RESEARCH ARTICLE Indian Journal of Agricultural Research, Volume 59 Special Issue: 31-35 (November 2025)

Exploring and Understanding the Association between Yield and its Components in Sesame using Correlation Analysis

D. Umamaheswari[1], S. Suganthi[2], S. Thirumeni[3], P. Satheesh Kumar[4]

10.18805/IJARe.A-6297

ABSTRACT

Background: Sesame has the oldest history of over 5000 years of its cultivation as an indigenous oilseed crop of India. Sesame oil has excellent nutritional, medicinal and cooking quality for which it is known as queen of oil seeds. It harbors greater diversity. Hence the present study portrayed to understand the association of different component characters towards yield by studying correlation and path coefficient analysis. This study insights into the relationship between variables and helps the breeder in identifying suitable selection indices.

Methods: In this study 40 genotypes were raised in completely randomized block design with three replications in the experimental field of Pandit Jawaharlal Nehru college of Agriculture and Research Institute, Karaikal during summer, 2023. Statistical Package STAR, IRRI were used to analyze the correlation between the traits.

Result: Characters such as number of capsules per plant, number of primary branches, thousand seed weight were identified as selection criteria for improving yield in sesame genotypes as these traits recorded positive correlation as well as high positive direct effect with seed yield per plant.

Key words: Component traits, Correlation, Path, Seed yield, Sesame.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an ancient oilseed crop belonging to the family Pedaliaceae (Abdipour *et al.,* 2018; Pathak *et al.,* 2017). This family includes 31 species distributed across Africa, Southeast Asia, Melanesia and Australia (IPGRI and NBPGR, 2004; POWO, 2019). Sesame can be grown in both tropical and subtropical regions and is rich in genetic diversity. It is renowned for its high-quality seed oil and numerous nutritional health benefits, often being referred to as the “queen of oil seeds”(Sundari *et al.,* 2024). Sesame is suitable for dryland farming due to its drought tolerant nature and adaptability to high temperature (Tripathi *et al.,* 2013).

In 2018, global sesame production was recorded to be 12.22 million tons (Girmay, 2018), with Sudan, Myanmar and India being the leading producers worldwide (Tripathi *et al.,* 2023). India alone accounts for more than 40% of the world’s sesame cultivation area and 27% of its production (UNSD, 2017; FAOSTAT, 2022), with an average productivity of around 441 kg/ha. The major sesame grown areas of India are Maharashtra, Rajasthan, Odisha, Andhra Pradesh, Tamil Nadu, West Bengal, Gujarat and Karnataka (Anishetra and Kalaghatagi, 2021). Since sesame is often grown on poor and marginal lands, increasing yield appears to be essential and a challenging task for breeder. So, the primary goal of any breeding program is yield improvement. Genetically, crop yield is controlled by polygenes and is quantitative in nature, making it complex to dissect and directly enhance the yield. Therefore, the present study aims to identify and analyze the most reliable yield-attributing traits through correlation and path coefficient analysis. By partitioning traits into direct and indirect effects *via* path coefficient analysis, researchers can uncover the true relationship prevailing between the yield and its component traits. For years, plant breeders have employed correlation and path coefficient analysis as one of the valuable tools to assist in the selection process of crop improvement.

[1]Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram-608 002, Tamil Nadu, India.

[2]Department of Genetics and Plant Breeding, Agricultural College and Research Institute, Tamil Nadu Agriculture University, Thiruvannamalai-606 601, Tamil Nadu, India.

[3]Department of Genetics and Plant Breeding, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Pondicherry University, Karaikal-609 603, Tamil Nadu, India.

[4]Department of Genetics and Plant Breeding, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agriculture University, Trichy-620 001, Tamil Nadu, India.

Corresponding Author: S. Suganthi, Department of Genetics and Plant Breeding, Agricultural College and Research Institute, Tamil Nadu Agriculture University, Thiruvannamalai-606 601, Tamil Nadu, India. Email: suginandan @gmail.com
ORCID: 0000-0003-2016-9981.

How to cite this article: Umamaheswari, D., Suganthi, S., Thirumeni, S. and Kumar, P.S. (2025). Exploring and Understanding the Association between Yield and its Components in Sesame using Correlation Analysis. *Indian Journal of Agricultural Research*. **59 (Special issue):** 31-35. doi: 10.18805/IJARe.A-6297.

