Original Research Article

Correlation and path analysis of yield and its contributing traits in sesame (*Sesamum indicum*)

ABSTRACT:

Aims: Evaluation of correlation between yield and yield contributing traits in Sesame, as well as to determine their direct and indirect effects on fruit yield of sesame genotypes. Study Design:Augmented block design (ABD) with non replicated data.Place and Duration of Study: RARS, Polasa, Jagtial between August 2019 and November 2019.

Methodology: For statistical analysis mean values are used. SPSS version 17.0 and GENRES were used to perform the correlation and path analysis using 106 genotypes and evaluated for the following eleven traits: days to 50% flowering, days to maturity, plant height, number of branches per plant,number of capsules per plant , 1000-seed weight and seed yield per plant.

Results: The correlation analysis indicated that number of capsules per plant (0.806) and 1000-seed weight (0.657) positively correlated with seed yield at phenotypic levels, respectively. Path coefficient analysis indicated that number of capsules per plant (0.806) and 1000-seed weight ()exhibited positive direct effect on seed yield.

Keywords: Correlation, path analysis, sesame, phenotypic and genotypic

Introduction

Sesame (*Sesamum indicum* L.) (2n = 26), also known as Til or Gingelly, it is one of the most important oilseed crop of tropical and temperate regions. It is commonly known as “Queen of oilseeds” due to its resistance to oxidation and rancidity, also it plays an important role as an industrial food crop because of its high nutritional value. The seeds of sesame contains 40 to 63 per cent oil, which contains significant amount of oleic and linoleic acids.

Globally, sesame is produced over an area of 8.8 mha and annual production around 2.8mt with average productivity of 382 kg/ha. India is still leading country with maximum (25.8 %) production from the largest (29.8 %) area and highest export (40 %) in the world. It is grown in India with an area of 16.27 lakh ha, 7.89 lakh tonnes production and 485 kg ha^{-1} productivity (www.indiastat.com, 2022). Sesame occupies an area of 0.34 lakh ha with production and productivity of 0.260 lakh tonnes and 766 kg ha^{-1} respectively in Telangana (www.indiastat.com, 2022). It is grown as summer crop in Northern Telangana districts *viz.*, Adilabad, Jagtial, Karimnagar and Nizamabad. However, the development of improved plant cultivars and increasing the production is restricted mainly due to narrow genetic pool, which results in limited possibility to restructure the sesame crop.Correlation studies, together with path analysis provide a better understanding of the association of different characters with grain yield. Path coefficient analysis separates direct effects from indirect effect through other related characters by partitioning the correlation coefficient (Dixit and Dubey, 1984). The relationship of yield with other characters is of great significance while formulating any selection programme for crop improvement. Selection based on only seed yield in white seeded sesame without considering the component characters is not effective since seed yield is a dependent character influenced by several other characters (Thouseem *et al*., 2022).

Correlation studies between yield and yield contributing traits of the crop will be of interest to breeders in planning the hybridization programme and evaluating the individual plants in segregating populations.

Yield is a polygenically controlled character and highly influenced by the environment. Selection merely based on yield is not effective. Selection based on its components increases yield as they are not only less complex but also relatively simply inherited and are much less influenced due to environmental deviations. The yield is a complex character resulting from interplay of various yield contributing characters, which have positive or negative association with yield and among themselves. Assessment of the magnitude of correlation for various characters with yield is immense help in the indirect selection for improvement of yield.

Correlation coefficient analysis measures the mutual relationship between various characters and can be used to determine the component character on which selection can be done for yield improvement.

Materials and methods

The experiment was carried out at Regional Agricultural Research Station, Polasa, Jagtial, during *kharif,* 2019. The research station is situated in Northern Telangana Zone of Telangana-India at 18º 48' N latitude, 78º 56' E longitude and 281m altitude of mean sea level. The experiment was laid out in Augmented block design (ABD) and 106 genotypes were sown in four blocks with inter-row spacing of 30 cm and intra-row spacing of 10 cm with plot size of 9.3 x 3 m. Sowing was done by dibbling the seed at 2-3 cm depth. All the standard packages of practices were followed during the crop growth period. The experimental material used in the present investigation consisted of 106 genotypes i.e. 50-Germplasm lines, 50-Advanced breeding lines and two National Checks i.e. TKG 22 and GT 10 and four Local checks i.e. YLM 11, YLM 66, Swetha thil and Hima of sesame. The present investigation was carried out on 106 genotypes of sesame toselect out the better genotypes for seed yield and its components. The experiment was conducted in augmented block design at Regional Agricultural Research Station, Polasa, Jagtial during *Kharif*, 2019.

2.1 Statistical Analysis

The mean values were utilized for statistical analysis. The correlation and path analysis was performed by using the software SPSS version17.0 and GENRES.

