Original Research Article

Study of correlation and path analysis in greengram [*Vigna radiata* (L.) Wilczek] for yield and yield attributing traits

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 seed yield by path analysis in twenty greengram genotypes carried out during *Kharif* 2021-2022 in a randomized block design with three replications. The results of association study revealed that, seed yield per plant showed highly significant and positive correlation at both genotypic and phenotypic levels with plant height, days to 50% flowering, days to maturity, number of primary branches, number of clusters per plant, number of pods per plant, no. of seeds per pod, pod length, biological yield per plant, harvest index indicating possibility of simultaneous improvement for these traits. Seed index at phenotypic level had highly significant but negatively correlated with seed yield per plant. Path analysis revealed that, number of seeds per pod, biological yield per plant, harvest index and seed index recorded the highest direct effect at in desirable direction. Their association with seed yield was also significant and positive indicating true and perfect association between these traits. Therefore direct selection for these characters would help in isolating high yielding genotypes from highly segregating population.

Keywords: Correlation, path analysis, greengram, seed yield.

Introduction

Greengram [*Vigna radiata* (L.) Wilczek], also known as mungbean, is an ancient pulse crop widely cultivated in India. It is a diploid species with the chromosomal number 2n=2x=22, a member of the subfamily Papilionaceae of the Leguminosae family, and its botanical name is *Vigna radiata* (L.) Wilczek. Mungbean is a native of South Asia (India), and its likely ancestor is *Vigna radiatavar. sublobata*. It may be produced in a variety of crop rotation strategies due to its short duration, broad adaptability, low water need, and photo insensitivity. India, Pakistan, Bangladesh, Sri Lanka, Nepal, and other Southeast Asian nations are where it is mostly grown (Singh *et al*., 2015).

Mungbean is one of the essential amino acids, including arginine, leucine, lysine, tryptophan, and valine, that is high in vitamin B among other pulses. Green gram sprouts contain vitamin C and E (Engel, 1978). Greengram is rich in protein (24gm/100gm) which is nearly 2.5 times more than cereals. It is also good source of carbohydrate (60gm/100gm), fat

(1gm/100gm), minerals (3gm/100gm) and fiber (1gm/100gm). Mungbean seeds contain about 124 mg Calcium/100 gm, 326 mg Phosphorus/100 gm, 1.3% Fat,7.3 mg Iron/100 gm,4.1 % Fiber and having 334 Kcal Calorific Value. In our country peoples are predominantly vegetarian and pulses are main sources of protein, thus its vital importance in daily diet.

Correlation estimates between yield and other characters are useful in selecting desired plant types in designing an effective breeding programme. Correlation coefficient measure the degree of association, genotypic or phenotypic relationship between two or more characters which forms the basis for selection. Path coefficients analysis (Wright, 1921) is an important tool for partitioning the correlation coefficient into direct and indirect effect of variables on dependent variable which can be an added advantage and helps in selection to a greater extent for improvement of yield.

Materials and Methods

The study of correlation and path analysis in greengram for yield and yield attributing traits was carried out under the field condition during *Kharif* 2021-2022 in a randomized block design with three replications at field experimental center and Seed Testing Laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Sciences Deemed to be University, Allahabad. The experimental area is situated on the left side of Allahabad Rewa road. It is nearly 5.0 km away from Allahabad city and very near to river Yamuna. The experimental plot had uniform topography with homogenous fertility and this condition was suitable for cultivation of greengram. The recommended packages of practices were followed for raising a healthy crop and all necessary plant protection measures were taken to control the pest and diseases. The experimental material consisted of 20 diverse lines of greengram (Table 1).

