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Correlation and path coefficient analysis studies on seed yield and its yield attributing traits in greengram (*Vigna radiata* (L.) Wilczek)

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Abstract
The aim of the study was to estimate correlation coefficients and investigate the direct and indirect influence of various yield-influencing traits on the seed yield of forty Greengram genotypes. The experiment was conducted in Kharif in 2021-2022 in a randomized block design with two replications at the farm of Badnapur Agricultural College. Analysis of the correlation coefficients suggests that the magnitude of the genotypic correlations was greater than the corresponding phenotypic correlations. The yield of seeds per plant showed a very positive and significant correlation with the number of pods per plant, the number of seeds per pod and the number of secondary branches per plant. Plants, both at the genotypic and phenotypic levels. However, a negative and highly significant correlation was found with number of days to 50% flowering, number of days to maturity and plant height at genotypic and phenotypic levels. Path coefficient analysis showed that the maximum direct effect on seed yield per plant was due to the number of pods per plant and the number of seeds per pod, while the indirect effect was due to plant height and the number of main branches per plant. Attachment. This suggests that these traits should be emphasized in the breeding program to improve grass seed yield.

Keywords: Greengram, correlation, path coefficient analysis and seed yield

Introduction

Greengram [*Vigna radiata* (L.) Wilczek] is one of the most important legumes due to its short growing season, adaptation to low water requirements and soil fertility. It is widely grown and consumed in India. Greengram, also popularly called Moong, Greengram or Golden Gram, belongs to the family Leguminosae or Fabaceae and the subfamily Papilionaceae with a diploid chromosome number of 2n=2x=22.

It is a warm-season, short-day crop grown primarily in the semiarid and subhumid tropics, with an annual rainfall between 600 and 1,000 mm, an average temperature during crop production between 22 and 35 °C, and an altitude of not more than 1,800 m 2,000 m above sea level. It is grown throughout the country at different times of the year as a single, mixed or mixed crop. It is also used in a multicultural system with cereals, peanuts, potatoes and many other crops and is an important part of crop rotation. Due to its short duration and insensitivity to photothermia, it is considered an excellent crop for intensification and diversification of cultivation. It is also used as green manure. It is a warm-season drought and heat tolerant plant grown in a variety of soils including black, red laterite, gravel and sandy soils, as well as well-drained, fertile sandy soils with a pH of 6.2 until 7. 2 is the best solution for growth.

The correlation coefficient is a statistical measure used to determine the magnitude and direction of the relationship between two or more variables.

The association of one or more traits influenced by a large number of genes is determined statistically using a correlation coefficient. Correlation studies provide information about traits that influence yield. It is therefore suitable for identifying yield elements that can be used to genetically improve yield. This information is useful for plant breeders to select elite genotypes from diverse genetic populations. A positive correlation between desired traits is beneficial to the breeder because it allows both traits to be improved simultaneously. Genetic improvement of a dependent trait can be achieved by strong selection for a trait that is genetically related to the dependent trait. The association of one or more traits influenced by a large number of genes is determined statistically using a correlation coefficient. The genotypic correlation coefficient is a measure of the conjugation of genotypes between traits. The method of partitioning the correlation into direct and indirect effects by path coefficient analysis was suggested by Wright (1921) [13].

Path coefficient analysis provides information about the cause and effect situation in understanding the cause of association between two variables. It also helps in determining yield components by providing estimates of direct effects of various traits on yield as well as indirect effects via other component traits. Therefore, it provides basis for selection of superior genotypes from the diverse breeding population.

In applied plant breeding, success of the programme may be predicted to its genetic variability of different selection method is known. Analysis of correlations and path coefficients provides information about the genetic relationship between yield and various traits that influence yield, which in turn is useful for developing breeding strategies.

Material and Methods

In the current investigation entitled correlation and path coefficient analysis studies on seed yield and its yield attributing traits in Greengram (*Vigna radiata* (L.) Wilczek)" the forty genotypes of greengram along with 4 checks namely BPMR-145, BM2002-1, BM-4, BM-2003- 2 were grown in a randomized block design with two replications during Kharif 2021-22 at College of Agriculture Badnapur. Each genotype is sown in single row of 4 m length with spacing 45 cm between rows and 10 cm between plants. The material used in the present study consisted of 40 greengram genotypes including 4 checks received from Agriculture Research Station, Badnapur.