Submitted: 14-08-2024 **Accepted:** 22-11-2024 **Online:** 15-04-2025

MATERIALS AND METHODS

The experiment was conducted at Pandit Jawaharlal Nehru college of Agriculture and Research Institute, Karaikal during summer, 2023. Forty sesame genotypes listed in Table 1 were collected from various research institutes such as National Bureau of Plant Genetic Resources, New Delhi (36) and Regional Research Station, Virudachalam (VRI), Tamil Nadu Agricultural University (10) and Tamil Nadu Agricultural University, Coimbatore (1), Regional Agricultural Research Station, Polasa, Jagital (2) and one local type from Puducherry (PY). The experiment was laid out in completely randomized block design with three replications. These forty genotypes were raised by adopting a row spacing of 30 cm and plant spacing of 15 cm. Standard agronomy practices were adopted throughout the study. From each genotype five plants were randomly selected to record the biometrical data for the following characters *viz.*, plant height (cm), days to 50% flowering (DF), number of primary branches per plant (NPB), number of capsules per plant (NCP), days to maturity (DM), number of seeds per capsule (NSC), capsule length (CL) (cm), 1000 seed weight (TSW) (g) and seed yield per plant (SYP) (g). All these data were recorded during physiological maturity except days to fifty percent flowering which was recorded from the date of onset of flowering to the extent of fifty percent of plants started flowering. However, the number of seeds per capsule, capsule length (CL) (cm), 1000 seed weight (TSW) (g) and seed yield per plant were measured after harvest. Statistical analysis was performed using STAR package of IRRI, version 2.0.1, (2014). The correlation between the quantitative traits were estimated and also the direct and indirect effects by path coefficient analysis were studied using the method suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation coefficient analysis is a valuable tool for determining the strength of the linear relationship between yield and yield-supporting traits in sesame. The genotypic correlation coefficients of seed yield per plant with other traits are presented in Table 2. Understanding the degree of association between these traits are crucial for identifying key components in selection processes aimed at yield improvement.

Among the traits studied, the number of capsules per plant exhibited the highest significant positive correlation with single plant yield (r = 0.731, p<0.01), indicating its strong influence on yield improvement. This was followed by plant height (r = 0.605), the number of primary branches (r = 0.524), thousand seed weight (r = 0.498) and capsule length (r = 0.492). As shown in Fig 1, the correlation aligns with findings of Bharati *et al.* (2014), who reported positive correlations for the number of primary branches, thousand seed weight and the number of capsules per plant. Similarly, Vanishree *et al.* (2013) confirmed the positive correlation between the number of capsules per plant,

Table 1: Lists of genotypes and its source.

Sl. no	Genotype and source	Sl. no	Genotype and source	Sl. no	Genotype and source	Sl. no	Genotype and source
1	TMV 3 - RRS, TNAU, VRI	11	EC351890 -NBPGR, New Delhi	21	IC500851-NBPGR, New Delhi	31	EC346449 -NBPGR, New Delhi
2	TMV 4 - RRS, TNAU, VRI	12	IC43078 -NBPGR, New Delhi	22	EC358020-NBPGR, New Delhi	32	IC204090-NBPGR, New Delhi
3	TMV6 - RRS, TNAU, VRI	13	IC130065-NBPGR, New Delhi	23	IC208501-NBPGR, New Delhi	33	TMV7- RRS, TNAU, VRI
4	Darab - RRS, TNAU, VRI	14	IC306052-NBPGR, New Delhi	24	IC43195-NBPGR, New Delhi	34	BD42-RRS, TNAU, VRI
5	IC127293 - NBPGR, New Delhi	15	IC132499-NBPGR, New Delhi	25	IC42459-NBPGR, New Delhi	35	KMR17, RRS, TNAU, VRI
6	SVPR 1- RRS, TNAU, VRI	16	IC110245-NBPGR, New Delhi	26	EC346393-NBPGR, New Delhi	36	NIC16227 -RRS, TNAU, VRI
7	VRI 1- RRS, TNAU, VRI	17	EC346980-NBPGR, New Delhi	27	IC500678-NBPGR, New Delhi	37	Swetha Til -RRS, Jagital
8	IC131518 NBPGR, New Delhi	18	IC204524 -NBPGR, New Delhi	28	ICl31997-NBPGR, New Delhi	38	Rajeswari -RRS, Jagital
9	CO 1 - TNAU, Coimbatore	19	IC510990 - NBPGR, New Delhi	29	IC132255 -NBPGR, New Delhi	39	Ettupattai ellu -Puducherry
10	IC132549 - NBPGR, New Delhi	20	IC203935 -NBPGR, New Delhi	30	IC132578 -NBPGR, New Delhi	40	IC205634- NBPGR, New Delhi

thousand seed weight and capsule length, further supporting the present study's results.

