Biological Forum – An International Journal **14(2): 766-770(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Study of Genetic Association and Path coefficient in Green Gram [*Vigna radiata* (L.) Wilczek] Genotypes

Prachi Mahla[1*], Manohar Ram[2], Dalip[3], Anju Nehra[3] and Rukoo Chawla[1]
[1]Ph.D. Scholar, Department of Genetics and Plant Breeding,
Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan), India.
[2]Assistant Professor, Department of Genetics and Plant Breeding,
Sri Karan Narendra Agriculture University, Jobner (Rajasthan), India.
[3]Ph.D. Scholar, Department of Genetics and Plant Breeding,
Sri Karan Narendra Agriculture University, Jobner (Rajasthan), India.

(Corresponding author: Prachi Mahla)*
(Received 27 February 2022, Accepted 02 May, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Green gram is an important pulse crop in India due to its nutritional factors but the production potential of the crop is hindered by various biotic and abiotic factors. Hence to improve the field performance of the crop it is important to understand the genetic makeup of the crop. Correlation and path analysis are useful tools for determining the inter-relationship among various traits in a crop and helps in formulating a breeding programme to boost output. In the present study forty four green gram genotypes were evaluated at Research Farm of Sri Karan Narendra College of Agriculture, Jobner, Jaipur (Rajasthan) to assess association between thirteen yield and yield attributing traits namely days to 50% flowering, days to maturity, plant height (cm), branches per plant, clusters per plant, pods per cluster, pods per plant, pod length (cm), seeds pod, 1000-seed weight (g), protein content (%), chlorophyll content (SPAD meter) and seed yield per plant (g) in Randomized Block Design during *kharif* 2020. According to association analysis, seed yield per plant had a positive and significant relationship with branches per plant, clusters per plant, pods per plant, plant height and chlorophyll content. Therefore, selection of these traits ultimately increases the seed yield per plant. Path coefficient analysis revealed that pods per plant, branches per plant, protein content, pod length, days to 50% flowering and chlorophyll content exhibited high positive and direct effect with seed yield per plant. Clusters per plant, branches per plant via pods per plant; seeds per pod via clusters per plant; clusters per plant via branches per plant exhibited high indirect positive effect on seed yield per plant. As a result, selecting green gram genotypes based on these characteristics may result in a desirable increase in yield.

Keywords: Green gram, correlation, path analysis, association, seed yield.

INTRODUCTION

Green gram [*Vigna radiata* (L.) Wilczek] is considered as the most consequential legume crop in India. Green gram is a self-pollinating pulse crop that belongs to the *Fabaceae* family and has a 2n=22 somatic chromosomal number. Green gram had supposed to be originated from Indian subcontinent. It is a warm season and frost intolerant crop and suitable for cultivation in temperate, tropical and sub-tropical regions. It is widely cultivated in India, Bangladesh, Pakistan, Thailand, Sri Lanka, Malaysia and Indonesia. India is one of the world's leading grower and user of green gram. Green gram is a popular legume crop because to its short growing season, minimal input requirements and great digestibility due to reduced gas generation (Shil and Bandopadhya 2007). It works well in intense crop rotations since it has a short growing season. In some sections of country, the crop is also farmed for fodder. Green gram is recognized for their magnificent nutritive values. It is a good source of proteins, fats, vitamins and several minerals viz., calcium, magnesium, iron, manganese, phosphorus, potassium and zinc and is great source of antioxidants like flavonoids, phenolic acid, cinnamic acid and caffeic acid. These nutritive properties have great health benefits and reduce risk of chronic diseases such as heart diseases, cancers and diabetes. Green gram also helps in atmospheric nitrogen fixation in soil making it suitable for green manure and cover crop.

Despite of such an important crop the average productivity of green gram is quite low as expected due to several reasons. Narrow genetic base and insufficient knowledge of genetics of crop is a major drawback. Yield is a complicated attribute that is influenced by several attributing characters either directly or indirectly. In developing a breeding program, understanding the genetic relationship of yield and its contributing factors is critical. Correlation analysis helps a breeder to perform both direct and indirect selection of yield attributing traits. Path coefficient analysis provides the information whether the relationship of yield attributing traits with yield is due to direct effect on yield or due to their indirect effect via some other component traits. The present investigation was carried out to evaluate the relationship between seed yield and its contributing traits in 44 genotypes of green gram.

