and Yield Components in *Vigna radiata* L.

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Abstract

Genetic variability and heritability of different characters were studied using 32 genotypes including two standard checks in green gram (*Vigna radiata* L.). The genotypes showed wide range of variation for all the characters. A high coefficient of variation was observed for seed yield plot^{-1} and number of pods plant^{-1}. High values of heritability coupled with high genetic advance as percentage of mean was observed for seed yield plot^{-1} and this character can be improved by selection. The days to maturity, number of clusters plant^{-1} was significantly and positively correlated with yield. Number of clusters plant^{-1} exerted maximum direct effect on seed yield followed by number of pods cluster^{-1}, pod length and number of seeds pod^{-1} had positive direct effect on seed yield.

1. Introduction

A well planned plant breeding programme for developing high yielding genotypes requires complete knowledge on phenotypic and genotypic variations available in the population. Green gram (*Vigna radiata* L.) breeding strategy involves assembling or generating variable germplasm and selection of superior germplasm for utilizing them in hybridization programme to develop a superior variety. Yield is a complex character being governed by a large number of cumulative, duplicate and dominant genes and highly influenced by environment. This necessitates thourough knowledge of variability owing to genetic factors, actual genetic variation heritable in the progeny and the genetic advance that can be achieved through selection. Moreover, heritability estimate along with the genetic advance is more useful than heritability estimate alone in predicting resultant effect for the selection of the best individual from segregating population. Correlation and path analysis will establish the extent of association between yield and yield components and bring out relative importance of their direct and indirect effects and these give a clear understanding of their association with yield.

2. Materials and Methods

The experimental material consisted of thirty two green gram genotypes including advanced breeding lines and two standard checks viz., MGG-295 and MGG-348, were grown in a randomized block design, replicated thrice with a spacing of 30 cm×10 cm during Kharif 2010-11 at Agricultural Research Station, Madhira, Andhra Pradesh, India. Each entry was sown in two rows with a row length of 4.5m. Five plants were randomly selected from each entry and replication; and observations were recorded on days to 50% flowering, days to maturity, plant height (cm), number of clusters plant^{-1}, number of pods plant^{-1}, number of seeds plant^{-1}, 100 seed weight (g) and seed yield plot^{-1}. Seed yield plot^{-1}, days to 50% flowering and days to maturity were recorded on plot basis. The phenotypic and genotypic variance, phenotypic and genotypic coefficient of variation, heritability, genetic advance as percentage of mean, Correlation and path analysis were calculated following standard methods. The estimates of PCV and GCV were classified as low, medium and high (Sivasubramanian and Madhavamenon, 1973) (less than 10%=low; 10-20%=moderate; greater than 20%=high). Heritability estimates (broad sense) for yield components of Green gram genotypes were worked out following Singh and Chaudhary (1985). The heritability estimates were categorized as (0-30%=low; 31-60%=moderate; above 60%=high) suggested by Robinson et al. (1949). Genetic advance was estimated and categorized (more than 20%=high; 10-20%=moderate; less than 10%=low) by adopting the method given by Johnson et al. (1955). Correlation coefficient and path analysis were estimated as per the methods suggested by Weber and Moorthy (1952) and Deway and Lu (1959), respectively.

3. Results and Discussion

The analysis of variance showed that the genotypes differed significantly among themselves for all the characters under study indicating the presence of adequate variability. The range of variation (Table 1) was maximum for seed yield plot^{-1} followed by days to maturity, plant height, number of pods plant^{-1}, days to 50% flowering, number of clusters plant^{-1}, number of seeds plant^{-1} and 100 seed weight. Variances and coefficient of variation indicated that there were little differences between phenotypic and genotypic variance for some of the characters *viz.,* 100 seed weight, number of seeds plot^{-1}, days to maturity and days to 50% flowering, indicating that these characters were less affected by environment. On the other hand, characters such as seed yield plot^{-1}, number of pods plant^{-1} and plant height were the most affected by the environment. For meaningful comparison among characters for variability, standardization with respective mean values was done to get PCVs and GCVs. It is clear that using coefficients of variation as a measure, the magnitude of variation was maximum for number of pods plant^{-1} followed by seed yield plot^{-1}. Low variability was observed for days to maturity, days to 50% flowering, 100 seed weight and number of seeds plant^{-1}. This may be due to the presence of both positive and negative alleles for these characters.