The characters days to fifty percent flowering, days to maturity and number of seeds per capsule recorded non-significant positive correlation as similar to the result concluded by Kumhar *et al.* (2020). Though these characters recorded non-significant positive correlation, it is considered to be an important while selecting the lines for early maturation.

In addition to examining how other traits are directly associated with yield, studying the intercorrelation among these traits and seed yield per plant is crucial for understanding their relationship and establishing appropriate selection criteria to improve the yield. The trait plant height showed a high significant positive inter-correlation with the number of capsules per plant, followed by capsule length, thousand seed weight, days to fifty percent flowering and days to maturity as reported by Goudappagoudra *et al.* (2011) and Akbar *et al.* (2011). Interestingly, days to fifty percent flowering exhibited a significant positive inter correlation with days to maturity as reported by Roy and Pal (2019) and the number of capsules per plant, whereas non-significant negative correlation with number of seeds per capsule and seed thousand weight. This implies that days to fifty percent flowering does not influence the seed yield parameter.

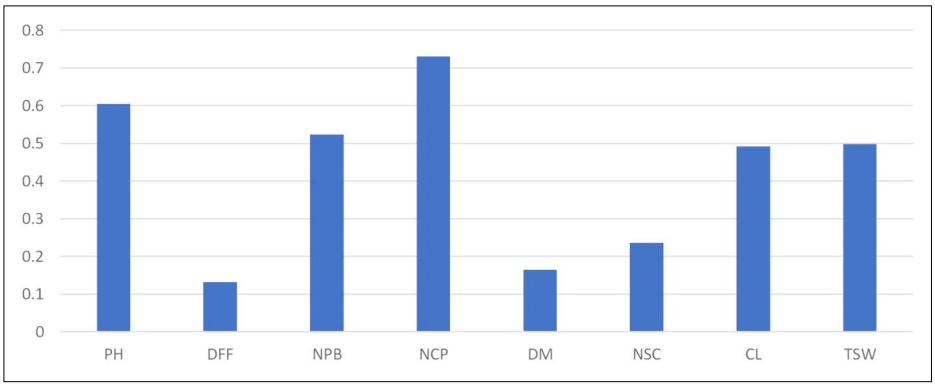


Fig 1: Association of component traits with seed yield per plant as r values.

Table 2: Correlation coefficients of seed yield per plant with other traits.

Characters	PH	DFF	NPB	NCP	DM	NSC	CL	TSW	SYP
PH	1.00	0.195	0.363	0.693**	0.192	0.108	0.426	0.350	0.605**
DFF		1.00	0.177	0.289**	0.537**	-0.029	0.002	-0.135	0.132
NPB			1.00	0.716**	0.177	0.091	0.321*	0.329**	0.524**
NCP				1.00	0.234*	0.165	0.427* *	0.343**	0.731**
DM					1.00	0.007	0.154	-0.019	0.165
NSC						1.00	0.331*	-0.315*	0.236
CL							1.00	0.365*	0.492**
TSW								1.00	0.498**
SYP									1.00

** 1% and* 5% significance respectively.

PH - Plant height, DFF - Day's to fifty percent flowering, NPB - Number of primary branches, NCP- No. of capsules per plant, DM - Days to maturity, NSC - Number of seeds per capsule, CL- Capsule length, TSW- Thousand seed weight, SYP- Seed yield per plant.

Table 3: Direct and indirect effect over seed yield per plant and other traits.

Character	PH	DFF	NPB	NCP	DM	NSC	CL	TSW	SYP
PH	0.339	0.066	0.195	0.235	0.065	0.037	0.144	0.119	0.605
DFF	-0.059	-0.285	-0.103	-0.082	0.153	0.008	-0.011	0.038	0.132
PB	0.004	0.013	0.007	0.005	0.003	0.017	0.003	0.013	0.524
NCP	0.179	0.075	0.185	0.308	0.065	0.043	0.112	0.089	0.731
DM	0.198	0.369	0.066	0.086	0.368	0.002	0.057	-0.017	0.066
NSC	0.127	-0.008	0.026	0.058	0.003	0.254	0.084	0.022	0.236
CL	0.040	0.001	0.030	0.040	0.004	0.031	0.094	0.034	0.492
TSW	0.122	0.047	0.114	0.119	-0.017	0.030	0.127	0.347	0.498

** Residual value 0.21.

Moreover, the number of primary branches was significantly positively inter correlated with the number of capsules per plant, capsule length and thousand seed weight. It also displayed a non-significant positive correlation with days to maturity. Similar observations were reported by Solanki and Gupta (2001); Vidhayavathi *et al.* (2005), confirming the association between these traits and their collective impact on yield.

