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Variability, heritability genetic advance and correlation coefficients for yield component characters and seed yield in Greengram (*Vigna radiate* (L.) Wilczek)

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Abstract
The present experiment was conducted to evaluate 22 greengram genotypes along with one check (SAMRAT). Analysis of variance showed high significant differences among 22 greengram genotypes for 12 quantitative characters studied. Maximum genotypic and phenotypic variance was recorded for pods/plant and harvest index, Maximum GCV and PCV were recorded for pods per plant, pods per plant. High heritability was recorded for harvest index, pod length, seeds per pod, and primary branches per plant. High heritability coupled with high genetic advance as percent of mean was recorded for harvest index. Correlation coefficient analysis revealed that seed yield/plant exhibited significant and positive correlation both at genotypic and phenotypic levels with seed index, seeds/pod and days to maturity. These characters can be used as selection indices for green gram yield improvement.

Keywords: Greengram, Variability, Heritability, Genetic advance, Correlation

Introduction

Greengram [*Vigna radiata (L.)* Wilczek] (2n= 2x= 22) is third important pulse after chickpea and Pigeon pea. It is a self-pollinated crop and is an important grain legume of the tropical area.

In India, production of pulses is around 13.5-15 million tonnes during the last decade, while annual domestic demand is 18-19 million tonnes. The yield of pulses has remained virtually stagnant for the last 40 year (539 kg/ha in 1961 to 544 kg/ha in 2001 to 651 kg/ha in 2013-14). India is short of supply by 2 to 3 million tonnes annually.

In India, it is cultivated in Maharashtra, Andhra Pradesh, Rajasthan, Orissa, Karnataka and Uttar Pradesh. Greengram contributes 18.07 % of total pulses area and 11.48 % of total pulses production in India. Area, production and productivity of greengram in India are 34.4 lakh ha, 14 lakh tonnes and 406.98 kg/ha respectively (iipr.res.in, 2014-15) [6].

Among the wide array of pulse cultivation in India, mungbean holds a highly valuable legume crop because of its wider adoptability, low water requirement, ability to improve soil fertility, high protein content and digestibility (Shil and Bandopanhya, 2007) [16]

Selection of superior parents exhibiting better heritability and genetic advance for various characters is an essential prerequisite for any yield improvement programme. The knowledge of genetic variability existing within the different parameters contributing to the yield is an important criterion for yield enhancement but in highly self- pollinating crops like greengram, natural variation is narrow resulting in limited selection opportunity. The efficacy of selection depends upon the magnitude of genetic variability for yield and yield contributing traits in the breeding material. The knowledge of heritability and genetic advance guides the breeder to select superior parents to initiate an effective and fruitful crossing programme (Johnson *et al.*1955) [8].

Materials and Methods

The research experiment was carried out during *kharif*, 2016 comprising 22 genotypes of greengram at the Field Experimentation Center, Department of Genetics and Plant Breeding, Sam Higgin bottom University of Agriculture, Technology & Sciences, Allahabad.Five plants of each treatment from each replication were selected at random at the time of recording the data on various characters. Data of five plants were averaged replication wise and mean data was used for statistical analysis. Recommended package of practices were applied to raise a good crop. The data were recorded for 12 characters as following

The estimates of PCV and GCV were classified as low, medium and high (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. The heritability estimates were categorized as (0-30%=low; 31-60%=moderate; above 60%=high) suggested by Genetic advance was estimated and categorized (more than 20%=high; 1020%=moderate; less than 10%=low) by adopting the method given by Johnson *et al.* (1955) [8]. Correlation coefficient and path analysis were estimated as per the methods suggested by respectively.

Result 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 mean sums of square due to genotypes were significant at 1% level of significance for all the 12 characters under the study. These quantitative characters are Days to 50% Flowering, Days to 50% maturity, plant height (cm), Primary branches per plant, clusters per plant, pods per plant, seeds per pods, pod length(cm), harvest index (%), seed index(g), seed yield per plant(g).This suggested that the genotypes selected were genetically variable and considerable amount of variability existed among of them. The presence of large amount of variability might be due to diverse source of material taken as well as environmental influence affecting the phenotypes. In the present investigation in Table 2 estimates of phenotypic coefficient of variation was found higher than their corresponding genotypic coefficient of variation, indicating that the little influence of environment on the expression of these characters. However, good correspondence was observed between genotypic coefficient of variation and phenotypic coefficient of variation in all the characters. The result of the genotypic coefficient of variation and phenotypic coefficient of variation present are summarized as under:

Phenotypic coefficient of variation

A wide range of phenotypic coefficient of variation (PCV) was observed for all the traits ranged from days to maturity (4.78) to number of harvest index (35.81). Higher magnitude of PCV were recorded for harvest index (35.81) followed by pods per plant (16.25), number of clusters per plant (16.16), seed yield per plant (15.09), biological yield (12.10), primary branches/plant (11.63), plant height (10.92), pod length (9.58), seeds per pod (9.52), days to 50%flowering (8.41), seed index (5.52),and days to maturity (4.78) suggested for a limited scope of selection for improvement of these trait. The studies on phenotypic coefficient of variation indicated the magnitude of PCV was highest in case of number of branches/plant, seed yield /plant, biological yield/ plant and harvest index, indicating the presence of high amount of variation in these traits. Sarkar *et al.* (2006) [6] observed similar results in greengram.