Table: 1 Genotypes of Greengram with their pedigree

Sno.	Genotypes names	Centre responsible for developing	Pedigree	Year of release
1	PUSA VISHAAL	IARI, New Delhi	Selected from NM92	2002
2	IIPM-99-125	IIPR, Kanpur	PM3 X APM36	2004
3	SML-832	PAU , Ludhiana	SML302 X PUSA BOLD1	2010
4	DGGV-2	UAS, Dharwad	CHINAMUNG X TM-98-50	2014
5	IPMD-604-1-7	IIPR, Kanpur	Germplasm	2016
6	PANT MUNGS-5	GBPUAT, Pantnagar	Selected from VC 6368	2002

7	SML-668	PAU , Ludhiana	Selected from NM94	2002
8	PUSA-9531	IARI, New Delhi	Selected from NM9473	2000
9	OBGG-58	OUAT, Berhampur	Mutant of K857	2002
10	IPM-2-3	IIPR, Kanpur	IPM99-125 X PUSA BOLD2	2009
11	MH-3-18	CCSHAU, Hisar	Germplasm	2016
12	PUSA 0672	IARI, New Delhi	11/395 X ML267	2009
13	HUM-16	BHU,Varanasi	PUSA BOLD-1 X HUM8	2006
14	MH-2-15	CCSHAU, Hisar	PDM116 X GUJRAT-1	2007
15	PUSA-9072	IARI,New Delhi	PUSA-106 X 10-215	1995
16	HUM-1	BHU,Varanasi	BHUMI X PANT U -30	1999
17	MH-421	CCSHAU, Hisar	MUSKAN X BDYR2	2014
18	IPM-409-4	IIPR,Kanpur	PDM2881 X IPM 3-1	2020
19	IPM-312-20	IIPR, Kanpur	IPM-1 X SPS 5	2020
20	PANT MOONG -4	GBPUAT, Pantnagar	T44 X UPU-2	1997

The estimation of correlation coefficient was done using formula given by Searle (1961) and test of significance was carried out by method described by Snedecor and Cochran (1967). The correlation coefficient were further partitioned into direct and indirect effect with the help of path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959). Seed yield was considered as dependent variable as factors assumed to be influenced by the other characters called independent variables as causes.

Results and Discussion

Crop improvement programmes depends to a large extent on availability of sufficient variability and association among different characters which are the pre-requisite for executing an effective selection programme. Seed yield, being a complex quantitative trait, is dependent on a number of component characters. Therefore, knowledge of association of different components together with their relative contributions has immense value in selection.

Correlation analysis

The genotypic and phenotypic correlation coefficients were computed among all characters under study is presented in Table 2 and 3. In general the genotypic correlation coefficients were comparatively higher than corresponding phenotypic correlation coefficient. Seed yield per plant (g) was found significant and positively correlated with plant height (0.529, 0.829), days to 50% flowering (0.252, 0.380), days to maturity (0.376, 0.425), number of primary branches (0.377, 0.425), number of clusters per plant (0.634, 0.651),

number of pods per plant (0.529, 0.376), no. of seeds per pod (0.327, 0.455), pod length (0.341, 0.446), biological yield per plant (0.901, 0.916), harvest index (0.448, 0.388) at both genotypic and phenotypic levels, respectively and with days to fifty percent pod setting (0.420) at phenotypic level and showed negative significant correlation with seed index (-0.316) at phenotypic level. Similar finding was earlier reported by Muthuswamy *et al.* (2019), Asari *et al.* (2019), Ahmad and Belwal (2020). Number of seeds per pod had positive and significant correlation with pod length (0.579, 0.696), biological yield per plant (0.381, 0.534) and seed yield per plant (0.327, 0.455) at both genotypic and phenotypic levels, respectively and number of clusters per plant was found significant and positively correlated with number of pods per plant (0.684, 0.762), biological yield per plant (0.593, 0.623) and seed yield per plant (0.634, 0.651) at both genotypic and phenotypic levels, respectively. Similar finding was earlier reported by Azam *et al.* (2018), Kumar *et al.* (2018), Muthuswamy *et al.* (2019).

Path analysis

The correlation coefficient becomes more meaningful when correlation coefficient are partitioned into components of direct and indirect effects through path analysis, because correlation coefficients indicate only the inter relationship of the characters irrespective of cause and effect (Dewey and Lu, 1959). For path analysis, seed yield was taken as the dependent variable and all other 12 characters used for correlation studies were taken as causal variables. The results are presented in table 4 and 5.

