International Journal of Environment and Climate Change

Volume 14, Issue 1, Page 558-564, 2024; Article no.IJECC.111386
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Path Coefficient Analysis to Evaluate Seed Yield in Green Gram [*Vigna radiata* (L.) R. Wilczek]: A Comprehensive Study

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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/IJECC/2024/v14i13870

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/111386

Original Research Article

Received: 12/11/2023
Accepted: 15/01/2024
Published: 19/01/2024

ABSTRACT

The current empirical study on "path coefficient analysis to evaluate seed yield in green gram [*Vigna radiata* (L.) R. Wilczek]: a comprehensive study" was conceded to assess path analysis in 72 genotypes of green gram. On 11 traits, observations were recorded. The genotypic path coefficient analysis revealed that the number of pods per plant, 100-seeds weight and number of seeds per pod expressed positive and higher direct effect on seed yield per plant. The phenotypic path coefficient analysis revealed that the number of pods per plant, 100-seeds weight and number of seeds per pod exhibited high and positive direct effects on seed yield per plant. Whereas,

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negative direct effect on seed yield per plant were contributed through number of clusters per plant and plant height at phenotypic level. The residual effect was found to be 0.0755 and 0.1321 at genotypic and phenotypic path coefficient analysis respectively.

Keywords: Path analysis; green gram; residual effect and Vigna radiata (L.) R. wilczek.

1. INTRODUCTION

"In Indian agriculture, pulse crops play an important role. Quality protein is higher in pulses nearly three times as compared to cereals. Green gram is a legume cultivated for its edible seeds and sprouts across Asia. It has a diploid chromosome number of 2n=2x=22 and is a member of the fabaceae family and subfamily papilionaceae. Green gram is a native of Central Asia and India", claims Vavilov [1]. "Green gram contains about 24 % protein, this is being about 2/3 of the protein content of soybean, twice that of wheat and thrice that of rice. This protein is relatively high in an amino acid and lysine that is lacking in cereal grains. So, green gram and cereal grains diet combining form a balanced amino acid diet. Every 100 g of green gram seed contain 132 mg calcium, 2.251 mg niacin, 4.8 mg ascorbic acid, 0.621 mg thiamine, 0.233 mg riboflavin and 114 IU vitamin A" [2].

"In exercising selection programs, the information on path analysis is of considerable importance. Multiplicative end product of many factors is being a polygenic complex trait and sensitive to environmental variations in grain yield. There are also several component characters of yield" [3]. It is necessary to examine whether the effects of different components of yield and other traits on yield are direct or indirect and to what extent? The path coefficient analysis provides an effective mean of finding direct and indirect causes of an association under such circumstances.

2. MATERIALS AND METHODS

A quantity, 72 genotypes of green gram from different origins obtained from the Pulses Research Station, J.A.U., Junagadh were sown in a RBD with 3 replications during *kharif*-2021 at Pulses Research Station, J.A.U., Junagadh. Each genotype was arranged in a single row that was 4 metres long with a spacing of 45 cm × 10 cm.

The observations were recorded for 11 traits *viz.,* days to 50 % flowering, days to maturity, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, number of seeds per pod, length of pod (cm), 100-seeds weight (g) and grain yield per plant (g) and mean values were used for statistical analyses.

"Path coefficient is a standardized partial regression coefficient and measures the direct and indirect effects of one variable upon another and permits the separation of correlation coefficient into the component of direct and indirect effects. The genotypic as well as phenotypic path coefficient analysis was done as per the method suggested" by Dewey and Lu [4].

3. RESULTS AND DISCUSSION

The path coefficient analysis was performed on yield and yield attributes to evaluate the direct and indirect effects of various characters on seed yield. Path coefficient analysis takes into account both direct and indirect impacts of factors by partitioning the correlation coefficients. In order to understand these effects, genotypic and phenotypic correlation coefficient of different characters with seed yield was portioned into their direct and indirect effects (Table 1). This facilitates the selection of genotypes on the basis of those traits which will eventually contribute more towards seeds yield.

The genotypic path coefficient analysis (Table 1). revealed that the number of pods per plant, 100-seeds weight and number of seeds per pod expressed positive and higher direct effect on seed yield per plant. These results were in conformity with earlier report of Ahmad et al. [5]. Goyal et al. [6] for 100-seeds weight and number of pods per plant. While, negative direct effect on seed yield per plant were contributed through number of clusters per plant, days to 50 % flowering and plant height at genotypic level, indicating that the selection for these traits may have an undesirable impact on seed yield. These results are in accordance with the reports of Prasanna et al. [7] and Mohammed et al. [8]. for number of clusters per plant and days to 50 % flowering. Garg et al. [9], Abbas et al [10] and Asari et al. [11] for plant height.