High heritability (broad sense) estimates were observed for days to 50% flowering, days to maturity and 100 seed weight, which indicated that the dependence of phenotypic expression reflect the genotypic ability to transmit the genes to their off spring. Johnson et al. (1955) further suggested that high heritability considered together with high genetic advance is more reliable in predicting desirable improvement for seed yield plant^{-1}. It further showed that this character is amenable for improvement by selection, particularly by mass selection. Such values of high heritability and genetic gain may be attributed to additive effect (Panse, 1957). Hence, selection in segregating generations would be very effective for this character.

Genetic correlation between different characters of plant could arise because of linkage, pleiotropy or developmentally induced functional relationships. For a rational approach towards the improvement of yield, selection has to be made for components traits. In general genotypic correlations were greater than the corresponding phenotypic correlations (Table 2), indicating the preponderance of genetic variance in expression of different characters (Malik et al., 1981). The correlation analysis revealed that. Days to maturity was significantly and positively correlated with plant height and number of seeds plant^{-1}. The number of clusters plant^{-1} was significantly and positively correlated with number of pods plant^{-1}. This indicates that selection based on these characters may result in improved yield. Similar results were reported by Naidu and Rosaiah (1993) and Sharma (1999). Days to 50% flowering and number of pods cluster^{-1} was significantly and negatively correlated with 100 seed weight. The correlation values decide only the nature and degree of association existing between pairs of characters. A character like seed yield is dependent on several mutually associated component characters and change in any one of the components is likely to affect the whole network of cause and effect relationship. This in turn might affect the true association of component characters, both in magnitude and direction and tend to vitiate association of yield and yield components.

Hence, it is necessary to partition the phenotypic correlations of component characters into direct and indirect effects through components. Path analysis (Table 3) revealed that number of clusters plant^{-1} exerted maximum direct effect on seed yield

Table 1: Variability parameters for seed yield and its component characters in Green gram

S. No.	Character	Range			Variance		Coefficient of variation		Heritability (%)	Genetic advance (% mean)
		Maximum	Minimum	Mean	Phenotypic	Genotypic	Phenotypic	Genotypic		
1.	Days to 50% flowering	40.00	35.00	37.98	1.917	2.15	3.86	3.64	89.0	7.081
2.	Days to maturity	74.33	68.66	71.13	4.98	5.69	3.35	6.13	87.6	6.048
3.	Plant Height (cm)	59.13	43.53	53.27	19.67	33.97	10.94	8.32	57.9	13.055
4.	No. of clusters plant^{-1}	5.53	3.33	4.47	0.14	0.60	17.41	8.49	23.8	8.530
5.	No. of pods plant^{-1}	25.73	11.46	18.95	5.31	20.25	23.74	12.16	26.2	12.829
6.	No. of seeds per plant	13.33	10.20	11.54	0.62	1.36	10.11	6.83	45.7	9.518
7.	100 seed weight (g)	3.20	2.00	2.84	0.05	0.07	9.60	8.19	72.8	14.406
8.	Seed yield plot^{-1}	386.66	160.00	325.72	2261.86	4506.88	20.61	14.60	50.2	21.308

Table 2: Genotypic (rg) and phenotypic (rp) correlation coefficients of yield components in green gram