The data were recorded on five randomly selected plants of each replication for all characters such as plant stand, days to 50% of flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, number of seeds per pod, 100 seed weight, seed yield and harvest index. The genotypic co-variance was calculated as per Johnson *et al*. (1955). To establish a cause and effect relationship the partitioning of genotypic and phenotypic correlation coefficient was done into direct and indirect effects by path analysis as suggested by Dewey and Lu (1959) [3] and developed by Wright (1921) [13].

Results and Discussion

Correlation coefficients

For all tested traits, genotypic and phenotypic correlation coefficients were calculated, as shown in Tables 1 and 2 and in the figure. 1. Only significant positive or negative correlations are described. In general, the genotypic correlations were higher than the corresponding phenotypic correlation coefficient.

Seed yield per plant showed a positive and significant correlation with the number of pods per plant (rg=0).6208 and rp= 0.5878), number of seeds per plant (rg= 0.4291 and rp= 0.2667) and secondary branches per plant (rg= 0.2768), at both genotypic and phenotypic levels.

Although it showed a negative correlation with days up to 50% flowering (rg=-0.0875 and rp = -0.0707), days to maturity (rg=-0.1019 and rp=-0.0866), plant height (rg=-0.1930 and rp=- 0. 1514) at genotypic and phenotypic levels. The traits days to 50% flowering, days to maturity, plant height and number of main branches per plant showed a negative and insignificant correlation with seed yield per plant at genotypic and phenotypic levels. Similar results were reported by Venkateswarulu *et al*. (2001) [12] and Mishra *et al*. (2014) [8].

Characters to know the number of secondary braches per plant, the number of pods per plant, the number of seeds per pod, the weight of 100 seeds and the harvest index showed a very positive and significant correlation with seed yield. In other words, increasing these traits would lead to an increase in grain yield. Similar results were also reported by Venkateswralu *et al*. observed. (2001) [12], Khanpara *et al*. (2012) [5], Kumar *et al*. (2017) [6], Das and Barua (2015) [1] and Rahman *et al*. (2017) [9].

Tables 1 and 2 show the phenotypic and genotypic correlation between all pairs of traits. It was observed that in most cases the genotypic correlation was greater than the phenotypic correlation, suggesting that environmental influences were not strong enough to alter the degree of correlation of all traits. From the previous discussion on correlation studies, it is clear that characteristics such as the number of secondary branches per plant, the number of pods per plant, the number of seeds per pod, the weight of 100 seeds (g) and harvest index (%) showed a positive correlation with yield per plant (g) at both genotypic and phenotypic levels. This suggests that emphasis should be placed on these traits in the breeding program to improve greengram seed yield.

Path Analysis

Because correlation coefficients do not take into account the extremely complex relationships between different characteristics, path coefficient analysis was used to separate the correlations into direct and indirect effects. In the present study, the number of pods per plant (g = 0.4102, p = 0.5964) was found to have the highest positive direct effect on seed yield per plant in mass, followed by the number of seeds per pod (g = 0.3322). Mass 100 seeds (g=0.2759, p=0. 2890), the number of secondary branches per plant (g=0.2304) from genotypic and phenotypic aspects. Shown in Table 4.

Similar results were recorded by Reddy (2003) [10], Thippani *et al*. (2013) [11], Rahman *et al*. (2017) [9] and Desai *et al*. (2020) [2] for number of pods per plant and number of seeds per pod. Likewise findings of Marawar *et al*. (2020) [7] were with accordance with present results for 100 seed weight. Phenotypic and genotypic path diagram were furnished in fig.3 and 4 respectively.

From the foregoing discussion about path coefficient analysis, it is evident that character number of pods per plant, number of seeds per plant, number of secondary branches per plant, 100 seed weight (g) showed positive direct effect on seed yield.

Table 1: Estimation of phenotypic (above diagonal) correlation coefficients in greengram

Character Number	Days to 50% flowering	Days to maturity	Plant height	No. of primary branches/plant	Number of secondary branches/Plant	Number of pods/Plant	Number of seeds/pods	100 seed weight	Harvest Index	Seed yield/plant
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Days to 50% flowering	1.0000	0.7105**	0.4009***	0.0871	-0.0167	- 0.2802*	-0.0570	-0.2265*	-0.2906**	-0.0707
Days to maturity		1.0000	0.4551***	0.0974	0.0329	- 0.2879**	-0.1881	0.0259	-0.0718	-0.0866
Plant height			1.0000	0.0057	- 0.0220	-0.0397	0.0733	-0.2411*	0.0130	-0.1514
Number of primary branches per plant				1.0000	0.2337*	-0.2041	-0.0457	0.0337	0.0133	-0.1985
Number of secondary branches per plant					1.0000	0.1430	0.0475	0.0516	-0.0458	0.1661
Number of pods per plant						1.0000	0.4106***	-0.1381	0.0711	0.5878***
Number of seeds per pod							1.0000	-0.1361	-0.0795	0.2667*
100 seed weight								1.0000	0.3263**	0.1633
Harvest Index									1.0000	0.0189
Seed yield per plant										1.0000