MATERIALS AND METHODS

The present study was carried out during *kharif* 2020, at Research Farm of Sri Karan Narendra College of Agriculture, Jobner, Jaipur (Rajasthan). Forty four green gram genotypes were evaluated in Randomized Block Design (RBD) with three replications (Table 1). Each genotype was sown in two rows in a plot of 2.50 m length, with a row to row and plant to plant distance of 30 and 10 cm, respectively, in each replication. The experimental material was assembled from All India Coordinated Research Project on MULLaRP, Rajasthan Agriculture Research Institute, Durgapura, Jaipur (Rajasthan). The observations for thirteen quantitative traits were observed on ten arbitrarily picked plants from each genotype in each replication for all the following characters namely, plant height (cm), branches per plant, clusters per plant, pods per cluster, pods per plant, pod length (cm), seeds per pod, seed yield per plant (g), protein content (%) and chlorophyll content (SPAD meter reading) with the exception of days to 50% flowering, days to maturity and 1000-seed weight (g) which were reported on plot basis. The genotypic and phenotypic correlation coefficients were determined using the formulas provided Johnson *et al.*, (1955); Singh and Choudhary (1985). Path coefficient analysis was used to assess the direct and indirect effects of various factors on seed yield, as stated by Wright (1921); Dewey and Lu (1959).

Table 1: List of 44 genotypes used in the study.

Sr. No.	Genotype	Sr. No.	Genotype
1.	Pusa M 1971	23.	IGKM 06-10-7
2.	Pusa M 1972	24.	IPM 409-4
3.	VGG 4604	25.	IPM 14-49-5
4.	RMG 975	26.	NDMK 17-07
5.	ML 2575	27.	IPM 02-3
6.	MH 125	28.	IPM 312-394-1
7.	PM 16-23	29.	Pusa BM-5
8.	RMG 62	30.	ML 2482
9.	OBGG 104	31.	ML 2459
10.	MH 1142	32.	MGG 389
11.	AKM 1801	33.	IGKM 05-18-2
12.	MH 318	34.	MH 421
13.	MSJ 158	35.	VGG 17-043
14.	PM 1618	36.	DGGV 80
15.	ML 818	37.	OBGG 103
16.	RMG 268	38.	PMD 14-10
17.	MH 2-15	39.	MH 1703
18.	JLPM 504-20-27	40.	GP 19
19.	VGG 17-038	41.	GP 18
20.	RMG 492	42.	GP 14
21.	BWMCG 31	43.	GP 12
22.	IPM 410-3	44.	GP 50

RESULT AND DISCUSSION

Correlation analysis. Knowing the interrelationships between different traits and seed yield is critical for formulating a rewarding breeding program. To determine the magnitude of both environmental and genetic impacts, the correlation coefficients must be evaluated at both phenotypic and genotypic levels. Genotypic coefficient of correlation is considered as the true estimate of correlation as it eliminates the environmental factor. The genotypic coefficient of correlation was greater than the phenotypic coefficient of correlation in the current study, suggested that there was a significant degree of correlation between traits at the genotypic level and its phenotypic expression was depleted by the environmental factors. The traits showing high genotypic correlation with each other and with seed yield are regarded crucial for applying selection pressure to improve seed yield genetically. The genotypic correlation coefficient between 13 traits in 44 genotypes of green gram are shown in Table 2.

Days to 50% flowering exhibited positive and significant correlation with days to maturity (0.684) and plant height (0.475), whereas a negative significant correlation with protein content (-0.388). Similar findings were observed by Varma *et al.*, (2018) for days to maturity and plant height. Days to maturity revealed positive significant correlation with plant height (0.272), clusters per plant (0.183), seeds per pod (0.204) and chlorophyll content (0.193). Plant height showed positive and significant correlation with branches per plant (0.560), clusters per plant (0.364), pods per clusters (0.225), pods per plant (0.406) and seed yield per plant (0.221), on the contrary it showed negative significant correlation with pod length (-0.180). Ramakrishnan *et al.* (2018) also got related results.