Each factor influenced the yield by a direct contribution and indirect contribution through other variables with which it was correlated. Among all the characters, positive direct effect on seed yield per plant were recorded by no. of seeds per pod (0.0089, 0.0149), biological yield per plant (0.9497, 0.8767), harvest index (0.4131, 0.4344) and seed index (0.0042, 0.0018) at both genotypic and phenotypic levels, respectively. On the other hand, negative direct effect on seed yield per plant were recorded by plant height (-0.0305, -0.0012) and number of primary branches (-0.0088, -0.0142) at both genotypic and phenotypic levels, respectively. Similar findings were reported by Parihar *et al.* (2018), Muthuswamy *et al.* (2019).

Number of seeds per pod exerted positive indirect effect *via* plant height (0.0053, 0.0077), days to 50% flowering (0.0020, 0.0021), days to fifty percent pod setting (0.0026, 0.0032), days to maturity (0.0018, 0.0035), number of primary branches (0.0006, 0.0007),

number of clusters per plant (0.0020, 0.0025), number of pods per plant (0.0006, 0.0004), pod length (0.0062, 0.0086) and biological yield per plant (0.0047, 0.0057) at both genotypic and phenotypic levels, respectively. Biological yield per plant exerted positive indirect effect *via* plant height (0.7709, 0.4619), days to 50% flowering (0.5458, 0.3339), days to fifty percent pod setting (0.5834, 0.3171), days to maturity (0.5921, 0.4247), number of primary branches (0.3013, 0.2658), number of clusters per plant (0.5914, 0.5195), number of pods per plant (0.4043, 0.4480), no. of seeds per pod (0.5071, 0.3336), and pod length (0.3596, 0.2558) both at genotypic and phenotypic levels, respectively.

Conclusion

From present investigation it can be concluded that, number of seeds per pod, biological yield per plant, harvest index and seed index were the major yield contributing characters which had positive and significant association with grain yield per plant 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 improve yield potential of greengram.

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Table 2: Genotypic Correlation Coefficient for Yield and Its Related Traits in 20 Greengram Genotypes

TRAITS	Plant height (cm)	Days to 50% flowering	Days to 50 % pod sett	Days to maturity	No. of Primary Branches	No. of clusters per plant	No. of pods per plant	No. of seeds/pod	Pod length(cm)	Biological yield /plant	Harvest index (%)	Seed Index (g)	Seed yield/ plant
Plant height(cm)	1.000	0.467**	0.498**	0.353*	0.112	0.617**	0.536**	0.598**	0.692**	0.812**	0.196	-0.153	0.829**
Days to 50% flowering		1.000	0.825**	0.874**	0.077	0.387*	0.398*	0.222	0.386*	0.575**	-0.370*	-0.441**	0.380*
Days to 50% pod sett			1.000	0.861**	0.105	0.385*	0.467**	0.292*	0.431**	0.614**	-0.361*	-0.365*	0.420**
Days to maturity				1.000	0.208	0.303*	0.439**	0.202	0.190	0.624**	-0.336*	-0.436**	0.425**
No. of Primary Branches					1.000	0.490**	0.246	0.062	0.242	0.317*	0.339*	0.096	0.425**
No. of clusters per plant						1.000	0.762**	0.228	0.433**	0.623**	0.184	-0.307*	0.651**
No. of pods per plant							1.000	0.073	0.017	0.426**	-0.022	-0.386*	0.376*
No. of seeds/pod								1.000	0.696**	0.534**	-0.102	-0.059	0.455**
Pod length(cm)									1.000	0.379*	0.225	0.181	0.446**
Biological yield/ plant										1.000	-0.017	-0.417**	0.916**
Harvest index (%)											1.000	0.165	0.388*
Seed Index (g)												1.000	-0.316*
Seed yield per plant													1.000

