International Journal of Plant & Soil Science

34(13): 99-105, 2022; Article no.IJPSS.85779
ISSN: 2320-7035

Association and Path Analysis of Yield and Its Component Traits for Yield Maximization in Green Gram (*Vigna radiata* L. Wilczek)

Surendra Singh [a], Pushpendra Singh [b*] and M. K. Bhargava [b]

[a] Brahmanand P.G. College, Rath (Hamirpur), Uttar Pradesh, India.
[b] Krishi Vigyan Kendra, Piparsama Road, Shivpuri (M.P.), India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i1330980

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/85779

Original Research Article

Received 02 February 2022
Accepted 10 April 2022
Published 14 April 2022

ABSTRACT

The present investigation was undertaken to estimate the correlation coefficients among thirteen quantitative traits and to study the direct and indirect effects of various yield contributing traits on grain yield by path analysis. Ten genetically diverse genotypes of green gram (*Vigna radiata* L.) were used as parents in line x tester mating design in addition to their twenty four F_2 lines at Educational and Research farm, Department of Genetics and Plant Breeding, Brahmanand P.G. College, Rath (Hamirpur), Uttar Pradesh during *zaid*, 2019 in a randomized block design with three replications each. The results of association study revealed that grain yield per plant showed highly significant and positive correlation, at both genotypic and phenotypic levels, with number of days to flowering, number of pods per cluster, number of clusters per plant, number of pods per plant and biological yield per plant (g) indicating possibility of simultaneous improvement for these traits. However, yield per plant for parents showed significant negative correlation with primary branches per plant and harvest index at both genotypic and phenotypic levels. In contrast, only clusters per plant, pods per cluster, pods per plant, biological yield per plant, seeds per pod, seed weight per pod and 100 seed weight exhibited significant positive association in F_2 generation, indicating existence of linkage. Harvest index had negative association with most of the traits at genotypic as well as phenotypic levels. Path analysis revealed that, biological yield per plant; harvest index and seeds per pod recorded the high direct effect in desirable direction. Their association with grain

**Corresponding author: E-mail: psinghkvk@gmail.com;*

yield was also significant and positive except with harvest index, indicating true and perfect association between these traits at both genotypic and phenotypic levels. Therefore, direct selection for these characters would help in isolating high yielding genotypes from highly segregating population. Among the traits showing negative direct effects were days to 50% flowering, branches per plant, plant height, pods per plant and seed weight per pod, however, these trait had positive association with yield. Hence, biological yield per plant, harvest index, seeds per pod and clusters per plant may be improved to enhance seed yield per plant and hybridization followed by direct and indirect selection for these traits may be undertaken for breeding high yielding cultivars.

Keywords: Green gram; yield; genotypic; phenotypic; correlation coefficient; path analysis.

1. INTRODUCTION

Green gram (*Vigna radiata* L. Wilczek) having 2n=2x=22 chromosomes in diploid cells, is a Leguminous crop, which stands as the third most important pulse crop of Asia after chickpea and pigeon pea. It is a widely adapted, highly versatile and drought tolerant legume crop having ability to improve soil fertility. High protein content, easy digestibility and low flatulence effect made this crop more acceptable to the people over world [1]. Being rich in its nutritional profile, it is a staple ingredient in the diet of large community in the Indian sub continent. However, the average consumption of green gram in India is quite low due to low production, which requires increased productivity in green gram. Seed yield is a complex character, depending on number of secondary traits. Correlation coefficient is an important statistical tool, which provides the degree and direction of association between yield and its component traits at both genotypic and phenotypic levels. The study of the inter-relationship between yield and yield contributing traits becomes more important to plant breeder for the execution of effective crop breeding program. But, the correlation coefficient does not always give precise information on the contribution of each trait towards dependent variable *viz*, yield. To understand the criteria effectively contributing towards grain yield, the path analysis is obvious. Path-coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation coefficient into direct and indirect effects. To accumulate optimum contribution of yield contributing characters, it is essential to know the association of various characters along with path coefficients [2]. In green gram, several findings based on fixed genotypes have been reported but such information are lacking for segregating generations. Therefore, the present investigation was undertaken to obtain information on correlation studies as well as the direct and indirect effects of twelve yield-contributing traits in F_2 segregating population along with their parents in green gram.