****** Significant at 5% level of probability or level of significance, ******* Significant at 1% level of probability or level of significance

Table 2: Estimation of Genotypical (above diagonal) correlation coefficients in greengram

Character number	Days to 50% flowering	Days to maturity	plant height	No. of primary branches/plant	Number of secondary branches/plant	Number of pods/plant	Number of seeds/pods	100 seed weight	Harvest Index	Seed yield/plant
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Days to 50% flowering	1.0000	0.7371**	0.4320**	0.1027	-0.0058	-0.0934	-0.0634	-0.2506*	-0.3081**	-0.0875
Days to maturity		1.0000	0.5573**	0.1259	0.0143	-0.2878**	-0.2183*	-0.02220	-0.1244	-0.1019
Plant height			1.0000	0.0243	0.0423	- 0.0935	0.1369	-0.2207*	-0.0337	-0.1930
Number of primary branches per plant				1.0000	0.0694	- 0.2247*	-0.0670	0.0511	0.0382	-0.1748
Number of secondary branches per plant					1.0000	0.2190*	-0.1149	0.1349	-0.0251	0.2768**
Number of pods per plant						1.0000	0.5478**	-0.1131	0.0675	0.6208**
Number of seeds per pod							1.0000	-0.1832	-0.1174	0.4291**
100 seed weight								1.0000	0.4031**	0.2006
Harvest Index									1.0000	0.0037
Seed yield per plant										1.0000

******* Significant at 5% level of probability or level of significance, ****** Significant at 1% level of probability or level of significance