Branches per plant showed positive and significant correlation with clusters per plant (0.804), pods per plant (0.550), chlorophyll content (0.253) and seed yield per plant (0.592) whereas a negative significant correlation was found with pods per cluster (-0.547), pod length (-0.234), seeds per pod (-0.830), 1000-seed weight (-0.230) and protein content (-0.207). Clusters per plant showed positive and significant correlation with pods per plant (0.847), chlorophyll content (0.336) and seed yield per plant (0.758) while negative significant correlation with pods per cluster (-0.338), pod length (-0.520), seeds per pod (-0.903) and 1000-seed weight (-0.281). Pods per cluster exhibited positive and significant correlation with pods per plant (0.292) and seeds per pod (0.325) while it showed negative and significant correlation with pod length (-0.269). Pods per plant showed positive and significant correlation with chlorophyll content (0.315) and seed yield per plant (0.708) while negative significant correlation with pod length (-0.687), seeds per pod (-0.842) and 1000-seed weight (-0.284). These results were in accordance with findings of Makeen *et al.*, (2007); Narasimhulu *et al.*, (2013) and Ramakrishnan *et al.*, (2018).

Table 2: Genotypic correlation coefficients between different traits in green gram genotypes.

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches per plant	Clusters per plant	Pods per cluster	Pods per plant	Pod length (cm)	Seeds per pod	1000-seed weight (g)	Protein content (%)	Chlorophyll content (SPAD meter)	Seed yield per plant (g)
Days to 50% flowering	1	0.684**	0.475**	0.080	0.078	0.126	0.142	0.014	0.168	0.041	-0.388**	0.152	-0.166
Days to maturity		1	0.272**	0.119	0.183*	-0.006	0.149	0.016	0.204*	-0.151	-0.075	0.193*	0.064
Plant height (cm)			1	0.560**	0.364**	0.225**	0.406**	-0.180*	-0.071	-0.152	0.161	0.161	0.221*
Branches per plant				1	0.804**	-0.547**	0.550**	-0.234**	-0.830**	-0.230**	-0.207*	0.253**	0.592**
Clusters per plant					1	-0.338**	0.847**	-0.520**	-0.903**	-0.281**	0.064	0.336**	0.758**
Pods per cluster						1	0.292**	-0.269**	0.325**	-0.077	0.082	-0.079	-0.109
Pods per plant							1	-0.687**	-0.842**	-0.284**	0.039	0.315**	0.708**
Pod length (cm)								1	1.428**	0.363**	0.085	-0.278**	-0.234**
Seeds per pod									1	0.341**	0.568**	-0.244**	-0.289**
1000-seed weight										1	0.179*	-0.137	-0.023
Protein content (%)											1	-0.322**	-0.024
Chlorophyll content (SPAD meter)												1	0.233**

*, ** Significant at 5% and 1% level of significance

Pod length revealed positive and significant correlation with seeds per pod (1.428) and 1000-seed weight (0.363) while negative and significant correlation with chlorophyll content (-0.278) and seed yield per plant (-0.234). These findings were in correspondence with investigations of Varma *et al.* (2018). Seeds per pod exhibited positive and significant correlation with 1000-seed weight (0.341) and protein content (0.568) while negative significant correlation with chlorophyll content (-0.244) and seed yield per plant (-0.289). 1000-seed weight showed positive and significant correlation with protein content (0.179). Protein content exhibited negative and significant correlation with chlorophyll content (-0.322). Chlorophyll content exhibited positive and significant correlation with seed yield per plant (0.233). The highest positive and significant correlation with seed yield per plant was exhibited by the branches per plant, clusters per plant and pods per plant. Such associations were also reported by Biradar *et al.* (2007); Tabasum *et al.*, (2010); Narasimhulu *et al.* (2013); Garje *et al.*, (2014); Anand *et al.* (2016); Bhutia *et al.* (2016); Sandhiya and Saravanan (2018). This implies that selecting these traits will eventually boost the seed yield per plant. Patel *et al.*, (2014) reported positive and significant association for plant height, 1000-seed weight and protein content and Kate *et al.* (2017) for days to maturity.