2. MATERIALS AND METHODS

The genetic material, consisted of 24 genotypes from F_2 generation of mungbean (*Vigna radiata* (L.) Wilczek) along with ten parents were grown during *zaid*, 2018-19 in a randomized block design with three replications at educational and research farm, department of Genetics and Plant Breeding, B.N.V. College Rath, dist. Hamirpur (UP). The F_2 segregating population was obtained by crossing ten parents in line x tester mating design and growing F_1s during kharif 2018 season.

The seed of all the 34 genotypes (24 F_2s and 10 parents) were sown at 0.30 m distance between rows and 0.10 m distance between plants. Each plot had 1.2 m x 3.0 m area with four rows for each population. Five plant from each parents and genotypes from F_2 generation were selected per treatment per replication for recording observations on yield and yield contributing traits *viz;* days to 50% flowering (No.), days to maturity (No.), number of branches per plant, plant height (cm), number of clusters per plant, number of pods per cluster, number of pods per plant, biological yield per plant (g), number of grains per pod, grain weight per pod (g), 100 seed weight (g), harvest index (%), and grain yield per plant (g). All the agronomic practices were followed to maintain good crop stand. The genotypic and phenotypic co-variances were worked out as per the formulae given by Singh and Chaudhary [3]. By using this, the phenotypic and genotypic correlation coefficients for all the characters were worked out as per procedure by Johnson *et al*. [4] whereas, the phenotypic as well as genotypic path coefficient analysis was done as per the method suggested by Dewey and Lu [5]. Analysis was carried out separately for parents and F_2 population.

Table 1. Genotypic and Phenotypic correlation coefficients among 13 characters in 10 parents in green gram (Genotypic upper diagonal and phenotypic lower diagonal)

Characters	Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield per plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)	Seed yield/ plant (g)
Days to 50% flowering		0.892**	-0.672**	0.613**	0.575**	0.166	0.441*	0.529**	0.268	0.252	0.335	-0.371	0.527**
Days to maturity	0.890**		-0.690*	0.808**	0.377	0.225	0.380*	0.423*	0.246	-0.042	0.070	-0.336	0.388*
Pr. branches / plant	-0.660**	-0.676**		-0.527**	-0.345	0.022	-0.094	-0.232	-0.011	-0.211	-0.023	-0.078	-0.449*
Plant height (cm)	0.608**	0.805**	-0.508*		-0.008	0.252	0.221	0.218	0.270	-0.492*	-0.414*	-0.140	0.194
Pods per cluster	0.570**	0.372	-0.318	-0.006		0.392*	0.797**	0.846**	0.203	0.524**	0.555**	-0.514*	0.895**
Clusters per plant	0.164	0.224	0.026	0.249	0.389*		0.819**	0.765**	-0.256	-0.304	-0.147	-0.692**	0.586**
Pods per plant	0.436*	0.375	-0.078	0.219	0.787**	0.802**		0.955**	0.067	0.052	0.195	-0.759**	0.830**
Biological yield (g)	0.528**	0.420*	-0.220	0.217	0.843**	0.759**	0.942**		-0.063	0.241	0.223	-0.802**	0.882**
Seeds per pod	0.263	0.244	-0.012	0.268	0.198	-0.253	0.062	-0.061		-0.243	0.031	0.411*	0.187
Seed weight/ pod (g)	0.251	-0.040	-0.203	-0.479*	0.520**	-0.304	0.051	0.240	-0.237		0.698**	-0.256	0.231
100-Seed weight (g)	0.334	0.070	-0.023	-0.411	0.550**	-0.146	0.194	0.221	0.032	0.695**		-0.275	0.163
Harvest index (%)	-0.356	-0.316	-0.063	-0.120	-0.491*	-0.662**	-0.719**	-0.773**	0.389*	-0.229	-0.258		-0.427*
Seed yield per plant (g)	0.521**	0.386*	-0.428*	0.200	0.882**	0..574**	0.811**	0.872**	0.185	0.237	0.162	-0.372	

** Significant at 5% level, ** Significant at 1% leve*

Table 2. Genotypic and Phenotypic correlation coefficients among 13 characters in F2 generation in green gram (Genotypic upper diagonal and phenotypic lower diagonal)