Table 1. Genotypic and Phenotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on seed yield per plant in 72 genotypes of green gram

Characters		Days to 50% flowering	Days to maturity	Plant height (cm)	Number of primary branches per plant	Number of clusters per plant	Number of pods per cluster	Number of pods per plant	Number of seeds per pod	Length of pod (cm)	100-seeds weight (g)
Days to 50% flowering	**G**	**-0.0380**	-0.0339	-0.0069	0.0006	0.0173	0.0215	0.0191	0.0065	0.0023	0.0110
	P	**0.0018**	0.0011	0.0003	0.0001	-0.0006	-0.0008	-0.0007	-0.0002	-0.0001	0.0004
Days to maturity	**G**	0.0674	**0.0754**	0.0280	0.0078	-0.0507	-00537	-0.0629	0.0198	0.0060	0.0406
	P	0.0006	**0.0010**	0.0003	0.0001	-0.0005	-0.0006	-0.0006	0.0002	0.0001	0.0004
Plant height (cm)	**G**	-0.0040	-0.0082	**-0.0221**	-0.0042	0.0020	0.0025	0.0028	-0.0067	-0.0074	0.0036
	P	-0.0014	-0.0026	**-0.0095**	-0.0015	0.0008	0.0010	0.0012	-0.0024	-0.0027	0.0015
Number of primary branches per plant	**G**	-0.0001	0.0005	0.0010	**0.0053**	0.0017	0.0012	0.0016	0.0006	0.0009	0.0011
	P	0.0005	0.0009	0.0023	**0.0147**	0.0045	0.0030	0.0038	0.0015	0.0020	0.0029
Number of clusters per plant	**G**	0.0329	0.0486	0.0067	-0.0233	**-0.0723**	-0.0477	-0.0591	0.0100	-0.0097	0.0183
	P	0.0184	0.0280	0.0046	-0.0166	**-0.0544**	-0.0336	-0.0408	0.0066	-0.0055	0.0126
Number of pods per cluster	**G**	-0.0436	-0.0548	0.0085	0.0168	0.0508	**0.0770**	0.0622	-0.0016	0.0049	0.0224
	P	-0.0300	-0.0382	-0.0074	0.0140	0.0429	**0.0696**	0.0513	-0.0015	0.0042	0.0190
Number of pods per plant	**G**	-0.4492	-0.7468	-0.1136	0.2720	0.7320	0.7234	**0.8948**	-0.0834	0.0732	0.3031
	P	-0.3284	-0.4914	-0.1014	0.2161	0.6216	0.6114	**0.8290**	-0.0696	0.0693	0.2649
Number of seeds per pod	**G**	-0.0754	0.1157	0.1330	0.0520	-0.0610	-0.0089	-0.0410	**0.4402**	0.1501	0.0510
	P	-0.0418	0.0843	0.1246	0.0488	-0.0584	-0.0103	-0.0406	**0.4837**	0.1419	0.0480
Length of pod (cm)	**G**	-0.0028	0.0037	0.0155	0.0076	0.0062	0.0029	0.0038	0.0157	**0.0460**	0.0012
	P	-0.0011	0.0027	0.0098	0.0046	0.0034	0.0021	0.0029	0.0101	**0.0343**	0.0005
100- seeds weight (g)	**G**	0.1787	0.3324	0.1017	0.1238	-0.1565	-0.1793	-0.2091	0.0715	-0.0158	**0.6174**
	P	0.1327	0.2226	0.0931	0.1146	-0.1352	-0.1596	-0.1867	0.0579	-0.0083	**0.5842**
Genotypic correlation with Seed yield per plant (g)	**G**	-0.334**	-0.267*	0.135	0.458**	0.469**	0.539**	0.612**	0.473**	0.250*	0.387**
Phenotypic correlation with Seed yield per plant (g)	**P**	-0.249*	-0.192	0.117	0.395**	0.424**	0.482**	0.619**	0.486**	0.235*	0.363**

**, **Significant at 5 and 1 % levels, respectively Genotypic residual effect = 0.0755 Phenotypic residual effect = 0.1321*

