Study of Genetic variability, Character association and Path analysis in Greengram [Vigna radiata (L.)Wilczek]

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A set of twenty genotypes of green gram were evaluated for studying ~~of **"Study of Genetic Variability, Character Association and Path Analysis in Greengram [*Vigna radiata* (L.)Wilczek]"**~~**the character association among them**. The experiment was conducted in a Randomized Complete Block Design with three replications during the *kharif* season, 2021. Analysis of variance showed significant differences among genotypes for all 13 characters. In the present investigation, both ~~at~~ phenotypic and genotypic correlation coefficients revealed that seed yield per plant exhibited positive and highly significant correlation with ~~Days~~ days to maturity and ~~Harvest~~ harvest Index. Maximum positive direct effects was depicted by ~~Harvest~~ harvest ~~Index~~ index (%) , ~~Number~~ number of seeds per pod and ~~Plant~~ plant height (cm) at both phenotypic and genotypic levels. Path analysis further revealed that direct effect of ~~Harvest~~ harvest ~~Index~~ index (%), ~~No~~no. of seeds per pod and ~~Plant~~ plant ~~Height~~ height (cm) was of high magnitude. The high positive association of other characters with grain yield per plant (g) was also due to high indirect effect through these characters. Therefore, these genotypes may be promoted for cultivation as well as in future breeding programme to develop superior varieties for sustainable agricultural production.~~This indicated that seed yield was mainly a product of direct and indirect effects of above three characters.~~

Key words: Greengram, Variability, Character Association, Correlation, Path coefficient etc.,

INTRODUCTION

The third most significant pulse crop in India is greengram, which is grown on around 8% of the nation's total pulse land. Because it provides a less expensive protein source and has a protein content of 24.7%, it is known as "poor man's meat" (Potter and Hotchkiss, 1997). Every 100 g of mungbean seeds contains vitamins, 6.74 mg of iron, 189 mg of magnesium, 367 mg of phosphorus, 124 mg of potassium, and 132 mg of calcium. (1986, Haytowitz and Matthews). The excellent digestion and taste of greengram make it a popular green vegetable.

As a self-pollinated species, greengram exhibits significant variation both within and among its related

species (Bisht et al., 2005). The base population serves as a valuable source of base population for

providing a wide range of genetic improvement, which is primarily dependent on the level of genetic variability present in the base population. One of the barriers to advancement in greengram production has been cited as the lack of genetic variety for high yield potential (Ramanujam, 1978).

With India's population continuing to increase and the impoverished sector suffering from malnutrition, there is a growing demand for greengram to be made available to the general public at reasonable pricing. This calls for the creation of high yielding cultivars that can provide both high production and high productivity. ~~The goal of the current study is to determine the optimum genotype that can produce a high yield per unit area.~~

The pulse improvement programmes highlighted the need to find genotypes for new niches and generate variability for high yield potential. Understanding the genetic makeup of varieties is crucial because gene action that controls yield and its auxiliary features raise yield per unit area.

The level of their genetic variability, heritability, and anticipated genetic advance are of utmost importance when starting breeding efforts to boost yield and the contributing features. The amount of genetic variability in a plant population influences how well selection works. As a result, whether genetic improvement of any character will be successful is determined by the type of diversity present in the character's germplasm. The evaluation aids in determining the relative worth of various genotypes in terms of specific features.

When selecting an appropriate plant type, understanding the relationship between yield and constituent qualities may be beneficial. The correlation must be divided into direct and indirect effects through route analysis in order to determine the actual contribution of each character to the yield. Correlation, in conjunction with path analysis, would thus aid in the establishment of appropriate selection criteria for increasing yield. As a result, the current investigation was carried out to evaluate the variability and establish relationships between the yield and the features that contribute to it in the green gram. The goal of the current study ~~is~~was to determine the optimum genotype that can produce a highyield per unit area.