Characters	Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield / plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)	Seed yield/ plant (g)
Days to 50% flowering		0.908**	-0.558**	0.319*	0.036	0.057	0.019	0.127	0.251*	-0.151	0.004	0.094	0.180
Days to maturity	0.902**		-0.346**	0.258*	0.093	0.124	0.134	0.199	0.129	-0.059	0.076	-0.044	0.188
Pr. branches / plant	-0.495**	-0.303*		-0.319*	0.084	0.248	0.241	0.049	0.072	0.248*	0.396*	0.105	0.097
Plant height (cm)	0.312*	0.248*	-0.265*		0.010	-0.036	-0.069	0.178	-0.118	-0.113	-0.056	0.017	0.205
Pods/ cluster	0.034	0.085	0.070	0.021		0.469**	0.855**	0.706**	0.246*cl	0.550**	0.263*	-0.125	0.653**
Clusters per plant	0.053	0.116	0.196	-0.027	0.437**		0.822**	0.260*	0.396**	0.325*	0.430**	0.433*	0.468**
Pods /plant	0.018	0.128	0.201	-0.056	0.798**	0.762**		0.641**	0.310*	0.601**	0.370**	0.105	0.690**
Biological yield (g)	0.128	0.198	0.028	0.181	0.684**	0.253*	0.604**		0.215	0.763**	0.311*	-0.263*	0.878**
Seeds/ pod	0.225	0.113	0.071	-0.102	0.217	0.336**	0.275*	0.195		0.438**	0.035	0.281*	0.338**
Seed weight / pod (g)	-0.090	-0.037	0.191	-0.071	0.315**	0.212	0.342**	0.463**	0.254*		0.299*	-0.096	0.708**

Characters	Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield / plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)	Seed yield/ plant (g)
100-Seed weight (g)	0.001	0.073	0.337**	-0.055	0.255*	0.401**	0.358**	0.302*	0.017	0.173		0.259*	0.441*
Harvest index (%)	0.075	-0.044	0.060	0.004	-0.090	0.398**	0.101	-0.243*	0.213	-0.068	0.268*		0.228
Seed yield per plant (g)	0.171	0.180	0.054	0.195	0.628**	0.454**	0.643**	0.857**	.0293*	0.412**	0.440**	0.288*	

* *Significant at 5% level, ** Significant at 1% level*

Table 3. Path Coefficient analysis of genotypic and phenotypic correlation coefficients regarding direct and indirect effects of 12 characters towards seed yield per plant in green gram in parents (P)

Characters		Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield / plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)
Days to 50% flower.	G	-0.036	-0.032	0.024	-0.022	-0.021	-0.006	-0.016	-0.019	-0.010	-0.009	-0.012	0.013
	P	-0.023	-0.021	0.015	-0.014	-0.013	-0.004	-0.010	-0.012	-0.006	-0.006	-0.008	0.008
Days to maturity	G	0.008	0.009	-0.006	0.007	0.003	0.002	0.003	0.004	0.002	0.000	0.001	-0.003
	P	-0.016	-0.018	0.012	-0.015	-0.007	-0.004	-0.007	-0.008	-0.005	0.001	-0.001	0.006
Primary bran. /plant	G	0.113	0.116	-0.167	0.088	0.058	-0.004	0.016	0.039	0.002	0.035	0.004	0.013
	P	0.122	0.125	-0.185	0.094	0.059	-0.005	0.014	0.041	0.002	0.038	0.004	0.012
Plant height (cm)	G	-0.084	-0.111	0.072	-0.137	0.001	-0.035	-0.030	-0.030	-0.037	0.067	0.057	0.019
	P	-0.072	-0.096	0.061	-0.119	0.001	-0.030	-0.026	-0.026	-0.032	0.057	0.049	0.014
Pods per cluster	G	0.005	0.003	-0.003	0.000	0.009	0.003	0.007	0.007	0.002	0.005	0.005	-0.004
	P	0.002	0.001	-0.001	0.000	0.004	0.002	0.003	0.003	0.001	0.002	0.002	-0.002
Clusters per plant	G	0.008	0.011	0.001	0.012	0.019	0.048	0.039	0.036	-0.012	-0.014	-0.007	-0.033
	P	0.008	0.011	0.001	0.012	0.019	0.049	0.039	0.037	-0.012	-0.015	-0.007	-0.032
Pods per plant	G	-0.069	-0.059	0.015	-0.034	-0.124	-0.127	-0.156	-0.148	-0.010	-0.008	-0.030	0.118
	P	-0.024	-0.021	0.004	-0.012	-0.043	-0.044	-0.055	-0.052	-0.003	-0.003	-0.011	0.039
Biological yield(g)	G	0.778	0.621	-0.341	0.319	1.242	1.123	1.401	1.468	-0.093	0.354	0.328	-1.177
	P	0.710	0.565	-0.296	0.292	1.134	1.020	1.267	1.345	-0.083	0.323	0.297	-1.039
Seeds per pod	G	0.027	0.025	-0.001	0.028	0.021	-0.026	0.007	-0.007	0.103	-0.025	0.003	0.042
	P	0.027	0.025	-0.001	0.027	0.020	-0.026	0.006	-0.006	0.102	-0.024	0.003	0.040
Seed weight / pod(g)	G	-0.004	0.001	0.003	0.007	-0.008	0.005	-0.001	-0.004	0.004	-0.015	-0.010	0.004
	P	0.004	-0.001	-0.004	-0.008	0.009	-0.005	0.001	0.004	-0.004	0.017	0.012	-0.004
100-Seed weight (g)	G	-0.005	-0.001	0.000	0.006	-0.008	0.002	-0.003	-0.003	-0.001	-0.010	-0.015	0.004
	P	-0.010	-0.002	0.001	0.012	-0.016	0.004	-0.006	-0.006	-0.001	-0.020	-0.029	0.007
Harvest index (%)	G	-0.214	-0.194	-0.045	-0.081	-0.296	-0.399	-0.438	-0.462	0.237	-0.148	-0.159	0.577
	P	-0.206	-0.183	-0.036	-0.069	-0.284	-0.383	-0.416	-0.447	0.225	-0.133	-0.150	0.579

