International Journal of Plant & Soil Science

Volume 36, Issue 7, Page 1043-1047, 2024; Article no.IJPSS.119544
ISSN: 2320-7035

Correlation Studies and Path Analysis in Sesame (*Sesamum indicum L*.)

Neeraj Kumar [a*], Subhash Chander [a], Rakesh Punia [a] and Dalip Kumar [a]

[a] *Department of Genetics and Plant Breeding, CCS HAU, Hisar, India.*

Authors' contributions

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

Article Information

DOI: https://doi.org/10.9734/ijpss/2024/v36i74818

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/119544

Original Research Article

Received: 28/04/2024
Accepted: 01/07/2024
Published: 06/07/2024

ABSTRACT

Sesame (*Sesamum indicum L*.), an ancient oilseed crop, is cultivated in central and northern India under rainfed conditions during the *kharif* season. Despite its high oil and protein content, sesame cultivation area and production remain low due to various reasons. This study conducted at CCS HAU, Hisar, aimed to improve sesame yield through plant breeding by examining correlation and path analysis. This trial was conducted using augmented RCBD and data was recorded on traits including plant height(cm), primary branches plant^{-1}, secondary branches plant^{-1}, number of capsules plant^{-1}, and seed yield plant^{-1}. Genotypic correlations showed that seed yield plant^{-1} positively correlated with the number of capsules plant^{-1} (r = 0.854**), primary branches plant^{-1} (r = 0.602**), secondary branches plant^{-1} (r = 0.283*) and slightly negatively with plant height (r = -0.064). Path analysis indicated the number of capsules plant^{-1} had the highest direct effect on seed yield plant^{-1} (0.769) followed by primary branches plant^{-1}. The study concludes that enhancing primary branches plant^{-1} and capsules plant^{-1} while managing plant height can significantly boost sesame yield.

**Corresponding author: E-mail: neerajkummar8@gmail.com;*

Cite as: *Kumar, Neeraj, Subhash Chander, Rakesh Punia, and Dalip Kumar. 2024. "Correlation Studies and Path Analysis in Sesame (Sesamum Indicum L.)". International Journal of Plant & Soil Science 36 (7):1043-47. https://doi.org/10.9734/ijpss/2024/v36i74818.*

Keywords: Sesame; correlation; path analysis; seed yield.

1. INTRODUCTION

Sesame (*Sesamum indicum* L.) is an ancient crop with a rich history of over 3000 years of cultivation. It belongs to the Pedaliaceae family and has a diploid genome with 2n = 2x = 26 [1]. Sesame is widely cultivated for its high oil content, which is 50%. Sesame oil is known for its premium quality in cooking due to its high stability, minimal rancidity, and zero cholesterol content. It's also rich in antioxidants such as sesamolin, sesamin, and sesamol [2,3]. Sesame seeds also have a significant protein content, averaging 21.9%. This crop is predominantly cultivated in India, China, Sudan, and Myanmar, contributing to 60% of the world's production. Notably, India leads in sesame seed production with 19.47 lakh hectares of cultivated area and a production of 8.66 lakh tons [4].

The seed yield in sesame is mostly determined by traits such as primary and secondary branches, number of capsules etc. In plant breeding, selection is crucial for increasing seed yield. The selection efficiency is enhanced by giving more weight to traits positively associated with seed yield [5-9].

The study of correlation and path analysis is beneficial in this context. Correlation analysis helps to identify the relationships among different traits, while path analysis goes a step further by dissecting each trait's direct and indirect contributions to dependent traits [10]. This information significantly impacts breeders' decisions regarding selection for increasing seed yield [11].

This study aims to achieve two main objectives: (i) determine the correlation between traits and seed yield, and (ii) identify the direct and indirect effects of traits on seed yield.