3. RESULTS

The observations recorded on 106 genotypes for eleven characters viz., Days to 50% flowering ,days to maturity, plant height, number of branches per plant, number of capsules per plant, 1000-seed weight and seed yield per plant were analyzed statistically for genetic parameters and character association among them was presented hereunder.

Seed yield is a complicated characteristic that is seen as the sum of its parts. a plant is a visible integrated structure, in which most of the traits are inter-connected and influenced by a larger number of genes(Srikanth and Ghodke 2022 and Lule *et al*.,2012), selecting superior genotypes based on seed yield is challenging. The inter-relationship of yield component characters provides an idea for the selection

and simultaneous improvement of desirable yield contributing characters. Hence, correlation studies were conducted to determine the association between seed yield and its component characteristics.

Seed yield per plant exhibited positive and significant correlation with number of capsules per plant (0.75) and 1000 seed weight (0.592).

while plant height (0.052) and number of branches per plant shown non-significant correlation with seed yield per plant and negative non-significant correlation with days to maturity (-0.129) and days to maturity (-0.015) at phenotypic levels.

Days to 50% flowering registered positive and significant correlation with days to maturity (0.675). This trait had a positive and significant correlation with 1000 seed weight (0.264) and seed yield per plant (0.759).While negative and significant association with number of capsules per plant (0.245). Days to 50% flowering registered positive and significant correlation with days to maturity (0.675). While negative and significant association with number of capsules per plant (0.245). Number of branches per plant (0.047) and plant height (0.052) recorded non significance positive association with seed yield per plant indicating that these traits could also be considered as yield attributing component.

3.1 Path Analysis

The genetic architecture of seed yield is a result of balance or overall net effect created by various yield components interacting with one another. Since, Correlation is not a reliable tool as it cannot be considered as causation, for instance there is a correlation between sunrise and rooster crowing. But, rooster crow does not cause sunrise. Thus, total correlation between yield and its component characters may be some times misleading, as it might be an over-estimate or under-estimate because of its association with other characters. Therefore it is important to reveal cause effects of yield attributing characters towards yield. Path analysis provides a route map of yield attributing characters that effects yield; it divides correlation into direct and indirect effects. In this study splitting total correlation into direct and indirect effect of cause using statistical design devised by Wright [1] and computed by Deway and Lu [2] would provide more meaningful interpretation. The direct and indirect effects of different yield contributing traits on yield were estimated using following genotypic and phenotypic correlation coefficients formula,

$$\text{Genotypic coefficient of correlation } (r_g) = r(x_i . x_j)g = \frac{\text{Cov.}(x_i . x_j)g}{\sqrt{v(xi)g . v(xj)g}}$$

where,

$r(x_i.x_j)$ - genotypic correlation between i^{th} and j^{th} characters

$Cov.(x_i.x_j)g$ - genotypic covariance between i^{th} and j^{th} characters

$v(x_i)g$ - genotypic variance of i^{th} character

$v(x_j)$ - genotypic variance of j^{th} character

$$\text{Phenotypic coefficient of correlation } (r_p) = r(x_i . x_j)p = \frac{\text{Cov.}(x_i . x_j)p}{\sqrt{v(x_i)p.v(x_j)p}}$$

Where,

$r(x_i.x_j)p$ - phenotypic correlation between i^{th} and j^{th} characters

$Cov.(x_i.x_j)$ - phenotypic covariace between i^{th} and j^{th} characters

$v(x_i)p$ - phenotypic variance of i^{th} character

$v(x_j)p$ - phenotypic variance of j^{th} character

To test the significance of correlation coefficients, the estimated values were compared with the tables of correlation coefficients (Fisher and Yates, 1963) at 5 per cent and 1 per cent level of significance with (n-2) degrees of freedom where 'n' is the number of genotypes used in the experiment.

And, genotypic and phenotypic correlation coefficients are presented in Table 3.

Direct effects: Days to maturity (0.098), number of branches per plant (0.052), number of capsules per plant (0.657) and 1000 seed weight (0.111) exhibited positive direct effect on seed yield, whereas negative direct effect was observed for days to fifty percent flowering (-0.014) and plant height (-0.001).

Indirect effects: Maximum positive indirect effect was exerted by number of branches per plant via number of capsules per plant (0.657). Number of capsules per plant exerted positive indirect effect via 1000 seed weight (0.111)

DISCUSSION:

Present study revealed that the traits viz., number of capsules per plant and 1000 seed weight. Such association was highly desirable as the improvement in any of the yield components results into overall increase in seed yield. Hence greater emphasis must be given on these associated traits as criteria for selection to target improvement of seed yield per plant. Similar results have been reported by Abate *et al*. (2018) for number of capsules per plant and Vanishree*et al*. (2011) for 1000 seed weight. Hence improvement of number of capsules per plant results in improvement of seed yield. These results are in accordance with studies of sesame genotypes of Saxena and Bisen (2016), Agrawal *et al.* (2017) and Bhagwat Singh and Rjani Bisen (2018).