Characters		Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield / plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)
Seed yield/ plant (g)	G	0.527**	0.388*	-0.448 *	0.194	0.895**	0.586**	0.830**	0.882**	0.187	0.231	0.163	-0.427*
	P	0.521**	0.386*	-0.428*	0.200	0.882**	0.574**	0.811**	0.872**	0.185	0.237	0.162	-0.372

Residual effect (Parents): (G) = -0.027 (P) = 0.032 Bold values are direct effects

Table 4. Path Coefficient analysis of genotypic and phenotypic correlation coefficients regarding direct and indirect effects of 12 characters towards seed yield per plant in green gram in F2 generation

Characters		Days to 50% flowering	Days to maturity	Primary branches / plant	Plant height (cm)	Pods/ cluster	Clusters per plant	Pods per plant	Biological yield / plant	Seeds per pod	Seed weight/ pod (g)	100-seed weight (g)	Harvest Index (%)
Days to 50% flower	G	-0.975	-0.885	0.544	-0.311	-0.035	-0.055	-0.018	-0.124	-0.244	0.147	-0.004	-0.092
	P	-0.029	-0.026	0.014	-0.009	-0.001	-0.002	-0.001	-0.004	-0.007	0.003	0.000	-0.002
Days to maturity	G	0.373	0.411	-0.142	0.106	0.038	0.051	0.055	0.082	0.053	-0.024	0.031	-0.018
	P	0.030	0.033	-0.010	0.008	0.003	0.004	0.004	0.007	0.004	-0.001	0.002	-0.001
Prim. Bran./ plant	G	0.313	0.194	-0.560	0.179	-0.047	-0.139	-0.135	-0.028	-0.040	-0.139	-0.222	-0.059
	P	0.001	0.001	-0.003	0.001	0.000	-0.001	-0.001	0.000	0.000	-0.001	-0.001	0.000
Plant height (cm)	G	0.109	0.088	-0.109	0.341	0.003	-0.012	-0.024	0.061	-0.040	-0.038	-0.019	0.006
	P	0.004	0.003	-0.003	0.013	0.000	0.000	-0.001	0.002	-0.001	-0.001	-0.001	0.000
Pods per cluster	G	-0.068	-0.178	-0.161	-0.018	-1.907	-0.894	-1.629	-1.346	-0.470	-1.048	-0.501	0.238
	P	0.001	0.002	0.002	0.001	0.022	0.010	0.018	0.015	0.005	0.007	0.006	-0.002
Clusters per plant	G	-0.144	-0.315	-0.631	0.091	-1.191	-2.541	-2.087	-0.661	-1.006	-0.826	-1.092	-1.101
	P	0.000	0.001	0.001	0.000	0.002	0.004	0.003	0.001	0.001	0.001	0.002	0.002
Pods per plant	G	0.075	0.537	0.968	-0.278	3.431	3.298	4.015	2.573	1.243	2.414	1.487	0.421
	P	-0.001	-0.004	-0.006	0.002	-0.022	-0.021	-0.027	-0.017	-0.008	-0.009	-0.010	-0.003
Biological yield (g)	G	0.093	0.146	0.036	0.131	0.518	0.191	0.470	0.734	0.158	0.560	0.229	-0.193
	P	0.126	0.194	0.027	0.178	0.673	0.249	0.595	0.984	0.192	0.455	0.297	-0.240
Seeds per pod	G	0.223	0.115	0.064	-0.105	0.219	0.352	0.276	0.191	0.890	0.390	0.031	0.250
	P	-0.001	-0.001	0.000	0.001	-0.001	-0.002	-0.002	-0.001	-0.005	-0.001	0.000	-0.001
Seed wt. per pod(g)	G	0.130	0.051	-0.214	0.097	-0.474	-0.280	-0.518	-0.658	-0.378	-0.862	-0.258	0.083
	P	0.000	0.000	-0.001	0.000	-0.001	-0.001	-0.002	-0.002	-0.001	-0.005	-0.001	0.000
100-Seed weight(g)	G	0.002	0.047	0.246	-0.035	0.163	0.267	0.230	0.193	0.022	0.186	0.621	0.161
	P	0.000	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.003	0.001
Harvest index (%)	G	0.050	-0.023	0.056	0.009	-0.066	0.230	0.056	-0.140	0.149	-0.051	0.138	0.531
	P	0.040	-0.023	0.032	0.002	-0.048	0.212	0.054	-0.130	0.114	-0.036	0.143	0.534
Seed yield/ plant(g)	G	0.180	0.188	0.097	0.205	0.653**	0.468**	0.690**	0.878**	0.339**	0.708**	0.441**	0.228
	P	0.171	0.180	0.054	0.195	0.628**	0.454**	0.643**	0.857**	0.293*	0.412**	0.440**	0.288*