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MATERIALS AND METHODS

A field experiment was conducted during *Kharif* – 2021, at Crop Rresearch Ffarm of Department of Geneticsand Plant Breeding of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagrajwhich is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the " sStudy of gGenetic vVariability, cCharacter association and pPath aAnalysis in gGreen gram [*Vigna radiata* (L.)Wilczek], the experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. The genotypes were sown on raised bed in July, 2021. The row to row and plant to plant distance was kept at 30×10 cm² spacing. The crop was fertilized with 20 Kg N□, 40 KgP□O5 and 20 Kg K□O per hectare. The nitrogen was applied in two splits, one at the time of sowing and other at 25 days after sowing. Entire Phosphorus was applied as basal dose. All recommended practiceswere followed and timely plant protection measures were taken to avoid damage through insect -pests and diseases. To minimise border effects, observations for these 13 characters were recorded for each genotype in each replication viz., days to 50% flowering, days to 50% pod setting, plant height (cm), number of primary branches per plant, days to maturity, number of clusters per plant, number of pods per plant, pod length, number of seeds per pod, biological yield seed index, harvest index and seed yieldper plant from competitive plants that were randomly selected and tagged, excluding border plants. All of the characteristics studied, with the exception of days to flowering and days to maturity, were recordedon five randomly selected plants per plot. The observations from the entire plot were recorded for days to flowering and days to maturity. Using a physical balance, all weights were recorded in grams. The observations were taken based on the descriptors. The cultivation practices like irrigation, weeding, fertilization and pesticide application etc. were followed on proper times. The analysis of variance ofRCBD and their significance for all the characters were worked out as suggested by Panse and Sukhatme (1967). The various genetic parameters viz., ECV, GCV, PCV, heritability were calculated by adopting the formulae given by Johnson *et al*., (1955). Genotypic correlation co- efficient was calculated byusing the formulae given by Al-Jibouri *et al*., (1958)

RESULTS AND DISCUSSION

The analysis of variance for the 13 characters under study is presented in the Table 1. It showed that there were significant differences for all the characters among 21 genotypes under study indicating presence of wide genetic variation for different characters among the genotypes of greengram. The mean performance of all the characters is presented in Table 2. The maximum and minimum values for different characters are highlighted. The genotype MGG-348 was earliest in terms of days to 50% flowering and PUSA VISHAL was late among all the genotypes. Pusa Vishal is not present in Table 2? VEENA had the minimum plant height of 48.33 cm and VIRAT had the maximum plant height of 71.77 cm.

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MGG-295 had the minimum values for

most of the characters like number of clusters per plant, number of pods per cluster and number of primary branches per plant and their value were 3.73, 10.60 and 2.33 respectively. Further, MGG-371, RM 12-11, WGG-37, RM 12-18, K-851, KM 11-564 and ML 131 exhibited superiority for primary branches per plant, number of clusters per plant, number of pods per plant, pod length, biological yield, seed index and harvest index respectively. K-851 showed the minimum for harvest index with the value 40.31 and WGG-37 showed minimum for seed index with the value 3.39. MGG-351 showed maximum seed yield per plant with the value 10.27 and minimum was observed in KM 11-564 with the value 8.17.

The magnitude of genetic variance for all the characters under study is depicted in Table 3. The phenotypic coefficient of variation for all the characters under study ~~is~~ was higher than the genotypic coefficient of variation indicating the involvement of both genotype and environment for variation. Hence, the selection for such traits often misleading. Lowest GCV and PCV were observed in days to maturity. Similar results are reported by Garg *et al*., (2017). High heritability coupled with higher genetic advance was recorded for all the thirteen characters which indicated that most likely the heritability is due to additive gene effects and selection may be effective for all the characters. However, the Table 3 shows moderate heritability and genetic advance.

The results are in accordance with that of Ahmad et al. (2015), Patel et al. (2014) [11,12] for high GCV andPCV of number of pods per plant and number of clusters per plant. Higher heritability and genetic advance as a percentage mean was observed in number of clusters per plant.

In the present investigation, Maximum positive direct effects was depicted by Harvest Index (%) , Number of seeds per pod and Plant height (cm) at both phenotypic and genotypic levels. While negative direct effects was depicted by Days to maturity and Seed Index. The residual component of path analysis indicated that more than 99 % of variability of seed yield was accounted for by these thirteen characters. Direct positive effect on seed yield through biological yield and harvest index was earlier reported by Gadakh *et al.* (2013) and Choudhary *et al.* (2016). Direct positive effect on seed yield through number of pods per plant, number of seeds per pod and 100-seed weight was earlier reported by Kapadia *et al.* (2015), Bhutia *et al.* (2016) and Choudhary *et al.* (2016). Direct positive effect on seed yield through pod length was earlier reported by Jyothsna and Anuradha (2013), Kapadia *et al.* (2015), Bhutia *et al.* (2016) and Choudhary *et al.* (2016). Direct positive effect on seed yield through days to maturity was earlier reported by Jeberson *et al.* (2015).In contrast, direct positive effect on seed yield through plant height was earlier reported by Makeen *et al.* (2007), Raturi *et al.* (2015), Kapadia *et al.* (2015) and Choudhary *et al.* (2016).