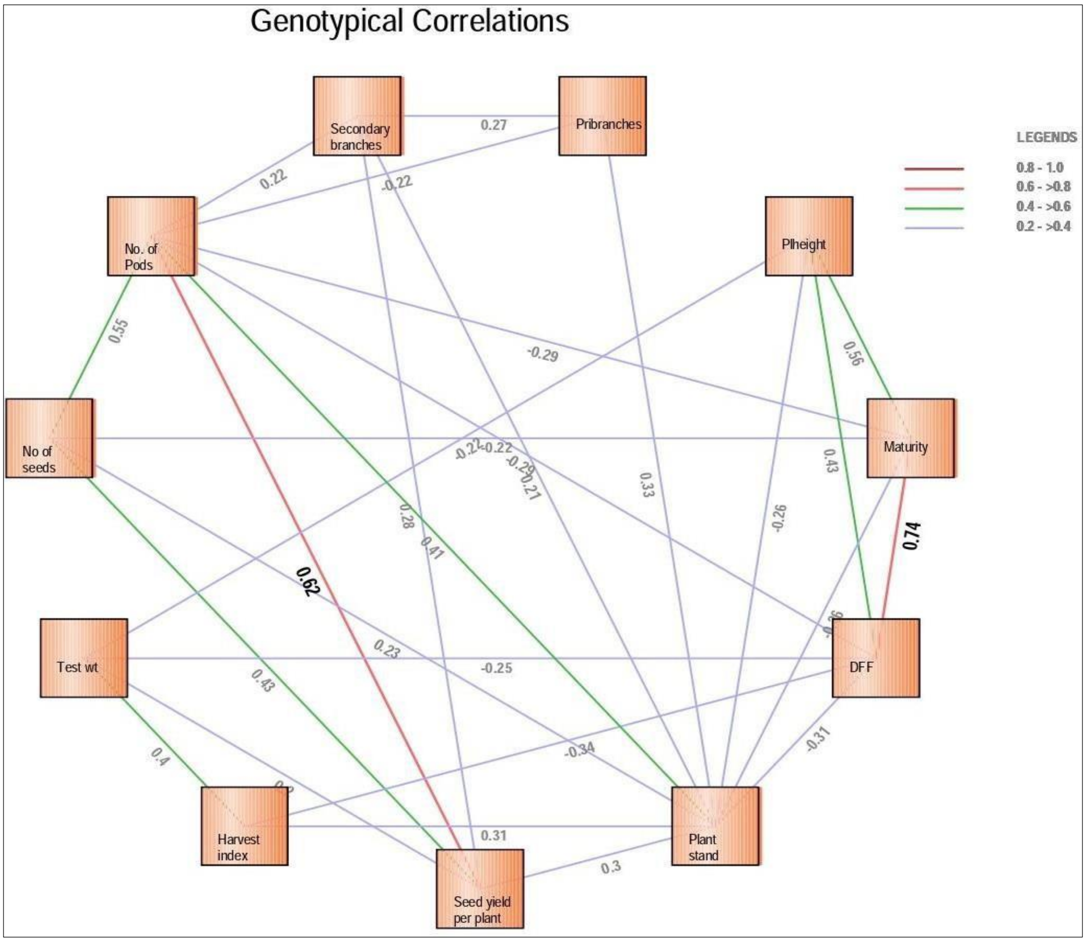

Fig 1: Diagram showing the genotypic correlation in yield and its component of greengram

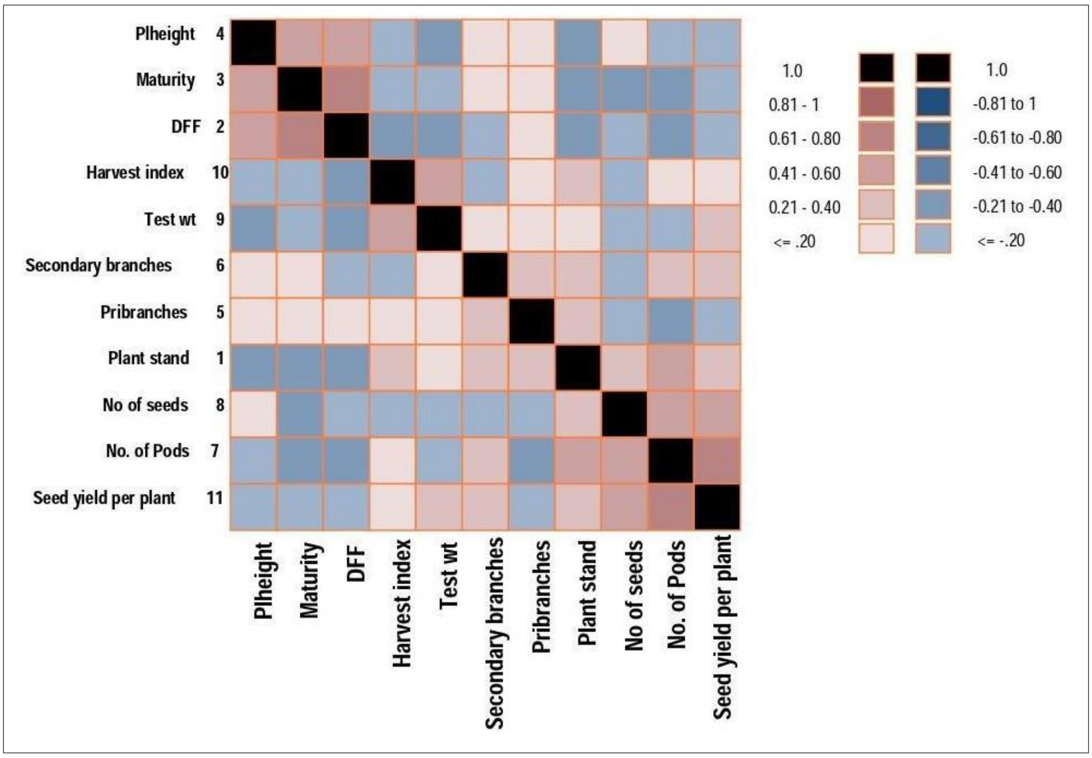

Fig 2: Shaded genotypic correlation matrix in greengram

Table 3: Direct and indirect effect of yield and its component characters on grain yield at phenotypic level