Notably, the number of seeds per capsule registered a negative correlation with thousand seed weight (r = -0.215), indicating seed weight and number are not directly proportionated. Conversely, it showed a positive significant correlation with capsule length, suggesting the complex interplay between these traits.

According to Bhatt (1973) correlation analysis might not be adequate to completely explicate the strength of interactions. Hence path analysis was used in this study to delineate the direct and indirect effects of each trait towards the correlated variable. The key important traits such as plant height, thousand seed weight, number of capsules per plant recorded positive direct effect towards seed yield per plant as corroborated by Yingzhong and Yishnu (2002) and Srikanth and Ghodke (2022). The diagonal values in the Table 3 represents the positive direct effect over single plant yield. These traits should be prioritized in selection strategies for yield enhancement. In contrast, days to fifty per cent flowering demonstrated a negative direct effect on yield (path coefficient = -0.285), which is in concordance with the report of Abate and Mekbib (2015). This finding suggests that selecting for earlier flowering genotypes may not always favor yield improvement and underscores the importance of balancing flowering time with other traits.

Indirect effects reveal additional layers of complexity. Plant height, for instance, exerted a positive indirect effect on yield through its influence on the number of primary branches, the number of capsules per plant, capsule length and thousand seed weight. Fazal *et al.* (2015); Sumathi and Muralidharan (2011) reported similar interactions, highlighting the importance of considering both direct and indirect pathways in plant breeding programs.

The indirect effect of days to fifty percent flowering on seed yield, primarily mediated through days to maturity, indicated a potential interaction between these phenological traits that warrants further exploration. Meanwhile, thousand seed weight demonstrates a positive indirect effect *via* plant height, number of primary branches, number of capsules per plant and capsule length suggesting its multifaceted role in contribution to yield.

The study reported a residual effect of 0.21, indicating that 79% of the traits were included in the study to understand the component characters contributing to seed yield per plant. Overall, the combination of correlation and path analysis underscores the importance of selecting sesame genotypes with traits such as more number of capsules with increase in primary branches, thousand seed weight and plant height to enhance the yield of the crop.

CONCLUSION

Sesame is widely cultivated in marginal and poor lands with low input technologies. Increasing the productivity is the major issue for the plant breeder who desires to bring notable improvement in the yield. Hence it is worthwhile to understand the relationship of independent variables along with its magnitude on dependent trait. In this background the present study revealed the strong associations of the characters such as plant height, number of primary branches, thousand seed weight and capsule length with seed yield. Further to explore the correlated responses between variables, the cause and its effect were studied through path coefficient analysis. Some of the traits are discerned to create large impact on seed yield directly *via* plant height, number of primary branches, number of capsules per plant, capsule length and thousand seed weight and also indirectly *via* days to maturity. Thus, the characters, number of capsules per plant, plant height, number of primary branches and thousand seed weight were identified as selection criteria for improving yield in sesame genotypes, as these traits recorded positive correlation as well as high positive direct effect with seed yield.

ACKNOWLEDGEMENT

The present study was not funded by any project work. The authors sincerely thank National Bureau of Plant Genetic Resources (NBPGR) New Delhi, Regional Agriculture Research Station (RRS) Jagital and Regional Research Station (RRS) Virudachalam, Tamil Nadu Agricultural University (TNAU), for providing the seed materials to conduct the experiment.

Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal Care and Handling Techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

REFERENCES

Abate, M. and Mekbib, F. (2015). Study on genetic divergence in low-altitude sesame (*Sesamum indicum L.*) germplasm of Ethiopia based on agro-morphological traits. *Journal of Advanced Studies in Agricultural, Biological and Environmental Sciences*. **2:** 78-90.

Abdipour, M., Ramazani, S.H.R., Younessi Hmazekhanlu, M. and Niazian, M. (2018). Modeling oil content of sesame (*Sesamum indicum* L.) using artificial neural network and multiple linear regression approaches. *Journal of the American Oil Chemists Society*. **95:** 283-297.

Akbar, F., Rabbani, M.A., Shinwari, Z.K. and Khan, S.J. (2011). Genetic divergence in sesame (*Sesamum indicum* L.) landraces based on qualitative and quantitative traits. *Pakistan Journal of Botany*. **43:** 2737-2744.

Anishetra, S. and Kalaghatagi, S.B. (2021). Evaluation of sesame (*Sesamum indicum* L.) based intercropping systems with millets by varying row proportions under dry condition. *Indian Journal of Agricultural Research*. **55:** 501-504. doi: 10.18805/IJARe.A-5596.

Bharathi, D., Venkanna, V. and Bhadru, D. (2014). Genetic variability in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*. **3:** 692-694.