Number of branches per plant (0.047) and plant height (0.052) recorded non significance positive association with seed yield per plant indicating that these traits could also be considered as yield attributing component. These observations are confirming with the results of Mansouri (2016) for number of branches per plant and Agrawal *et al*. (2017) for plant height. As a nutshell, these characteristics should keep in view to improve seed yield per plant (SYP) using them in selection criteria. .Seemingly and definitely the number of capsules per plant directly contributes to yield i.e., more number of capsules leads to more seed yield. This character exhibited the highest direct positive effect and indirect effect through other characters 1000-seed weight and number of branches per plant. Since this trait has a strong correlation and direct effect on seed yield per plant, selecting for this trait may greatly contributes to seed yield per plant. These results are in agreement with Abate and Mekbib 2015 and Srikanth and Ghodke (2022). Days to maturity influenced seed yield per plant by low positive direct effect at both levels. Days to 50% flowering influenced seed yield per plant negatively direct effect at both levels. The similar reports were reported by Abate and Mekbib 2015. Plant height also showed negative direct effect on seed yield at both levels, these results are in congruence with Saipriya et al.2018. The results indicated those characters with positive correlation

have shown high direct effects. Hence, number of capsules and 1000-seed weight has high direct and correlation values.

Residualfactor

The residual of path coefficient is square root of 1-r^2 (multiple r) from the regression analysis used to compute the path coefficient. The residual effects are introduced to indicate the effect of variables not included in the model. The residual factor was low (0.4998) in the genotypes which suggested that, the variables choosen in the present study were sufficient to explain seed yield per plant with different characters. The results of path analysis study affirm that the characters like number capsules per plant and 1000 seed weight were most important yield determinants, because of their high direct effects via many other yield improving characters and indirect contribution of these characters towards the yield is negligible (Lule *et al*., 2012). This suggests that emphasis must be given on such traits while exercising selection to improve the yield in sesame.

Table 1. Estimates of correlation coefficients for yield and it's component characters

Trait	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	1000 seed weight (g)	Seed yield per plant
Days to 50% flowering	**1.00**	0.675*	0.157	-0.165	-0.245*	-0.024	-0.129
Days to maturity		**1.00**	0.091	-0.174	-0.133	-0.014	-0.015
Plant height (cm)			**1.00**	0.041	0.113	-0.047	0.052
Number of branches per plant				**1.00**	0.031	-0.023	0.047
Number of capsules per plant					**1.00**	0.264*	0.759**
1000 seed weight (g)						**1.00**	0.592**
Seed yield per							**1.00**

plant							

*- significance at 5% level (0.190) **- significance at 1% level (0.249)

Table 2. Genotypic path coefficients among yield attributes in 106 sesame genotypes

Trait	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of capsules per plant	1000 seed weight (g)	Seed yield per plant(g)
Days to 50% flowering	**-0.014**	0.066	-0.001	-0.008	-0.161	-0.010	-0.129
Days to maturity	-0.009	**0.098**	-0.001	-0.009	-0.088	-0.005	-0.015
Plant height (cm)	-0.002	0.009	**-0.001**	0.002	0.074	-0.019	0.052
Number of branches per plant	0.002	-0.0172	-0.000	**0.052**	0.001	0.657	0.112
Number of capsules per plant	0.003	-0.013	-0.001	0.001	**0.657**	0.111	0.759**
1000 seed weight (g)	0.000	-0.001	0.000	-0.001	0.173	**0.420**	0.592**

Residual effect = 0.4998

*- significance at 5% level (0.190) **- significance at 1% level (0.249)

CONCLUSION

Correlation studies indicated that number of capsules and 1000-seed weight had significant positive association with seed yield per plant. Path coefficient analysis revealed that high positive direct effect of number of capsules and 1000-seed weight with seed yield per plant Therefore, simultaneous selection for the said traits is suggested for improvement of seed yield in sesame.