Residual effect (F_2): (G) 0.118 (P) = 0.056 Bold values are direct effects

3. RESULTS AND DISCUSSION

3.1 Correlation Coefficients

The genotypic and phenotypic correlation coefficients were computed among all characters under study and presented in Table 1 and 2 for parents and F_2s respectively. In general, the genotypic correlation coefficients were comparatively higher than corresponding phenotypic correlation coefficient. Low phenotypic correlations can be explained due to masking or modifying effects of environment on genetic association between characters. Similar findings were reported by earlier researchers [6,7,8,9]. Seed yield per plant had significant positive correlation with days to 50% flowering, days to maturity, pods per cluster, cluster per plant, pods per plant and biological yield per plant in both genotypic and phenotypic levels in parents while it showed positive association with pods per cluster, cluster per plant, pods per plant, biological yield per plant, seeds per pod, seed weight per pod and 100 seed weight in F2s. Therefore, selection for these traits might lead to enhanced productivity. Positive correlations for one or more of these traits were reported by many earlier researchers [10,6] for clusters per plant and pods per plant; for clusters per plant [11], for number of clusters per plant and number of pods per plant [12], for number of pods per plant [13] and for all the traits [9]. From such positive correlation of these traits in parents and F_2s, it was inferred that this correlation caused might be due to linkage of genes governing these traits that is beneficial in selection. Harvest index and primary branches per plant in parents showed negative significant association with most of the traits in parents. Days to 50% flowering showed significant negative association with primary branches per plant in both parents and F_2, while days to maturity showed negative association with primary branches per plant in parent and F_2. Seed yield per plant had significant negative association with primary branches per plant and harvest index in parents only. This might be caused due to pleiotropy and linkage, which may possibly be broken by breeding methods such as biparental mating or disruptive selection [14].

3.2 Path Coefficient Analysis

From the estimates of direct and indirect effect of 12 characters towards seed yield per plant in parents and F_2 presented in Table 3 and table 4 respectively, it may be noted that biological yield per plant and harvest index had the high positive direct effect on seed yield per plant in both parent and F_2 generations while pods per cluster and cluster per plant had high negative direct effect on seed yield per plant in F_2 generation. Pods per plant had the highest positive direct effect towards yield per plant in F_2 at genotypic level while biological yield per plant in parent population at both genotypic and phenotypic level. These results are in agreement for biological yield and harvest index [6]; for harvest index [7] and for biological yield per plant [15]. The remaining characters such as pods per cluster, clusters per plant and pods per cluster, which had significant positive correlations with seed yield per plant did not exhibit considerable direct influence on seed yield per plant. Instead, they contributed much indirectly via biological yield per plant. However, few researchers reported high direct effect of these traits such as pods per plant, clusters per plant and pods per cluster [8] and for number of pods per plant, pods per cluster, clusters per plant, and 100 seed weight [12]. Days to 50% flowering and days to maturity also contributed through biological yield per plant. These results are in agreement with other researchers [15,16]. Therefore, direct selection for high biological yield per plant, pods per cluster, clusters per plant, pods per plant and harvest index will result in improvement of seed yield per plant. Since, other component traits had indirect effect on seed yield per plant via biological yield per plant; correlated response in component traits will ultimately be realized.