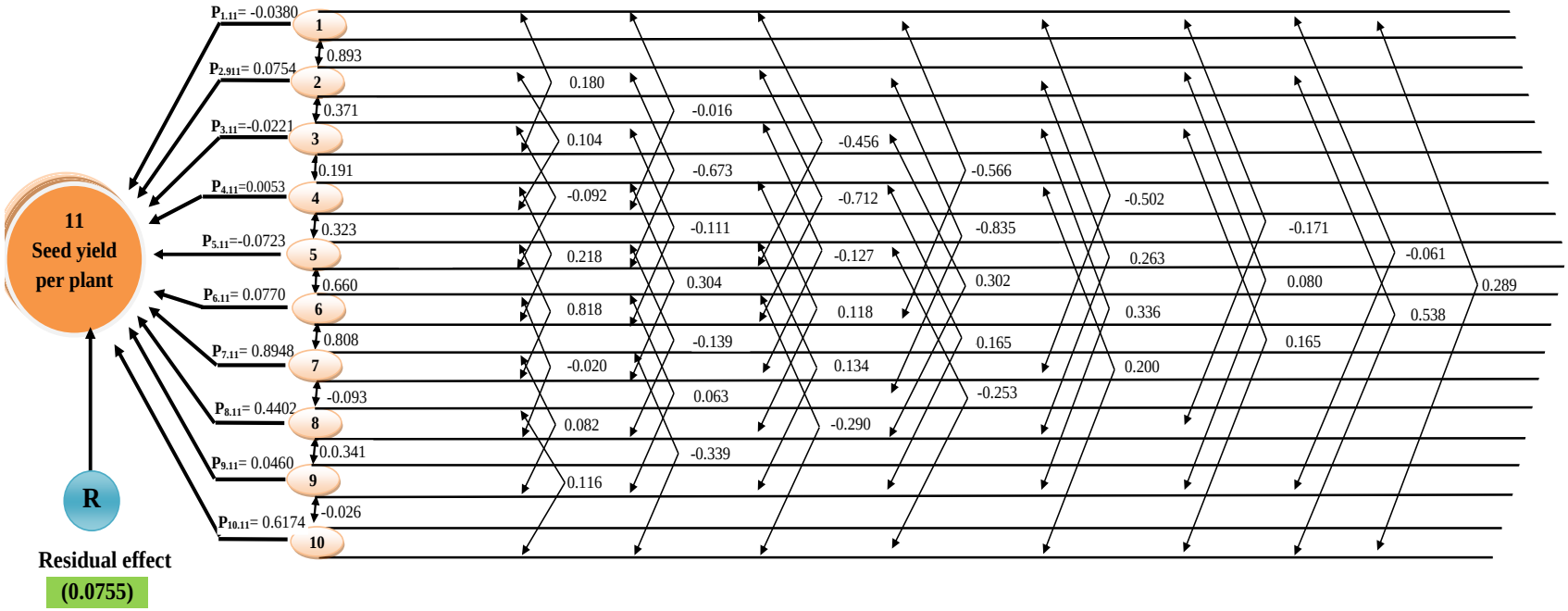

Fig. 1. Diagrammatic representation of genotypic path coefficient analysis for 11 characters in green gram

1. Days to 50% flowering
2. Days to maturity
3. Plant height (cm)
4. Number of primary branches per plant
5. Number of clusters per plant
6. Number of pods per cluster
7. Number of pods per plant
8. Number of seeds per pod
9. Length of pod (cm)
10. 100-seeds w eight (g)
11. Seed yield per plant (g)