		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of clusters plant-1	No. of pods plant-1	No. of seeds plant-1	Seed index (g)
Days to 50% flowering	G	1.00	0.11	0.12	-0.15	0.26	-0.08	-0.41
	P	1.00	0.1.	0.11	-0.11	0.06	-0.02	-0.31**
Days to maturity	G	0.10	1.00	0.52	0.37	-0.07	0.32	0.03
	P	0.09	1.00	0.35**	0.15	0.08	0.24*	0.03
Plant height (cm)	G	0.11	0.53	1.00	0.71	0.28	0.51	0.04
	P	0.11	0.36**	1.00	0.17	-0.01	0.18	-0.01
No. of clusters plant-1	G	-0.16	0.38	0.72	1.00	0.75	0.53	-0.08
	P	-0.12	0.16	0.18	1.00	0.75**	0.07	-0.08
No. of pods plant-1	G	0.23	-0.02	0.28	0.75	1.00	0.13	-0.45
	P	0.07	0.09	-0.01	0.75**	1.00	0.04	-0.23*
No. of seeds plant-1	G	-0.08	0.32	0.51	0.53	0.13	1.00	-0.24
	P	-0.02	0.25*	0.18	0.07	0.04	1.00	-0.12
Seed index (g)	G	-0.41	0.03	0.04	-0.08	-0.45	-0.24	1.00
	P	-0.31**	0.03	-0.01	-0.08	-0.23*	-0.12	1.00
Seed yield plant-1	G	0.15	0.65	0.77	0.97	0.69	0.51	-0.13
	P	0.02	0.54	0.38	0.44	0.52	0.20	-0.05

*significant at p=0.05; **significant at p=0.01

Table 3: Phenotypic and phenotypic path coefficient analysis with yield in green gram

		Days to 50% flowering	Days to maturity	Plant height (cm)	No. of clusters plant-1	No. of pods plant-1	No. of seeds plant-1	Seed index (g)
Days to 50% flowering	G	-0.02	-0.03	-0.06	0.06	-0.08	0.05	0.01
	P	-0.08	-0.07	-0.09	0.06	-0.04	0.07	0.02
Days to maturity	G	0.05	0.50	0.26	0.18	-0.06	0.16	0.01
	P	0.03	0.41	0.14	0.06	0.03	0.10	0.01
Plant height (cm)	G	0.02	0.11	0.21	0.15	0.06	0.11	0.09
	P	0.02	0.08	0.25	0.04	-0.03	0.04	-0.08
No. of clusters plant-1	G	0.01	-0.02	-0.05	-0.07	-0.05	-0.04	0.08
	P	0.01	-0.01	-0.01	-0.10	-0.07	-0.05	0.05
No. of pods plant-1	G	0.20	-0.01	0.22	0.59	0.79	0.17	-0.36
	P	0.03	0.05	-0.06	0.43	0.58	0.02	-0.13
No. of seeds plant-1	G	-0.02	0.07	0.12	0.12	0.03	0.23	-0.05
	P	-0.01	0.01	0.03	0.03	0.08	0.04	-0.08
Seed index (g)	G	-0.09	0.04	0.01	-0.09	-0.11	-0.05	0.24
	P	-0.01	0.01	-0.05	-0.06	-0.01	-0.06	0.04
Seed yield plant-1	G	0.15	0.65	0.77	0.96	0.69	0.51	-0.13
	P	0.02	0.54	0.38	0.44	0.52	0.20	-0.05

Bold values along the diagonal are direct effects

followed by number of pods cluster^{-1}, pod length and number of seeds pod^{-1} had positive direct effect on seed yield. Such a character is expected to be more useful as selection criterion in selection programme for improving yield. The number of clusters plant^{-1} had been reported to be the most prominent yield component in green gram by Veerabadhiran and Jehangir (1995).

Days to 50% flowering has negative effect on seed yield.

4. Conclusion

From the present study, it is evident that improvement in seed yield in green gram could be brought through selection of component characters like number of clusters plant^{-1}, number of pods cluster^{-1}, pod length, number of seeds pod^{-1} and test weight, which showed positive direct effect on seed yield.

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