2. MATERIALS AND METHODS

This experiment was conducted at the Oilseeds Section experimental site of the Department of Genetics and Plant Breeding, CCS HAU, Hisar. The experiment included 52 sesame genotypes, with two varieties serving as checks. It was carried out during the Kharif 2023 season, with a plot size of 5.0 m (row length) x 0.6 m (width, 2 rows per plot with 30 cm row spacing). The genotypes were evaluated using an Augmented Randomized Complete Block Design. The experimental site was divided into five blocks, and within each block, randomization was performed to ensure that each block consisted of 10 randomly selected genotypes along with two check genotypes. Data was recorded for the following traits: plant height (cm), number of primary plant^{-1} and secondary branches plant^{-1}, number of capsules plant^{-1}, and seed yield plant^{-1} (gm). Data was collected from three competitive plants, excluding border plants. The collected data was then analyzed using the Augmented RCBD package in R version 4.4.1 to conduct an analysis of variance (ANOVA) following the augmented design [12].

Phenotypic and genotypic correlations were estimated using the standard procedure [13]. Adjusted mean values were used for genotypic correlation, while phenotypic mean values were used for phenotypic correlation. Path coefficient analysis was conducted at the genotypic level to determine the direct and indirect effects of yield component traits on seed yield plant^{-1}, using the general formula [11] with seed yield plant^{-1} as the dependent variable. All statistical analyses were performed in R version 4.4.1.[14].

3. RESULTS AND DISCUSSION

The findings of the augmented ANOVA are presented in Table 1. According to the table, the genotypes showed significant differences for all traits under consideration, indicating substantial variation among them. No significant differences were observed among the blocks. We have two checks, and no significant differences were observed for these. However, significant differences were observed when comparing genotypes with checks.

Seed yield is a complex phenomenon that results from a combination of various factors. For the identification of yield-contributing traits, we look for correlation analysis. The correlation coefficients among major traits are shown in Table 2. For genotypic correlation, seed yield plant^{-1} exhibited a high positive correlation with the number of capsules plant^{-1} (r = 0.854**) and primary branches plant^{-1} (r = 0.602**), moderate positive correlation with secondary branches plant^{-1} (r = 0.283*). However, seed yield plant^{-1} showed a negative correlation with plant height (r = -0.064). The number of capsules plant^{-1} exhibited a strong positive association with primary branches plant^{-1} (r = 0.578**) and a moderate positive association with secondary branches plant^{-1} (r = 0.407**), but a non-significant negative association with plant height (r = -0.002). Additionally, secondary branches plant^{-1} exhibited a positive correlation with primary branches plant^{-1} and plant height. For phenotypic correlation, a similar pattern was observed; however, the coefficient values were found lower compared to genotypic correlation. It is important to note that the phenotype is the result of both genotype and environmental effects. A higher genotypic coefficient value indicates that inherent associations among traits are present [15]. Consider these correlations when selecting sesame plants in segregating generations, giving more weightage to medium plant height, an increased number of primary branches plant^{-1} and a higher capsule count plant^{-1} which are helpful in genetically improving seed yield. Correlation results for these traits are reported in [16-21].

Further confirming the usefulness of the correlation coefficient, we go for the path analysis. Path analysis is a technique used to dissect the correlation coefficient between direct and indirect effects. Selecting traits based on correlation value and direct effects is thoughtful as these both present a clearer picture. More accuracy is achieved if we give weightage to traits based on correlation and path analysis. The results of the path analysis are presented in Table 3. The maximum direct effect on seed yield per plant is exerted by the number of capsules per plant with a value of 0.769 followed by primary branches with a value of 0.190. Plant height and secondary branches negatively affect the seed yield per plant by exerting negative direct effects. The maximum positive indirect effect on seed yield was exerted by capsules through primary branches. Secondary branches also had a positive indirect effect through capsules per plant. However, secondary branches have a negative direct effect, indicating that they reduce seed yield. This may be because the capsules on secondary branches remain immature at the time of harvesting, causing the seeds in these capsules to remain small. Plant height is negatively correlated and has a negative direct effect on seed yield per plant. This is because tall plant height is directly correlated with the more vegetative phase, which means less reproductive phase. A decreased reproductive phase leads to reduced seed yield. Therefore, it seems that medium plant height, number of branches, especially primary branches plant^{-1} and number of capsules plant^{-1} are important traits for improving seed yield in sesame. A residual of 0.243 in path analysis suggests that these traits are sufficient to elucidate the correlation and path analysis. For path analysis, similar results were reported in [22-25].