REFERENCES

1. Abate M and Mekbib F. 2015. Assessment of genetic variability and character association in Ethopian low-altitude sesame (Sesamum indicum L.) genotypes. Journal of Advanced Studies in Agricultural, Biological and
2. Abate, M. 2018. Correlation and path coefficient analysis in mid-altitude sesame (Sesamum indicum L.) germplasm collection of Ethiopia. Journal of Plant Science Current Research. 2(1): 1-7.
3. Abhijatha, A., Arya, K., Madhukar, K and Srinivas, G. 2017. Evaluation of sesame (Sesamum indicum L.) genotypes to the shaded uplands of Southern region. International Journal of Current Microbiology and Applied Sciences. 6(7): 332-339.
4. Agrawal, M.M., Singh, S., Wawge, M.N., Macwana, S and Sasidharan, N. 2017. Correlation and path analysis for seed yield and yield attributing traits in sesame germplasm (Sesamum indicum L.). International Journal of Chemical Studies. 5(4): 1099-1102.
5. Bamrotiya, M.M., Patel, J.B., Ashok, M., Chetariya, C.P., Ahir, D and Kadiyara, J. 2016. Genetic variability, character association and path analysis in sesame (Sesamum indicum L.). International Journal of Agriculture Sciences. 8(54): 2912-2916.
6. Bhagwat Singh and Rjani Bisen. 2018. Association and path analysis of yield and yield attributing traits in sesame (Sesamum indicum L.). International Journal of Current Microbiology and Applied Sciences. 7(7): 4041-4048.
7. Bhagwat Singh and Rjani Bisen. 2018. Association and path analysis of yield and yield attributing traits in sesame (Sesamum indicum L.). International Journal of Current Microbiology and Applied Sciences. 7(7): 4041-4048.
8. Dewey, J.R and Lu, K.H. 1959. Correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal. 51: 515-518.
9. Divya, K., Shobha Rani, T., Kiran Babu, T and Padmaja, D. 2018. Assessment of genetic variability, heritability and genetic gain in advanced mutant breeding lines of sesame (Sesamum indicum L.). International Journal of Current Microbiology and Applied Sciences. 7(6): 1565-1574.
10. Dixit, P., & Dubey, D. K. (1984). Coheritable Variations In Lentil (*Lens Culinaris* Med.). Bionature, *4*(2), 75–77.

11. Fisher, R.A and Yates, F. 1963. Statistical tables for biological, agricultural and medical research. Oliver and Boyd, Edinberg.
12. Johnson, H.W., Robinson, H.F and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybean. Agronomy Journal. 47: 314-318.
13. Lule D, Tesfaye K, Fetene M, De Villiers S. Inheritance and association of quantitative traits in finger millet (Eleusine coracanaSubsp. Coracana) landraces collected from eastern and south eastern Africa. International journal of genetics. 2012;2(2):12-21.
14. Mansouri, S. 2016. Analysis of yield and yield components in sesame (Sesamum indicum L.). Advances in Bioresearch. 7(6): 60-64.
15. Rajitha, D. 2019. Studies on genetic divergence and characterization of sesame germplasm (Sesamum indicum L.). M.Sc. Thesis. Professor Jayashankar Telangana State Agricultural University. Rajendranagar, Hyderabad. India.
16. Sasipriya S. Correlation and path analysis for seed yield and its components in sesame (Sesamum indicumL.). Elec. J. of Pl. Breed. 2018;9(4):1594-9.DOI: 10.5958/0975-928X.2018.00199.0
17. Saxena, K and Bisen, R. 2016. Genetic variability, correlation and path analysis studies for yield and yield component traits in sesame (Sesamum indicum L.). International Journal of Agriculture Sciences. 8(61): 3487-3489.
18. Srikanth K and Ghodke M. K. Correlation and Path Analysis in Sesame (Sesamum indicumL.) Genotypes. 2022: International Journal of Plant & Soil Science34(18): 228-235
19. Teklu, D.H., Kebede, S.A. and Gebremichael, D.E. 2017. Assessment of genetic variability, genetic advance, correlation and path analysis for morphological traits in sesame genotypes. International Journal of Novel Research in Life Sciences. 4(2): 34-44.
20. Thouseem N, Arya K, Gayathri G and Anju Mariam Joseph. 2022. Genetic variability, heritability and genetic advance for seed yield and yield associated traitsin White seeded sesame (Sesamum indicum L.). The Pharma Innovation Journal 2022; 11(6): 385-388.
21. Vanishree, Lokesha, R., Diwan, J.R and Ravi, M.V. 2011. Study on character association and contribution of yield related traits to seed yield in segregating generations (F2) of sesame (Sesamum indicum L.). Electronic Journal of Plant Breeding. 2(4): 559-562.

22. Vanishree., Lokesha, R., Goudappagoudra, R and Chetankumar, N.B. 2013. Analysis of genetic variability for yield and its components in sesame (Sesamum indicum L.). International Journal of Plant Sciences. 8(1): 91-93.
23. Wright S. Correlation and causation. Journal of Agricultural Research. 1921;20: 557-585.2.Dewey DI and Lu KH. A Correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agr. Journal. 1959;51:515-518.