Bhatt, G.M. (1973). Path coefficient analysis in determining the nature of character association. *Euphytica*. **22:** 383-393.

Dewey, D.H. and Lu, K.H. (1959). A correlation and path-coefficient analysis of components of crested wheat grass seed production. *Agronomy Journal*. **51:** 515-518.

Goudappagoudra, R., Lokesha, R. and Ranganatha, A.R.G. (2011). Trait association and path coefficient analysis for yield and yield attributing traits in sesame (*Sesamum indicum* L.) *Electronic Journal of Plant Breeding*. **2:** 448-452.

Kumhar, S., Kumari, B. and Sirohi, S. (2020). Correlation and path coefficient analysis of seed yield and yield related characters in sesame (*Sesamum indicum* L.): *Journal of Oilseeds Research*. **37**. doi: org/10.56739/jor.v37i1.136393.

Fazal, A., Mustafa, H.S.B., Hasan, E.U., Anwar, M., Tahir, M.H.N. and Sadaqat, H.A. (2015). Interrelationship and path coefficient analysis among yield and yield-related traits in sesame (*Sesamum indicum* L.). *Nature and Science.* **13:** 27-32.

Food and Agriculture Organization of the United Nations statistics Division. FAOSTAT (2022). Production crops and livestock products. https://www.fao.org/faostat.

Girmay, A.B. (2018). Sesame production, challenges and opportunities in ethiopia. *Agricultural Research and Technology: Open Access Journal.* **15(5):** 555972. doi: 10.19080/ARTOAJ. 2018.15.555972.

International Plant Genetic Resources Institute (IPGRI) and National Bureau of Plant Genetic Resources (NBPGR) (2004). Descriptors for Sesame (*Sesamum* spp.). IPGRI, Rome, Italy.

Pathak, K., Rahman, S.W., Bhagawati, S. and Gogoi, B. (2017). Sesame (*Sesamum indicum* L.), an underexploited oil seed crop: Current status, features and importance - A review. *Agricultural Reviews*. **38(3):** 223-227. doi: 10.18805 /ag.v38i03.8982.

POWO (2019). Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. http://www.plants of the world online.org.

Roy, B. and Pal, A.K. (2019) Selection criteria of some advance lines of sesame by the study of correlation and path coefficient analysis. *Plant Science Today*. **6:** 356-359.

Solanki, Z.S. and Gupta, D. (2001). Variability and correlation studies for seed yield and its components in sesame. *Annals of Plant and Soil Research*. **3:** 256-259.

Srikanth, K. and Ghodke, M.K. (2022). Correlation and path analysis in sesame (*Sesamum Indicum* L.) genotypes. *International Journal of Plant and Soil Science*. **34:** 228-35. doi.org/ 10.9734/ijpss/2022/v34i1831075.

Sundari, K.S., Vasline, Y.A. and Saravanan, K. (2024). Choice of traits for seed yield improvement based on association analysis studies in sesame (*Sesamum indicum* L.). *Agricultural Science Digest*. **44(4):** 701-707. doi: 10.18805/ag. D-5641.

Sumathi, P. and Muralitharan, V. (2011). Analysis of genetic variability, association and path analysis in the hybrids of sesame (*Sesamum indicum* L.). *Tropical Agricultural Research and Extension*. **13:** 63-67.

STAR, version 2.0.1 (2014). Biometrics and Breeding Informatics, PBGB Division, International Rice Research Institute. Los Banos, Laguna.

Tripathi, A., Bisen, R., Ravindra, P., Paroha, A.S., Sahu, R. and Ranganatha, A.R.G. (2013). Study on genetic divergence in sesame (*Sesamum indicum* L.) germplasm based on morphological and quality traits. *An International Quarterly Journal of Life Sciences*. **8:** 1387-1391.

Tripathi, S., Kalia, A., Mishra, B.P., Mishra, S., Mishra, D. and Shukla, G. (2023). Trends in area, production and productivity of sesame in Bundelkhand region of Uttar Pradesh. *Indian Journal of Extension Education*. **59:** 40-43. doi: 10.48165/ IJEE.2023.59408.

United Nations Statistics Division (UNSD). 2017. UNdata. Available at:http://data.un.org/Data. aspx?d =FAOandf= item Code %3A289.

Vanishree, R., 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:** 91-93.

Vidhyavathi, R., Manivannan, N. and Muralidharan, V. (2005). Association studies in sesame (*Sesamum indicum* L.). *Agricultural Science Digest*. **25:** 131-132.

Yingzhong, Z. and Yishou, W. (2002). Genotypic correlation and path coefficient analysis in sesame. *Sesame and Safflower Newsletter*. **17:** 10-12.