***5%Level of significance** ****1%Level of significance**

Table 3: Phenotypic Correlation Coefficient for Yield and Its Related Traits in 20 Greengram Genotypes

TRAITS	Plant height (cm)	Days to 50% flowering	Days to 50 % pod sett	Days to maturity	No. of Primary Branches	No. of clusters per plant	No. of pods per plant	No. of seeds/pod	Pod length	Biological yield /plant	Harvest index (%)	Seed Index (g)	Seed yield/ plant
Plant height(cm)	1.000	0.326*	0.414*	0.274*	0.094	0.209	0.304*	0.517**	0.592**	0.527**	0.125	-0.143	0.529**
Days to 50% flowering		1.000	0.941**	0.619**	0.078	0.232	0.237	0.140	0.271*	0.381*	-0.238	-0.345*	0.252
Days to 50% pod sett			1.000	0.596**	0.111	0.214	0.267*	0.215	0.299*	0.362*	-0.253	-0.294*	0.226
Days to maturity				1.000	0.169	0.252	0.381*	0.235	0.136	0.485**	-0.162	-0.400*	0.376*
No. of Primary Branches					1.000	0.338*	0.221	0.047	0.206	0.303*	0.278*	0.091	0.377*
No. of clusters per plant						1.000	0.684**	0.168	0.201	0.593**	0.242	-0.198	0.634**
No. of pods per plant							1.000	0.030	0.013	0.511**	0.156	-0.314*	0.529**
No. of seeds/pod								1.000	0.579**	0.381*	-0.051	-0.048	0.327*
Pod length(cm)									1.000	0.292*	0.176	0.163	0.341*
Biological yield/ plant										1.000	0.023	-0.346*	0.901**
Harvest index (%)											1.000	0.143	0.448**
Seed Index (g)												1.000	-0.253
Seed yield per plant													1.000

***5%Level of significance** ****1%Level of significance**

Table 4: Genotypic Path Coefficient for Yield and Its Related Traits in 20 Greengram Genotypes

	Plant height (cm)	Days to 50% flowering	Days to 50 % pod sett	Days to maturity	No. of Primary Branches	No. of clusters per plant	No. of pods per plant	No. of seeds/pod	Pod length	Biological yield /plant	Harvest index (%)	Seed Index (g)	Seed yield/ plant
Plant height(cm)	**-0.0305**	-0.0143	-0.0152	-0.0108	-0.0034	-0.0188	-0.0164	-0.0183	-0.0211	-0.0248	-0.0060	0.0047	0.829**
Days to 50% flowering	-0.0013	**-0.0028**	-0.0028	-0.0024	-0.0002	-0.0011	-0.0011	-0.0006	-0.0011	-0.0016	0.0010	0.0012	0.380*
Days to 50% pod sett	0.0324	0.0655	**0.0650**	0.0559	0.0068	0.0250	0.0304	0.0190	0.0280	0.0399	-0.0235	-0.0237	0.420**
Days to maturity	-0.0236	-0.0583	-0.0574	**-0.0667**	-0.0138	-0.0202	-0.0293	-0.0135	-0.0127	-0.0416	0.0224	0.0290	0.425**
No. of Primary Branches	-0.0010	-0.0007	-0.0009	-0.0018	**-0.0088**	-0.0043	-0.0022	-0.0005	-0.0021	-0.0028	-0.0030	-0.0008	0.425**
No. of clusters per plant	0.0098	0.0061	0.0061	0.0048	0.0078	**0.0158**	0.0121	0.0036	0.0069	0.0099	0.0029	-0.0049	0.651**
Number of pods per plant	-0.0060	-0.0045	-0.0053	-0.0049	-0.0028	-0.0086	**-0.0113**	-0.0008	-0.0002	-0.0048	0.0002	0.0043	0.376*
No. of seeds/pod	0.0053	0.0020	0.0026	0.0018	0.0006	0.0020	0.0006	**0.0089**	0.0062	0.0047	-0.0009	-0.0005	0.455**
Pod length(cm)	-0.0076	-0.0042	-0.0047	-0.0021	-0.0026	-0.0047	-0.0002	-0.0076	**-0.0109**	-0.0041	-0.0025	-0.0020	0.446**
Biological yield per plant	0.7709	0.5458	0.5834	0.5921	0.3013	0.5914	0.4043	0.5071	0.3596	**0.9497**	-0.0163	-0.3956	0.916**
Harvest index (%)	0.0809	-0.1526	-0.1492	-0.1387	0.1402	0.0759	-0.0092	-0.0420	0.0928	-0.0071	**0.4131**	0.0679	0.388*
Seed Index (g)	-0.0006	-0.0018	-0.0015	-0.0018	0.0004	-0.0013	-0.0016	-0.0002	0.0008	-0.0017	0.0007	**0.0042**	-0.316*
Seed yield per plant (g)	0.829**	0.380*	0.420**	0.425**	0.425**	0.651**	0.376*	0.455**	0.446**	0.916**	0.388*	-0.316*	1.0000
Partial R^2	-0.0253	-0.0011	0.0273	-0.0284	-0.0037	0.0103	-0.0042	0.0040	-0.0049	0.8697	0.1604	-0.0013	