Table 1. Analysis of variance for various traits in sesame

		Mean sum of squares				
Source	**df**	**Plant height (cm)**	**Primary branches plant-^{1}**	**Secondary branches plant-^{1}**	**Capsules plant^{-1}**	**Seed yield plant^{-1}**
Block (Ignoring Treatments)	4	51.33	0.22	0.11	20.15	7.11
Treatment (Eliminating Blocks)	51	155.77*	0.61*	7.45*	152.05**	33.85**
Treatment: Check	1	4.90	0.10	6.40	32.40	10.00
Treatment: test and test vs. Check	50	158.79*	0.62*	2.38	154.45**	34.32**
Residuals	4	19.90	0.10	1.15	5.15	1.75

**, ** significant at 5 and 1 per cent respectively*

Table 2. Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients among various traits of sesame

Characters	**Plant height (cm)**	**Primary branches plant-^{1}**	**Secondary branches plant-^{1}**	**Capsules plant^{-1}**	**Seed yield plant^{-1}**
Plant height		0.168	0.319*	-0.002	-0.064
Primary branches plant-^{1}	0.311*		0.307*	0.578**	0.602**
Secondary branches plant-^{1}	0.024	0.346*		0.407**	0.283*
Capsules plant^{-1}	-0.055	0.181	-0.113		0.854**
Seed yield plant^{-1}	-0.041	0.144	0.174	0.841**	

**, ** significant at 5 and 1 per cent respectively*

Table 3. Direct (diagonal) and indirect (off-diagonal) effects of various traits on sesame seed yield

Characters	Plant height (cm)	Primary branches plant-^{1}	Secondary branches plant-^{1}	Capsules plant^{-1}	Seed yield plant^{-1}
Plant height	-0.074	0.032	-0.021	-0.002	-0.064
Primary branches plant-^{1}	-0.012	0.190	-0.020	0.445	0.602
Secondary branches plant-^{1}	-0.023	0.058	-0.066	0.313	0.283
Capsules plant^{-1}	0.002	0.110	-0.027	0.769	0.854

4. CONCLUSION

Correlation and path studies show that the number of capsules and primary branches plays a very prominent role in determining the sesame yield. During selection in segregation generation emphasis on these traits helps in immediate increase in sesame seed yield.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENTS

The authors his heartfelt gratitude to the Oilseeds Section, Department of Genetics & Plant Breeding, CCSHAU, Hisar, for the financial support.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ashri A. Sesame (*Sesamum indicum* L.). In R. J. Singh (Ed.), Genetic Resources, Chromosome Engineering and Crop Improvement. 2007;4:231-289.
2. Bedigian D. History and lore of sesame in Southwest Asia. Economic Botany. 2004; 58:329-353.
DOI: 10.1663/0013-00.
3. Brar GS, Ahuja KL. Sesame: Its culture, genetics, breeding and biochemistry. Annual Review of Plant Science. 1979:245-313.
4. FAOSTAT, Food and Agriculture of the United Nation Statistical database; 2022.
Available:http://www.fao.org/faostat/en/#compare
5. Singh B, Upadhyay PK, Sharma KC. Genetic variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* (L.) R. Br.). Indian Research Journal of Genetics and Biotechnology. 2014;6(3):491-500.
6. Aye, Myint, and Nyo Mar Htwe. Trait Association and Path Coefficient Analysis for Yield Traits in Myanmar Sesame (*Sesamum Indicum* L.) Germplasm. Journal of Experimental Agriculture International. 2019;41(3):1-10.
Available:https://doi.org/10.9734/jeai/2019/v41i330402
7. Sunagar, Ramesh, and Manoj Kumar Pandey. Genomic Approaches for enhancing yield and quality traits in Mustard (*Brassica* spp.): A Review of Breeding Strategies. Journal of Advances in Biology & Biotechnology. 2024;27 (6):174-85.
Available:https://doi.org/10.9734/jabb/2024/v27i6877.
8. Udall JA, Quijada PA, Lambert B, Osborn TC. Quantitative trait analysis of seed yield and other complex traits in hybrid spring rapeseed (*Brassica napus* L.): 2. Identification of alleles from unadapted germplasm. Theoretical and Applied Genetics. 2006;113:597-609.
9. Jain SM, Brar DS, Ahloowalia BS, editors. Molecular techniques in crop improvement. Dordrecht, The Netherlands: Springer; 2010.
10. Fazal A, Mustafa HSB, Hasan EU, Anwar M, Tahir MHN, Sadaqat HA. Interrelationship and path coefficient analysis among yield and yield related traits in sesame (*Sesamum indicum* L.). Nature and Science. 2015;13(5):27-32.
11. Dewey DR, Lu KH. A correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agronomy Journal. 1959;51(9):515-518.