Path analysis. Correlation analysis merely reveals the nature and degree of association between two characters, whereas, path analysis helps in understanding the direct and indirect association of characters as well as the relative contribution of different traits with respect to seed yield. As a result, the correlation coefficients were subdivided into direct and indirect effects at both genotypic and phenotypic levels. The seed yield per plant was used as the dependent character and others were considered independent in the present path analysis. Path coefficient values among 13 traits in 44 green gram genotypes are presented in Table 3. Path diagram as shown in Fig. 1 in which seed yield is considered as dependent trait and other traits as independent traits.

Direct effect. Pods per plant (1.954) revealed highest direct and positive effect on seed yield per plant followed by branches per plant (1.526), protein content (0.767), pod length (0.427), days to 50% flowering (0.348) and chlorophyll content (0.293). These findings were agreed with those of Haritha *et al.* (2002); Makeen *et al.* (2007); Biradar *et al.*, (2007); Thippani *et al.*, (2013); Eswaran and Senthilkumar (2015); Jyothsna *et al.* (2016); Varma *et al.* (2018); Mohammed *et al.* (2020). These results indicate that for yield improvement direct selection for these traits would be rewarding. Whereas clusters per plant (-1.906), plant height (-0.949), pods per cluster (-0.213), seeds per pod (-0.106), 1000-seed weight (-0.047) and days to maturity (-0.032) exhibited negative and direct effect on seed yield per plant.

Indirect effect. Seeds per pod (1.721), pods per cluster (0.644) via clusters per plant; clusters per plant (1.654), branches per plant (1.075), plant height (0.793) via pods per plant; clusters per plant (1.227), plant height (0.854), pods per plant (0.839) via branches per plant; seeds per pod (0.61) via pod length had high indirect and positive effect on seed yield per plant. However, seeds per pod (-1.266), pods per cluster (-0.834) via branches per plant; pods per plant (-1.614), branches per plant (-1.533), plant height (-0.694) via clusters per plant; seeds per pod (-1.645), pod length (-1.342) via pods per plant; branches per plant (-0.531) via plant height had high negative indirect effect on seed yield per plant.

Table 3: Direct (diagonal) and indirect effects (non-diagonal) of different traits on seed yield per plant (g) in green gram genotypes.

Characters	Days to 50 % flowering	Days to maturity	Plant height (cm)	Branches per plant	Clusters per plant	Pods per cluster	Pods per plant	Pod length (cm)	Seeds per pod	1000-seed weight (g)	Protein content (%)	Chlorophyll content (SPAD meter)	Seed yield per plant (g)
Day to 50 % flowering	**0.348**	-0.022	-0.451	0.122	-0.148	-0.027	0.278	0.006	-0.018	-0.002	-0.297	0.044	-0.166
Days to maturity	0.238	**-0.032**	-0.258	0.181	-0.349	0.001	0.291	0.007	-0.022	0.007	-0.057	0.057	0.064
Plant height (cm)	0.166	-0.009	**-0.949**	0.854	-0.694	-0.048	0.793	-0.077	0.008	0.007	0.123	0.047	0.221
Branches per plant	0.028	-0.004	-0.531	**1.526**	-1.533	0.117	1.075	-0.100	0.088	0.011	-0.159	0.074	0.592
Clusters per plant	0.027	-0.006	-0.346	1.227	**-1.906**	0.072	1.654	-0.222	0.096	0.013	0.049	0.098	0.758
Pods per cluster	0.044	0.000	-0.213	-0.834	0.644	**-0.213**	0.571	-0.115	-0.035	0.004	0.063	-0.023	-0.109
Pods per plant	0.05	-0.005	-0.385	0.839	-1.614	-0.062	**1.954**	-0.294	0.089	0.013	0.030	0.092	0.708
Pod length (cm)	0.005	-0.001	0.171	-0.357	0.991	0.057	-1.342	**0.427**	-0.152	-0.017	0.065	-0.082	-0.234
Seeds per pod	0.058	-0.007	0.067	-1.266	1.721	-0.069	-1.645	0.610	**-0.106**	-0.016	0.436	-0.072	-0.289
1000-seed weight (g)	0.014	0.005	0.144	-0.352	0.535	0.016	-0.555	0.155	-0.036	**-0.047**	0.137	-0.040	-0.023
Protein content (%)	-0.135	0.002	-0.152	-0.316	-0.122	-0.017	0.077	0.036	-0.060	-0.008	**0.767**	-0.095	-0.024
Chlorophyll content (SPAD meter)	0.053	-0.006	-0.153	0.387	-0.640	0.017	0.616	-0.119	0.026	0.006	-0.247	**0.293**	0.233