***5%Level of significance** ****1%Level of significance**

Table 5: Phenotypic Path Coefficient for Yield and Its Related Traits in 20 Greengram Genotypes

	Plant height (cm)	Days to 50% flowering	Days to 50 % pod sett	Days to maturity	No. of Primary Branches	No. of clusters per plant	No. of pods per plant	No. of seeds/pod	Pod length	Biological yield /plant	Harvest index (%)	Seed Index (g)	Seed yield/ plant
Plant height(cm)	**-0.0012**	-0.0004	-0.0005	-0.0003	-0.0001	-0.0003	-0.0004	-0.0006	-0.0007	-0.0006	-0.0002	0.0002	0.529**
Days to 50% flowering	0.0108	**0.0331**	0.0311	0.0205	0.0026	0.0077	0.0078	0.0046	0.0090	0.0126	-0.0079	-0.0114	0.2515
Days to 50% pod sett	-0.0092	-0.0209	**-0.0222**	-0.0132	-0.0025	-0.0047	-0.0059	-0.0048	-0.0066	-0.0080	0.0056	0.0065	0.2255
Days to maturity	0.0027	0.0060	0.0058	**0.0097**	0.0016	0.0024	0.0037	0.0023	0.0013	0.0047	-0.0016	-0.0039	0.376*
No. of Primary Branches	-0.0013	-0.0011	-0.0016	-0.0024	**-0.0142**	-0.0048	-0.0031	-0.0007	-0.0029	-0.0043	-0.0039	-0.0013	0.377*
No. of clusters per plant	-0.0002	-0.0002	-0.0002	-0.0002	-0.0003	**-0.0009**	-0.0006	-0.0001	-0.0002	-0.0005	-0.0002	0.0002	0.634**
Number of pods per plant	0.0035	0.0027	0.0031	0.0044	0.0026	0.0079	**0.0116**	0.0003	0.0001	0.0059	0.0018	-0.0036	0.529**
No. of seeds/pod	0.0077	0.0021	0.0032	0.0035	0.0007	0.0025	0.0004	**0.0149**	0.0086	0.0057	-0.0008	-0.0007	0.327*
Pod length(cm)	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	**0.0002**	0.0001	0.0000	0.0000	0.341*
Biological yield per plant	0.4619	0.3339	0.3171	0.4247	0.2658	0.5195	0.4480	0.3336	0.2558	**0.8767**	0.0198	-0.3030	0.901**
Harvest index (%)	0.0544	-0.1032	-0.1099	-0.0705	0.1209	0.1049	0.0679	-0.0221	0.0765	0.0098	**0.4344**	0.0621	0.448**
Seed Index (g)	-0.0003	-0.0006	-0.0005	-0.0007	0.0002	-0.0004	-0.0006	-0.0001	0.0003	-0.0006	0.0003	**0.0018**	-0.2531
Seed yield per plant (g)	0.529**	0.2515	0.2255	0.376*	0.377*	0.634**	0.529**	0.327*	0.341*	0.901**	0.448**	-0.2531	1.0000
Partial R^2	-0.0006	0.0083	-0.0050	0.0036	-0.0053	-0.0005	0.0061	0.0049	0.0001	0.7901	0.1944	-0.0005	