S. N.	Characters	Days to 50% flowering	Days to maturity	Plant Height	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	No. of seeds per pod	100 seed weight	Harvest index	Seed yield per plant
1.	Days to 50% flowering	0.2342	0.1664	0.0939	0.0204	-0.0039	-0.0656	-0.0133	- 0.0531	-0.0680	-0.0707
2.	Days to maturity	0.0130	0.0183	0.0083	0.0018	0.0006	-0.0053	-0.0034	0.0005	-0.0013	-0.0866
3.	Plant height	-0.0565	-0.0641	-0.1409	-0.0008	0.0031	0.0056	-0.0103	0.0340	-0.0018	-0.1514
4.	No. of primary branches per plant	-0.0129	-0.0145	-0.0008	-0.1484	-0.0347	0.0303	0.0068	- 0.0050	-0.0020	-0.1985
5.	No. of secondary branches/plant	-0.0013	0.0026	-0.0017	0.0183	0.0782	0.0112	0.0037	0.0040	-0.0036	0.1661
6.	No. of Pods per plant	-0.1671	-0.1717	-0.0237	-0.1217	0.0853	0.5964	0.2449	-0.0824	0.0424	0.5878
7.	No. of seeds per pod	-0.0032	-0.0105	0.0041	-0.0025	0.0027	0.0229	0.0558	-0.0076	-0.0044	0.2667
8.	100 seed weight	-0.0655	0.0075	- 0.0697	0.0097	0.0149	-0.0399	-0.0393	0.2890	0.0943	0.1633
9.	Harvest index	0.0172	0.0042	-0.0008	-0.0008	0.0027	-0.0042	0.0047	-0.0193	-0.0592	0.0189

Residual effect= 0.7183 R SQUARE = 0.4840, Underlined figures indicate direct effect. Bold and underlined figures = Direct effect Normal figures = indirect effect ***, ** indicates significant at 5 and 1% level of significant respective

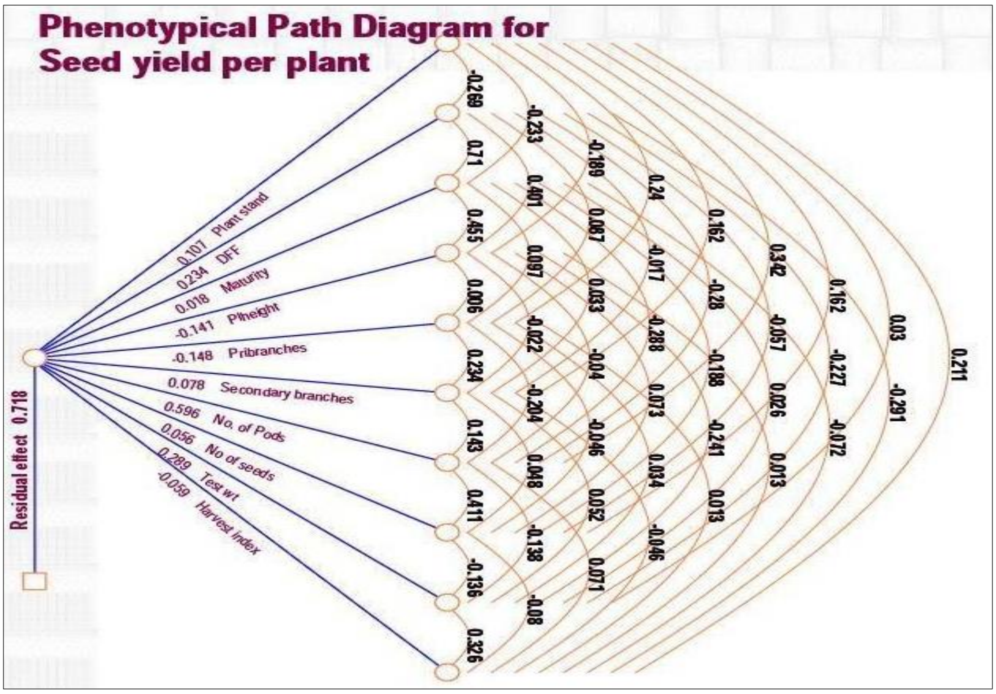

Fig 3: Diagram showing the phenotypic path correlation of yield and its component characters in greengram

Table 4: Direct and indirect effect of yield and its component characters on grain yield at genotypic level