Path analysis further revealed that direct effect of Harvest Index (%), No. of seeds per pod and Plant

Height (cm) was of high magnitude. The high positive association of other characters with grain yield

per plant (g) was also due to high indirect effect through these characters. This indicated that grain yield was mainly a product of direct and indirect effects (through each other) of Harvest Index (%), No. of seeds per pod and Plant Height (cm). Path analysis further revealed days to maturity was negatively associated with seed yield per plant (g) because of negative direct effects and indirect effects of Harvest Index (%), No. of seeds per pod and Plant Height (cm). This indicated that seed yield was mainly a product of direct and indirect effects of above three characters.

CONCLUSION

From the present investigation, greatest estimates of PCV and GCV were recorded for ~~Harvest~~ harvest ~~Index~~ index and ~~Days~~ days to maturity. Both at phenotypic and genotypic correlation coefficients revealed that seed yield per plant exhibited positive and highly significant correlation with ~~Days~~ days to maturity and ~~Harvest~~ harvest ~~Index~~index. Maximum positive direct effects was depicted by ~~Harvest~~ harvest ~~Index~~ index (%) , ~~Number~~ number of seeds per pod and ~~Plant~~ plant height (cm) at both phenotypic and genotypic levels. Path analysis further revealed that direct effect of ~~Harvest~~harvest ~~Index~~ index (%), ~~No~~no. of seeds per pod and ~~Plant~~ plant ~~Height~~ height (cm) was of high magnitude. Among the tested genotypes the higher seed yield per plant were reported by MGG 351, WGG 37 .Therefore, it can be concluded from the present investigation that the characters viz., ~~Harvest~~harvest ~~Index~~ index (%), ~~No~~no. of seeds per pod and ~~Plant~~ plant ~~Height~~ height (cm) had the highest direct positive effect on seed yield per plant. Utmost importance can be given to these characters during selectionfor yield improvement in green gram.

Table 1 Analysis of variance for 13 biometrical traits of Greengram

		Mean sum of squares		
S. No.	Source	Replications	Treatments	Error
	Degrees of freedom	2	20	40
1	Days to fifty percent flowering	16.6930	14.559**	5.503
2	Days to fifty percent pod setting	2.3970	21.744**	4.497
3	Plant height (cm)	24.40	81.067**	27.493
4	Number of primary branches per plant	0.1080	0.416**	0.131
5	Days to maturity	33.0060	50.931**	14.349
6	Number of clusters per plant	0.0490	1.589**	0.2
7	Number of pods per plant	1.5810	10.048**	1.818
8	Pod length (cm)	0.7580	0.573**	0.239
9	Number of seeds per pod	0.3060	0.441**	0.148
10	Biological yield (g)	0.2060	11.586**	2.028
11	Seed Index (g)	00	0.339**	0.048
12	Harvest Index (%)	113.2750	207.897**	42.728
13	Seed yield per plant (g)	1.1630	1.538**	0.529

**1% level of significance

Table 2 : Mean performance of greengram genotypes for 13 quantitative characters of Greengram