4. CONCLUSION

From the present investigation it can be concluded that number of pods per cluster, number of clusters per plant, number of pods per plant, biological yield per plant, harvest index and seed weight per pod were the major yield contributing characters which had positive and significant association with seed yield per plant in both or one of the populations and also exhibited high direct effect on grain yield per plant. Therefore, due emphasis should be given on these characters in the selection which would help in isolating high yielding genotypes from highly segregating population to enhance the productivity and yield potential of green gram cultivars.

ACKNOWLEDGEMENT

Authors are highly thankful to the Dean, Brahmanand PG College, Rath, Hamirpur (UP)

for providing all necessary facilities to conducting the research work and also acknowledge to MULLaRP project RAK College of Agriculture, Sehore (M.P.) for providing genetic material for research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Prasanna LB, Rao PJM, Murthy KGK, Prakash KK, Yamini KN, Srividhya A. Genetic diversity and molecular characterization of mungbean genotypes (*Vigna radiata* (L.) Wilczek). International Journal of Applied Biology and Pharmaceutical Technology. 2013;4(4):151-160.
2. Eswaran R, Senthilkumar N. Correlation and path analysis in green gram [*vigna radiate* (L.) wilczek] for drought stress. Plant Archives. 2015;1(15):247-249.
3. Singh RK, Choudhury BD. Biometrical methods in quantitative genetic analysis. Kalyani publishers, New Delhi;1977.
4. Johnson HW, Robinson HF, Comstock PE. Estimate of genetic and environmental variability in Soybeans. Agronomy Journal. 1955;47:314-318.
5. Dewey DR, Lu KH. A correlation and path analysis of crested wheat grass and seed production. Agronomy Journal. 1959;51:315-318.
6. Vikas, Paroda, R.S. and Singh, S.P. Phenotypic correlation and direct and indirect relation of component characters with seed yield in mungbean (*Vigna radiata* (L.) Wilczek) over environments. Annals Agric. Bio. Res. 1999;20(4):411-417.
7. Sirohi, A. and Kumar Lokendra. Studies on genetic variability, heritability and genetic advance in mungbean (*Vigna radiata* (L.) Wilczek). International J. of Agric. Sciences. 2006; 2(1): 174-176.
8. Khanpara MD, Vachhani JH, Jivani LL, Jethava AS, Vaghasia PM. Correlation and Path Coefficient Analysis in Green gram [*Vigna radiata* (L.) Wilczek]. Asian J. Bio. Sci. 2012; 7(1): 34-38.
9. Sneha M, Sarvanan S, Premkumari SM, Pillai MA. Validation of genetic parameter for yield related traits among indigenous mungbean (*Vigna radiata L.)* germplasm. Electronic Journal of Plant Breeding. 2019;10(2):673-679.
10. Pundir SR, Singh VP, Gupta KR. Studies on correlation coefficients and path-coefficient analysis in mungbean (*Vigna radiata* (L.) Wilczek). Haryana Agri Univ. J. Res. 1992;22(4):143-148.
11. Reddy NBR, Lad DB, Mukhekar GD. Correlation and path analysis studies in green gram. J. of Maharastra Agric. Univ. 2005;30(2):156-159.
12. Hemavathy AT, Shunmugavalli N, Anand G. Genetic variability, correlation and path co-efficient studies on yield and its components in mung bean [*Vigna radiata (*L.) Wilezek]. Legume Research. 2015;38(4):442-446.
13. Jyothsna S, Patro TSSK, Ashok S, Rani YS, Neeraja B. Character Association and Path analysis of Seed Yield and its Yield Components in Green gram (Vigna radiata). International Journal of Theoretical and Applied Sciences. 2016;8(1):31-36.
14. Kushwah PS. Genetic analysis and stability parameters for yield in barley (*Hordeum vulgare* L.). Ph.D. Thesis. BU Jhansi;2011.
15. Singh SK, Singh I, Singh BB, Singh O. Correlation and path coefficient studies for yield and its components in mungbean (*Vigna radiata* (L.) Wilczek). Legum. Res. 2009;32(3):180-185.
16. Kalpande HV, Patil JG, Deshmukh RB. Effects of environmerntal variation on growth and yield attributes, their inter relationships and path coefficient analysis in green gram. J. Soil and Crops. 1997;71(1):76-79.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/85779