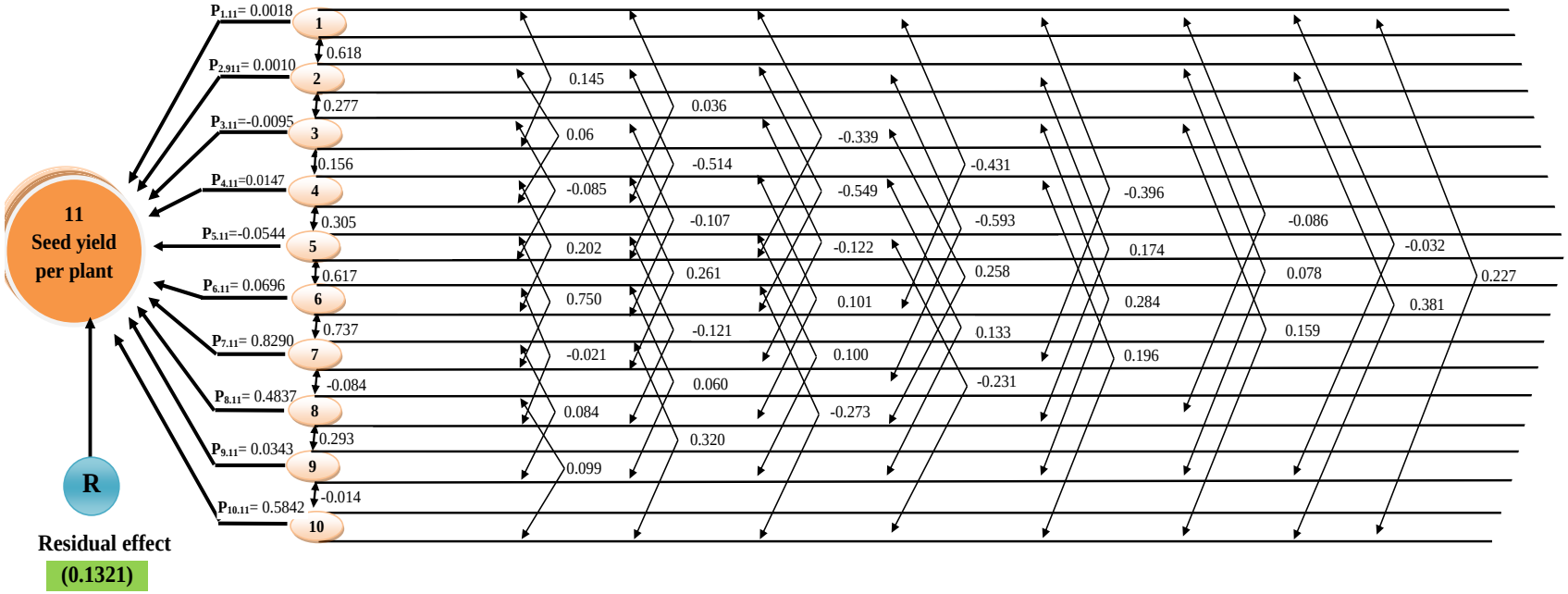

Fig. 2. Diagrammatic representation of phenotypic path coefficient analysis for 11 characters in green gram

1. *Days to 50% flowering*
2. *Days to maturity*
3. *Plant height (cm)*
4. *Number of primary branches per plant*
5. *Number of clusters per plant*
6. *Number of pods per cluster*
7. *Number of pods per plant*
8. *Number of seeds per pod*
9. *Length of pod (cm)*
10. *100-seeds w eight (g)*
11. *Seed yield per plant (g)*

The phenotypic path coefficient analysis (Table 1). revealed that the highest positive direct effect on seed yield were exerted through the number of pods per plant followed by 100-seeds weight and number of seeds per pod. So, emphasis should be given to these traits in selection program for improvement of seed yield in green gram. Which coincides with the results earlier reported by Parihar et al. [12]. for 100-seeds weight and number of seeds per pod; Ahmad et al. [5] and Prasanna et al. [7] for number of seeds per pod, 100-seeds weight and number of pods per plant; Tabasum et al [13]. for number of pods per plant and 100-seed weight. However, negative direct effect on seed yield per plant were contributed through the number of clusters per plant and plant height at phenotypic level, indicating that the selection for these traits may have an undesirable impact on seed yield. Similar outcome was also reported by Abhisheka and Mogali [14]. and Mohammed et al [8]. for number of clusters per plant; Goyal et al [6]. and Abbas et al [10]. for plant height.

It was apparent from the phenotypic path analysis that the higher direct effects as well as appreciable indirect influences were exerted by the number of pods per plant, 100-seeds weight and number of seeds per pod towards seed yield per plant. These three characters also exhibited highly significant and positive association with seed yield per plant. Hence, these may be considered as most important yield contributing characters and due emphasis should be placed on this component while breeding for high seed yield in green gram.

The residual effect was found to be 0.0755 at genotypic path coefficient analysis, while it was 0.1321 at phenotypic path coefficient analysis. The results of residual effect indicated that the majority of the yield attributes have been included in the study of path analysis. It is also possible to conclude that the characteristics that are most essential in correlation research are likewise important in path analysis. Thus, it can be suggested that correlation and path analysis study should be considered together for rapid gain in final genetic improvement for seed yield in green gram. These results are in accordance with the reports of Manivelan et al [15]. Kumar et al [16] and Garg et al [9].

4. CONCLUSION

The study concluded that the number of pods per plant, 100-seeds weight and number of seeds per pod expressed positive and higher direct effect on seed yield per plant at genotypic path analysis. The phenotypic path analysis revealed that the number of pods per plant, 100-seeds weight and number of seeds per pod had high and positive direct effect on seed yield per plant and that was found to be the most important yield components. The residual effect was of low magnitude suggesting that the majority of the yield attributes have been included in the study of path analysis.

ACKNOWLEDGEMENT

Indeed, the words at my command are not adequate to convey the depth of my feeling and gratitude to my major guide Dr. B. A. Monpara, Associate Research Scientist, Pulse Research Station, JAU, Junagadh for his keen interest, scientific guidance, constructive criticism and inspiration during the course of research work and preparation of this dissertation.

I have no words to express my heartiest thanks and gratitude to my beloved parents. Most humbly, I bow with sense of reverence to my venerable Grandfather Shri Kalidas Patel, Grandmother Smt. Shardaben, Father Shri Jitendrakumar Kalidas Patel, Mother Smt. Jyotshnaben Jitendrakumar Patel and wife Priyal Patel whose affection, sacrifices and blessing have always been the most vital source of inspiration to me. I also express my deep feelings of affection and love to all family members for their everlasting love, day by day help and bearing of hardship without which this would not have been reality.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/111386