Sl. No.	Genotypes	Days to fifty percent flowering	Days to fifty percent pod setting	Plant height (cm)	Number of primary branches per plant	Days to maturity	Number of clusters per plant	Number of pods per plant	Pod length (cm)	Number of seeds per pod	Biological yield (g)	Seed Index (g)	Harvest Index (%)	Seed yield per plant (g)
1	MGG-2	34.27	39.67	60.17	3.60	82.93	5.33	15.47	7.50	8.00	19.70	3.77	47.70	9.37
2	R288-8	35.93	41.33	58.17	3.33	89.80	5.87	14.47	7.07	7.07	19.83	3.82	42.52	8.43
3	KM-2	36.87	42.67	57.53	3.27	83.13	5.80	14.53	7.73	7.53	20.53	3.73	44.24	9.07
4	MGG-348	33.20	39.33	62.40	2.87	83.20	5.53	11.73	8.00	7.80	18.63	4.12	52.78	9.87
5	Virat	35.47	41.33	71.77	3.67	81.53	4.40	13.07	8.37	7.47	17.63	4.03	48.59	8.57
6	Veena	38.20	43.33	48.33	3.40	85.00	6.67	15.47	7.33	6.94	18.00	3.75	46.93	8.43
7	MGG-385	38.47	44.00	62.13	3.67	85.13	5.47	13.07	8.00	7.60	15.80	3.78	56.51	8.87
8	MGG-295	38.27	43.67	52.57	2.33	87.93	3.73	10.60	7.40	7.00	16.27	4.00	58.86	9.57
9	MGG-371	39.13	46.33	56.77	3.87	85.60	5.13	14.67	7.63	7.47	16.63	3.74	58.42	9.73
10	WGG-42	40.27	46.00	52.87	3.07	87.53	5.20	15.20	7.73	7.40	19.23	3.93	44.52	8.47
11	MGG-347	40.13	50.00	53.30	3.33	82.07	6.00	16.60	7.30	7.40	19.93	3.54	43.88	8.60
12	WGG-37	40.27	46.00	59.17	3.13	87.80	6.20	18.47	7.47	7.80	18.10	3.39	57.33	10.23
13	RM 12-18	36.80	42.33	55.30	2.87	79.93	5.67	15.47	8.67	6.40	14.80	3.83	65.38	9.54
14	RM 12-11	34.40	40.33	56.13	3.27	88.87	7.13	17.33	7.50	7.67	15.90	3.70	62.34	9.93
15	ML 131	39.33	45.33	48.90	3.20	86.67	4.93	12.80	8.27	7.47	14.77	3.99	67.60	9.93
16	KM 11-564	39.87	45.00	57.57	2.73	76.33	5.60	15.87	7.87	7.80	18.77	5.10	43.53	8.17
17	K-851	37.47	43.00	55.47	2.93	78.93	5.20	13.53	7.43	7.47	20.83	4.00	40.31	8.40
18	RM 12-13	36.93	43.00	53.70	3.00	85.27	5.27	14.27	7.40	7.40	20.50	3.74	40.82	8.37
19	IPM-2-14	37.00	43.00	58.43	3.53	81.80	5.20	14.93	7.90	7.40	20.77	3.80	46.12	9.57
20	MGG-351	35.93	41.33	56.73	3.53	79.47	5.67	15.33	7.23	7.40	19.03	3.66	54.42	10.27
21	INDI – 495 (CHECK)	41.00	47.67	63.38	3.59	93.54	6.14	16.20	8.46	8.13	19.72	4.17	57.35	10.11
	Mean	37.58	43.56	57.18	3.25	84.40	5.53	14.72	7.73	7.46	18.35	3.89	51.45	9.21
	CV	6.24	4.87	9.17	11.17	4.49	8.09	9.16	6.33	5.16	7.76	5.64	12.71	7.90
	SEm	1.35	1.22	3.03	0.21	2.19	0.26	0.78	0.28	0.22	0.82	0.13	3.77	0.42
	CD at 5%	3.87	3.50	8.65	0.60	6.25	0.74	2.22	0.81	0.64	2.35	0.36	10.79	1.20
	CD at 1%	5.18	4.68	11.58	0.80	8.36	0.99	2.98	1.08	0.85	3.14	0.48	14.43	1.61
	Minimum	33.20	39.33	48.33	2.33	76.33	3.73	10.60	7.07	6.40	14.77	3.39	40.31	8.17
	Maximum	41.00	50.00	71.77	3.87	93.54	7.13	18.47	8.67	8.13	20.83	5.10	67.60	10.27

Table 3 Genetic parameters for 13 quantitative characters of Greengram genotypes

Sl.No.	TRAITS	GCV	PCV	h^2 (Broad Sense)	Genctic Advance 5%	Gen.Adv as % of Mean 5%
1	Days to fifty percent flowering	4.623	7.768	35.421	2.13	5.668
2	Days to fifty percent pod setting	5.505	7.349	56.112	3.7	8.495
3	Plant height (cm)	7.39	11.777	39.377	5.463	9.553
4	Number of primary branches per plant	9.487	14.653	41.915	0.411	12.652
5	Days to maturity	4.137	6.104	45.942	4.876	5.777
6	Number of clusters per plant	12.301	14.721	69.824	1.171	21.175
7	Number of pods per plant	11.254	14.511	60.147	2.646	17.98
8	Pod length (cm)	4.316	7.664	31.717	0.387	5.007
9	Number of seeds per pod	4.19	6.649	39.709	0.406	5.439
10	Biological yield (g)	9.726	12.443	61.101	2.874	15.661
11	Seed Index (g)	8.018	9.803	66.91	0.525	13.511
12	Harvest Index (%)	14.422	19.22	56.303	11.469	22.292
13	Seed yield per plant (g)	6.292	10.098	38.832	0.744	8.077

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