Genotypic coefficient of variation

A wide range of genotypic coefficient of variation (GCV) was observed for all the traits ranged from days to maturity (3.23) to harvest index (32.06). High magnitude of GCV were recorded for number of harvest index (32.06) followed by pods per plant (16.25), number of clusters per/plant (11.05), seed yield per plant (10.53), primary branches/plant (8.69), plant height (7.37), pod length (7.26), biological yield (7.05), days to 50%flowering (5.49), seeds per pod (4.78), seed index (3.61), Sarkar *et al.* (2006) [6] also reported high genotypic coefficient of variation maximum for number branches per plant.

The studies on genotypic coefficient of variation indicated the magnitude of GCV was high in case of number of branches/plant, biological yield/ plant, seed yield /plant and harvest index, indicating the presence of high amount of variation in these traits. Phenotypic coefficient of variation is higher than GCV, it means that the apparent is not due only to genotypes but also due to the influence of environment. Rao *et al.* (2006) [13] also reported high estimates of GCV and PCV for clusters per plant, seed yield per plant, and biological yield per plant. Marappa *et al.* (2007) [11] also reported genetic variability and reported high GCV and PCV for plant height, primary number of branches per plant, days to maturity indicating the predominance of additive gene action.

Heritability (broad sense)

Burton (1952) [3] suggested the genetic variation along with heritability estimates would give a better idea about the expected efficiency of selection thus a character possessing high GCV along the high heritability will be valuable in selection programme. The perusal of the table 4.3 revealed the estimates of heritability (%) in broad sense for 12 characters studied, ranged from (25%) to (80%). Harvest index (80%), pod length (58%),primary branches per plant(56%),seed length per plant (49%), number of clusters per plant (47%),days to 50% maturity (46%) and pods per plant (45%) showed high heritability. Neelawati and Govindarasu (2010) [12] also reported high heritability for branches per plant, biological yield and seed yield. Moderate heritability was recorded for plant height (45%), seed index (43%), days to 50% flowering (43%), biological yield/plant (34%), seeds per pod (25%).

Estimates of heritability are useful in predicting the transmission of characters from parents to their offspring**.** It is a good index of transmission of characters from parents to their off spring (Falconer, 1981) [4].

Characters exhibiting high heritability may not necessarily give high genetic advance

Johnson and Robinson (1955) [8] showed that high heritability should be accompanied by high genetic advance to arrive at more reliable conclusion. The breeder should be cautious in making selection best on heritability as it includes both additive and non- additive gene effect.

Correlation between seed yield and other characters

Seed yield per pant exhibited positive and significant correlation with seed index (0.7949) followed by seeds/pod (0.5709), days to 50% maturity (0.3395) Positive association of seed yield per plant with biological yield/plant earlier reported by Bhattacharya (2002) [2] and with cluster/plant reported by Bharti *et al*. (2014) [1].

Seed yield per pant exhibited positive and significant correlation with days to 50%maturity (0.3029), It is concluded from the present study that all 22 genotypes of greengram showed significant genetic variability. High heritability was recorded for harvest index (80%), and seed yield per plant exhibited significant and positive correlation genotypic level with phenotypic level only with one character. Hence, direct selection for these traits could be helpful in the improvement of greengram breeding.

Table 1: Analysis of variance for 12 characters of greengram genotypes

S. No.	Characters	Mean sum of squares		
		Replications (d.f.= 2)	Treatments (d.f.= 21)	Error (d.f.= 42)
1	Days to 50% flowering	1.02	16.02**	5.24
2	Plant height	18.00	94.88**	27.08
3	Number of branches per plant	0.002	0.100	0.02
4	Number of clusters per plant	0.19	2.20*	0.60
5	Pods per plant	22.27	48.33**	14.02
6	Pod length	0.06	1.29*	0.25
7	Number of seeds per pod	0.07	1.89*	0.94
8	Days to maturity	12.37	17.02**	4.85
9	Seed index	0.001	0.10	0.03
10	Harvest index	11.99	127.88**	86.09
11	Biological yield	4.74	15.19**	5.98
12	Seed yield per plant	1.32	4.18**	1.08