Sr. No.	Characters	Days to 50% flowering	Days to maturity	Plant height	Number of primary branches per plant	Number of secondary branches per plant	Number of pods per plant	Numbers of seeds per pod	100 seed weight	Harvest index	Total phenotypic correlation with Seed yield per plant
1	Days to 50% flowering	0.1394	0.0405	0.0479	0.0170	0.0065	-0.0038	0.0030	0.0182	0.0150	0.0645
2	Days to maturity	-0.0086	-0.0295	-.0011	-0.0127	-0.0138	-0.0144	0.0094	0.0093	0.0127	-0.1533
3	Plant height	0.0387	0.0043	0.1128	-0.0141	-0.0275	-0.0088	0.0398	-0.0084	-0.0067	0.1821
4	Number of primary branches per plant	0.0018	0.0063	-.0018	0.0146	0.0131	0.0086	-0.0117	-0.0023	-0.0024	-0.0900
5	Number of secondary branches per plant	0.0043	0.0428	-.0224	0.0826	0.0919	0.0524	-0.0721	-0.0221	-0.0157	0.1583
6	Number of pods per plant	-0.0102	0.1829	-.0292	0.2217**	0.2142	0.3759	-0.1933	-0.1242	-0.0324	0.0442
7	Numbers of seed per pod	0.0070	-0.1016	0.1132	-0.2558	0.2516**	-0.1649	0.3207***	0.0237	0.0464	0.2020
8	100 seed weight	-0.0679	-0.1640	-.0386	-0.0818	-0.1251	-0.1722	0.0385	0.5212***	0.2477**	0.5342***
9	Harvest index	-0.0342	-0.1.367	-.0188	-0.0511	-0.0539	-0.0273	0.0459	0.1505	0.3168***	0.5557***

Residual effect= 0.6304, R SQUARE = 0.6026, Underlined figures indicate direct effect. Bold and underlined figures = Direct effect Normal figures = indirect effect ***, ** indicates significant at 5 and 1% level of significant respective

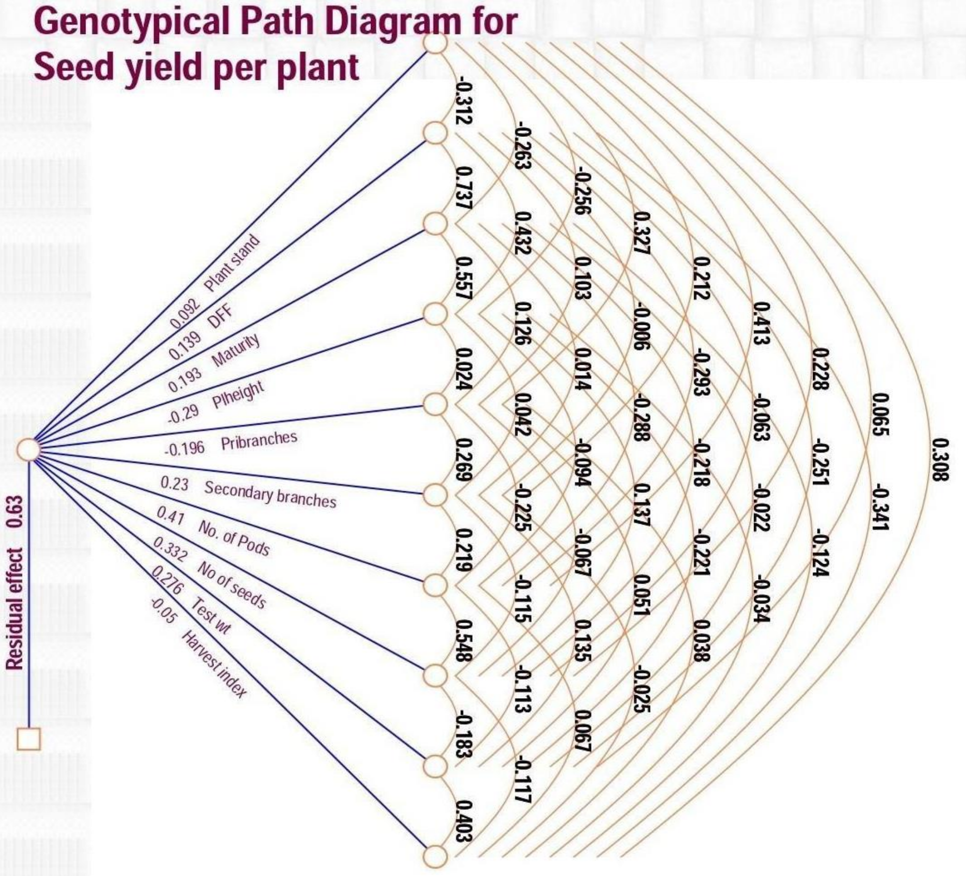

Fig 4: Diagram showing the genotypic path correlation of yield and its component characters in greengram

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