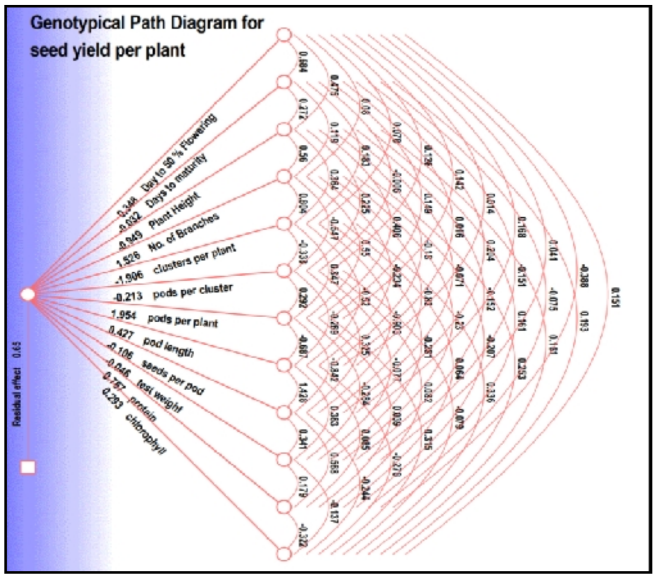

Fig. 1. Path diagram. Direct and indirect effects of different traits on the seed yield per plant considered as dependent character.

CONCLUSION

The genotypic correlation coefficient was larger than the phenotypic correlation coefficient in association analysis, showing a significant degree of correlation among characters. Seed yield per plant showed positive and significant correlation with branches per plant, clusters per plant, pods per plant, plant height and chlorophyll content and should be given more importance for improving seed yield. According to path coefficient analysis, seed yield per plant had a positive and direct relationship with pods per plant, branches per plant, protein content, pod length, days to 50% flowering and chlorophyll content. Pods per plant had the greatest direct and positive effect on seed yield per plant of all the variables studied. As a result, when developing a crop improvement programme, the above listed characteristics should be prioritised.

FUTURE SCOPE

The results indicate that yiels is a complex trait which is correlated to various component traits, this association helps in indirect selection for boosting yield traits in green gram and conducting a crop improvement breeding programme.

Acknowledgement. This study was financially supported by Sri Karan Narendra Agriculture University, Jobner (Rajasthan). This work would not have been possible without the constant support, guidance and assistance of a my advisor Dr. Manohar Ram and so many people from the department.
Conflict of Interest. None.

REFERENCES

Anand, G., Anandhi, K. and Paulpandi, V. K. (2016). Genetic variability, correlation and path analysis for yield and yield components in F_6 families of green gram [*Vigna radiata* (L.) Wilczek] under rainfed condition. *Electronic Journal of Plant Breeding*, *7*(1): 434-437.

Bhutia, P., Lal, G. M. and Thomas, N. (2016). Studies on genetic variability, correlation and path analysis in green gram [*Vigna radiata* (L.) Wilczek]. *International Journal of Agricultural Sciences*, *8*: 2267-2272.

Biradar, K., Salimath, S. P. M. and Ravikumar, R. L. (2007). Genetic studies in green gram and association analysis. *Karnataka Journal of Agricultural Science*, *20*(4): 843-844.

Dewey, D. R. and Lu, H. K. (1959). A correlation and path coefficient analysis of components of crested wheat grass and seed production. *Agronomy Journal*, *51*(6): 515-518.

Eswaran, R. and Senthil kumar, N. (2015). Correlation and path analysis in greengram [*Vigna radiata* (L.) Wilczek] for drought stress. *Plant Archive*, *15*(1): 247-249.

Garje, U. A., Bhailume, M. S., Nagawade, D. R. and Sachin, D. P. (2014). Genetic association and path coefficient analysis in greengram [*Vigna radiata* (L.) Wilczek]. *Journal of Food Legumes*, *27*(2): 151-154.