***5%Level of significance** ****1%Level of significance**

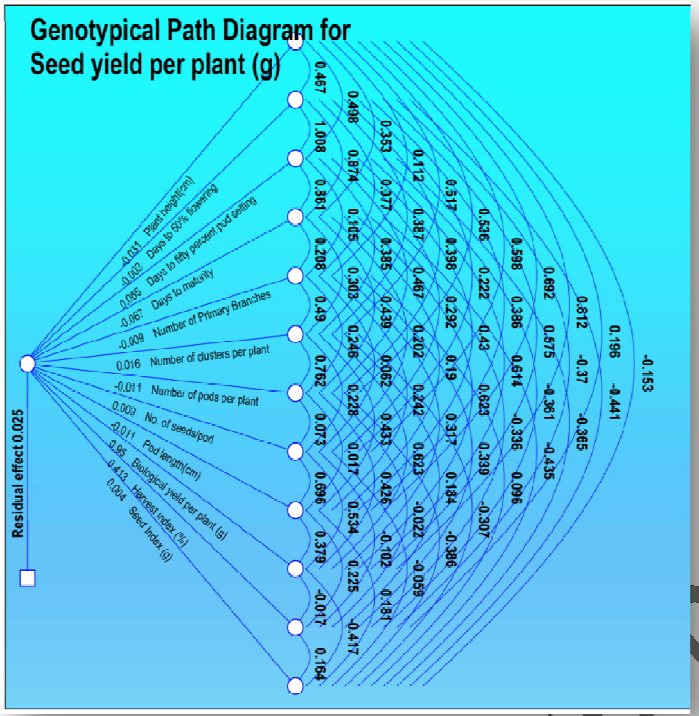

Fig. 1: Genotypic path diagram for seed yield per plant

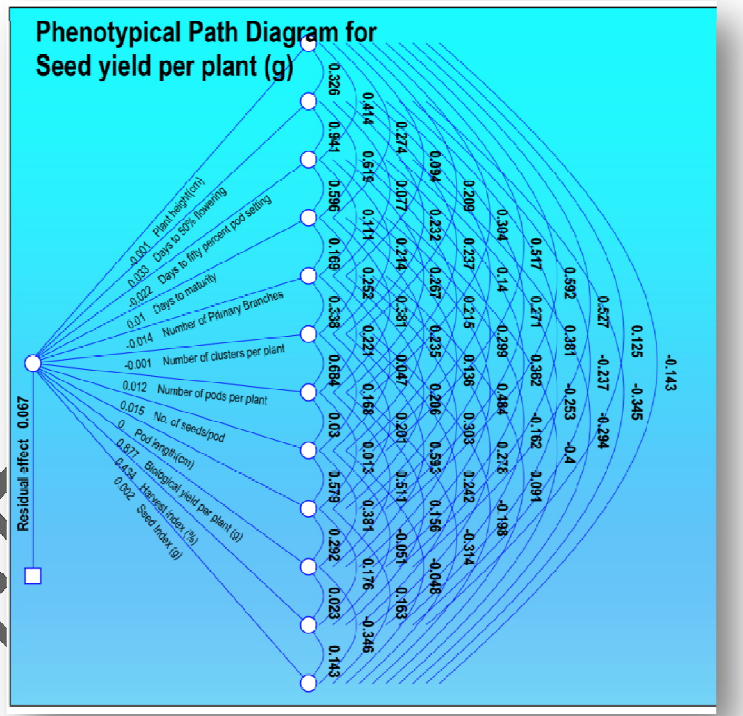

Fig. 2: Phenotypic path diagrams for seed yield per plant