12. Aravind J, Mukesh SS, Wankhede DP. Augmented RCBD: Analysis of augmented randomised complete block designs; 2020. Available:https://CRAN.R-project.org/ package= AugmentedRCBD
13. Nadarajan N, Manivannan N, Gunasekaran M. Quantitative Genetics and Biometrical Techniques in Plant Breeding, Kalyani publishers. New Delhi, India; 2016.
14. R Core Team. R: A language and environment for statistical computing (, Version 4.4.1). R Foundation for Statistical Computing; 2023. Available:https://www.R-project.org
15. Singh B, Upadhyay PK, Sharma KC. Genetic variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* (L.) R. Br.). Indian Research Journal of Genetics and Biotechnology. 2014;6(3):491-500.
16. Pawar KN, Chetti MB, Jahagirdar S. Association between seed yield and yield attributing characters in sesamum *(Sesamum indicum* L.). Agricultural Science Digest. 2002;22(1):18-20.
17. Mohammed A, Firew M, Amsalu A, Mandefro N. Genetic variability and association of traits in mid-altitude sesame (*Sesamum indicum* L.) germplasm of Ethiopia. American Journal of Experimental Agriculture. 2015;9(3):1-14.
18. Azeez MA, Morakinyo JA. Path analysis of the relationships between single plant seed yield and some morphological traits in sesame (Genera *Sesamum* and *Ceratotheca*). International Journal of Plant Breeding and Genetics. 2011;5:358-368.
19. Saha S, Begum T, Dasgupta T. Analysis of genotypic diversity in sesame based on morphological and agronomic traits. *In* Conference on International Research on Food Security, Natural Resource Management and Rural Development organized by Georg-August Universität Göttingen and University of Kassel-Witzenhausen, Germany during September; 2012.
20. Madhu B, Padmaja D, Srikanth T, Balram N. Studies on correlation and path analysis of yield and its contributing traits in sesame (*Sesamum indicum*). International Journal of Environment and Climate Change. 2023;13(11):3420-3425. https://doi.org/10.9734/IJECC/2023/104074
21. Singh A, Bisen R, Tiwari A. Genetic variability and character association in sesame (*Sesamum indicum* L.) genotypes. International Journal of Current Microbiology and Applied Sciences. 2018;7 (11): 2407-2415.
22. Goudappagoudra R, Lokesha R, Ranganatha ARG. Trait association and path coefficient analysis for yield and yield attributing traits in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2011;2(3):448-452.
23. Gnanasekaran M, Jebaraj S, Muthuramu S. Correlation and path coefficient analysis in sesame (*Sesamum indicum* L.). Plant Archives. 2008;8(1):167-169.
24. Disowja A, Parameswari C, Gnanamalar RP, Vellaikumar S. Evaluation of sesame (*Sesamum indicum* L.) based on correlation and path analysis. Electronic Journal of Plant Breeding. 2020;11(02): 511-514.
25. Kumar V, Sinha S, Tomar S, Sinha S, Singh RS, Singh SN. Assessment of genetic variability, correlation and path analysis in sesame (*Sesamum indicum* L.). Electronic Journal of Plant Breeding. 2022;13(01):208-215.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/119544