*and ** significant at 5% and 1% level of significance

Table 2: Genetic parameters for 12 biometrical characters in greengram

S. No.	Characters	Genotypic Variance (V g)	Phenotypic Variance (V p)	Genotypic Coefficient of variation	Phenotypic coefficient of variation	Heritability (%) (broad sense)	Genetic advance	Genetic advance as % of mean
1	**Plant height**	22.60	49.68	7.37	10.92	45.01	6.61	10.24
2	Primary branches/plant	0.03	0.05	8.69	11.63	56.14	0.25	13.38
3	Days to 50% flowering	3.91	9.15	5.49	8.41	43.13	2.66	7.40
4	Days to 50% maturity	4.06	8.91	3.23	4.78	46.10	2.80	4.48
5	No. of cluster/plant	0.53	1.14	11.05	16.16	47.20	1.03	15.57
6	Pods/plant	11.44	25.46	16.25	24.24	45.21	4.67	22.43
7	Seeds/pods	0.32	1.26	4.78	9.52	25.01	0.58	4.95
8	Pod length	0.35	0.60	7.26	9.58	58.20	0.92	11.35
9	Seed index	0.02	0.06	3.61	5.52	43.20	0.21	4.87
10	Harvest index	347.26	433.36	32.06	35.81	80.21	34.36	59.11
11	Biological yield/plant	3.07	9.05	7.05	12.10	34.10	2.10	8.46
12	Seed yield/plant	1.03	2.12	10.53	15.09	49.23	1.46	15.14

*and ** significant at 5% and 1% level of significance

Table 3: Correlation coefficient between yield and its related traits in 22 greengram genotypes at genotypic level

No	Character	Primary branches per plant	Days to 50% flowering	Days to maturity	Clusters per plant	Pods Per plant	Seeds Per pod	Pod length (cm)	Seed index (g)	Harvest index (%)	Biological yield(g)	Seed yield per plant (g)
1	Plant Height(cm)	0.5474**	0.4471*	0.0478	0.7867**	-0.8009**	-0.3100*	-0.6863**	0.2550	-0.4118*	-0.5203**	0.1199
2	Primary Branches Per Plant	1.0000	0.3346*	-0.2622*	0.1910	-0.6302**	0.3792*	-0.3837*	0.2725*	-0.5359**	-0.3281*	-0.2057
3	Daysto 50% Flowering		1.0000	0.6842**	0.7496**	-0.3048*	-0.2678*	-0.3848*	0.6923**	-0.6067**	0.1025	0.0331*
4	Days to Maturity			1.0000	0.3623*	-0.1588	0.1648	-0.2500*	0.3905*	0.0121	-0.1343	0.3395**
5	Numberof Clusters				1.0000	-0.6843**	-0.5497**	-0.6469**	0.6138**	-0.3550*	0.0224	-0.2475*
6	Pods Per Plant					1.0000	0.1164	0.3220*	-0.5828**	0.4883*	0.1126	-0.3257*
7	Seeds Per Pod						1.0000	0.1729	0.3704*	-0.0017	0.1576	0.5709**
8	Pod Length							1.0000	0.0915	0.4664	0.4505	0.0026
9	Seed Index (g)								1.0000	-0.2835	0.2487	0.7949**
10	Harvest Index									1.0000	0.1895	0.1628
11	Biological Yield/plant										1.0000	0.0902

*and ** significant at 5% and 1% level of significance

Table 4: Correlation coefficient between yield and its related traits in 22 greengram genotypes at Phenotypic level

Character	Plant Height (cm)	Primary Branches Per Plant	Days to 50% Flowering	Days to 50 % Maturity	Clusters per plant	Pods Per Plant	Seeds Per Pod	Pod Length (cm)	Seed Index (g)	Harvest Index (%)	Biological Yield (g)	Seed Yield Per Plant (g)
Plant Heigh t(cm)	1.0000	0.2249	0.1695	0.0279	0.5526 ***	-0.2125	0.0709	-0.3599**	0.0548	-0.3470**	-0.0992	0.0943
Primary Branches Per Plant		1.0000	0.2609*	-0.0913	0.0866	-0.3887 **	0.1212	-0.1664	0.0344	-0.4234***	-0.3082*	-0.0395
Days to 50% Flowering			1.0000	0.3550 **	0.2966 *	-0.2413	0.0648	-0.2210	0.2788 *	-0.3489**	-0.0668	-0.0149
Days to 50 % Maturity				1.0000	0.1640	-0.1079	0.0036	-0.2052	0.1330	-0.0246	-0.0224	0.3029*
No. of Clusters					1.0000	-0.1827	-0.0960	-0.3048*	0.1884	-0.3070 *	0.1206	0.1141
Pods Per Plant						1.0000	0.1162	0.2267	-0.2636 *	0.3414**	0.2023	-0.0748
Seeds Per Pod							1.0000	0.0691	0.2221	0.0251	0.1579	0.1787
Pod Length								1.0000	0.1251	0.3442**	0.1422	0.0327
Seed Index (g)									1.0000	-0.1056	0.2071	0.1843
harvest Index										1.0000	0.1278	0.0894
Biological Yield											1.0000	0.0464

*and ** significant at 5% and 1% level of significance

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