Haritha, S. and Reddy, S. M. (2002). Correlation and path coefficient analysis in green gram [*Vigna radiata* (L.) Wilczek]. *Legume Research, 25*(3): 180-183.

Johnson, H. F., Robinson, H. F. and Comstock, R. E. (1955). Estimates of genetic and environmental variability in soybean. *Agronomy Journal*, *47*: 314-318.

Jyothsna, S., Patro, T. S. S. K., Ashok, S., Rani, Y. S. and Neeraja, B. (2016). Character association and path analysis of seed yield and its yield components in green gram (*Vigna radiata*). *International Journal of Theoretical and Applied Sciences*, *8*(1): 31-36.

Kate, A. M., Dahat, D. V. and Chavan, B. H. (2017). Genetic variability, heritability, correlation and path analysis studies in greengram (*Vigna radiata* (L.) Wilczek). *International Journal of Development Research*, *7*(11): 16704-16707.

Makeen, K., Abrahim, G., Jan, A. and Singh, A. K. (2007). Genetic variability and correlations studies on yield and its components in green gram [*Vigna radiata* (L.) Wilczek]. *Journal of Agronomy*, *6*(1): 216-218.

Mohammed, R. J., Prasanthi, Vemireddy, L. R. and Latha, P. (2020). Studies on genetic variability and character association for yield and its attributes in greengram [*Vigna radiata* (L.) Wilczek]. *Electronic Journal of Plant Breeding*, *11*(2): 392-398.

Narasimhulu, R., Naidu, N. V., Shanthi Priya, M., Govardhan, G., Reddy, D. M., Reddy, K. H. P. and Raja Rajeswari, V. (2013). Genetic divergence studies in green gram [*Vigna radiata* (L.) Wilczek]. *International Journal of Applied Biology and Pharmaceutical Technology*, *4*(4): 277-280.

Patel, S. R., Patel, K. K. and Parmar, H. K. (2014). Genetic variability, correlation and path analysis for seed yield and its components in green gram [*Vigna radiata* (L.) Wilczek]. *The Bioscan*, *9*(4): 1847-1852.

Ramakrishnan, C. K., Savithramma, D. L. and Vijayabharathi, A. (2018). Studies on genetic variability, correlation and path analysis for yield and yield related traits in green gram [*Vigna radiata* (L.) Wilczek]. *International Journal of Current Microbiology and Applied Sciences, 7*(3): 2753-2761.

Sandhiya, V. and Saravanan, S. V. (2018). Genetic variability and correlation studies in green gram [*Vigna radiata* (L.) Wilczek]. *Electronic Journal of Plant Breeding, 9*(3): 1094-1099.

Singh, R. K. and Chaudhury, B. D. (1985). Biometrical methods of quantitative genetic analysis. *Haryana Journal of Horticulture Sciences, 12*: 151-158.

Shil, S. and Bandopadhyay, P. K. (2007). Retaining seed vigour and viability of mung bean by dry dressing treatments. *Journal of Food Legumes, 20*: 173-175.

Tabasum, A., Saleem, M. and Aziz, I. (2010). Genetic variability, trait association and path analysis of yield and yield components in mung bean [*Vigna radiata* (L.) Wilczek]. *Pakistan Journal of Botany*, *42*(6): 3915-3924.

Thippani, S., Eswari, K. B. and Rao, M. V. (2013). Character association between seed yield and its components in green gram [*Vigna radiata* (L.) Wilczek]. *International Journal of Applied Sciences and Pharmaceutical Technology*, *4*(4): 295-297.

Varma, P. N., Baisakh, B. and Swain, D. (2018). Study on genetic variability, correlation and path coefficient analysis for yield and component traits in greengram. *International Journal of Current Microbiology and Applied Sciences*, *7*(10): 3429-3436.

Wright, S. (1921). Correlation and causation. *Journal of Agricultural Res*earch, *20*: 257-287.

How to cite this article: Prachi Mahla, Manohar Ram, Dalip, Anju Nehra and Rukoo Chawla (2022). Study of Genetic Association and Path coefficient in Green Gram [*Vigna radiata* (L.) Wilczek] Genotypes. *Biological Forum – An International Journal*, *14*(2): 766-770.