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Research Article

Assessment of genetic variability, character association and path analysis in F_2 population of sesame (*Sesamum indicum L.*)

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Abstract

The present study was carried out in the F_2 population of the cross OMT 21 A × JLSC 96 of sesame with the objective to assess the genetic variability, character association of yield and yield related traits in sesame. Experimental materials were raised during *Kharif* season of 2019 at Tamil Nadu Agricultural University, Coimbatore. Seven biometrical traits *viz*., days to first flowering, plant height, the number of branches per plant, the number of capsules per plant, the number of seeds per capsule, 1000 seed weight and yield per plant were recorded. The magnitude of PCV and GCV values were higher for the traits yield per plant, the number of branches per plant and the number of capsules per plant. The traits number of branches per plant and 1000 seed weight exhibited a high heritability along with a high genetic advance as per cent of mean. Yield per plant had a significant positive correlation with the number of capsules per plant followed by 1000 seed weight, plant height and the number of branches per plant. Path analysis revealed that the number of capsules per plant had a high positive direct effect on yield per plant. So, the selection based on these traits such as number of capsules per plant, plant height, 1000 seed weight and the number of branches per plant would be advantageous for crop improvement.

Keywords

Sesame, genetic variability, correlation, path analysis, yield and its related traits

INTRODUCTION

Sesame (*Sesamum indicum* L.) is considered as one of the ancient oilseed crops extensively cultivated in Asia and Africa. Sesame is also known as "Queen of Oilseeds" because of its high amount of quality oil. Seeds of sesame have 50% oil, 23% protein and 15% carbohydrate (Ranganatha *et al.* 2012). Sesame oil has a long shelf life due to the presence of lignans such as sesamin, sesamolin, sesamol and sesaminol. Antioxidant property of these compounds prevents oxidative rancidation of oil. Other than these some other beneficial compounds like tocopherol, phytates, phytosterols and some micronutrients are also present (Bedigian, 2004). Sesame crop is fairly tolerant to drought, suitable for well-drained soils and can be cultivated in various agro-climatic regions. But sesame yield gets badly affected by continuous flooding and high drought (Mensah *et al.* 2006). Though it occupies the most important place among oilseeds, its productivity has been less compared to that of other oilseed crops. The major problems in sesame cultivation are non-synchronous maturity, narrow adaptability, yield instability, seed shattering, non-availability of high yielding varieties with resistance to stresses and the presence of fertilization barriers *etc*. (Rao *et al.* 2002).

Knowledge of existing genetic variability helps in the selection of superior plants and hence it is essential to assess the existing genetic variability before starting any breeding programme. Variability assessment forms the basis of any crop improvement programme. Also success of any breeding programme relies on the genetic variability present in the germplasm. Yield is a complex trait which depends on the action and interaction of various independent yield-related traits, which are positively or negatively associated with yield and among themselves.

Knowledge of strength and direction of the relationship between yield and yield-related traits is essential for an effective selection in breeding programmes and it can be measured by correlation analysis. It helps in determining the critical component trait of yield. Path analysis is standardized partial regression analysis, which further allows the splitting of correlation coefficient into components of direct and indirect effects of yield contributing traits on yield. Consequently, a correlation analysis along with the path analysis is more successful in the study of yield attributing traits. Hence, the present study was carried out to assess the variability parameters, character association and path analysis in F_2 population of the cross OMT 21 A × JLSC 96 of sesame.

MATERIALS AND METHODS

The experimental materials for the present study included F_2 population of the cross OMT 21A × JLSC 96 and its parents. The seeds of experimental materials were obtained from Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore. The experiment was conducted in Oilseeds farm at TNAU, Coimbatore during *Kharif* season of 2019. All the cultural practices like irrigation, thinning, weeding was done at the proper stage of the crop. Data were recorded from all the plants in F_2 population of the cross OMT 21A × JLSC 96 and five randomly selected plants in parents on days to first flowering, plant height, the number of branches per plant, the number of capsules per plant, the number of seeds per capsule, 1000 seed weight and yield per plant.

According to Goulden (1952), the variance existing in F_2 population is considered as phenotypic variance, whereas the variance existing in parents is considered as the environmental variance. Genotypic variance is calculated by subtracting the environmental variance from the phenotypic variance. PCV and GCV were computed based on the methods given by Burton (1952) and classified as suggested by Sivasubramanian and Madhavamenon (1973). Heritability and genetic advance were calculated by the formula used by Lush (1949) and Johnson *et al*. (1955) respectively. Correlation coefficients were calculated according to the formula recommended by Goulden (1952). Path coefficients were estimated as per the methods given by Dewey and Lu (1959). The estimates of correlation coefficient and path coefficient analysis were calculated by analyzing data using TNAUSTAT statistical package.

RESULTS AND DISCUSSION

Presence of variability was confirmed through a range of variation for each character in F_2 population. The range of variation for plant height was 39.2 to 110.5 cm. Likewise, the characters days to first flowering (43 to 51 days), the number of branches per plant (0 to 11), the number of capsules per plant (17 to 133), the number of seeds per capsule (32 to 72), 1000 seed weight (1.1 to 3.1g) and yield per plant (0.93 to 14.55g) also showed adequate variation in F_2 population.

Table 1. Estimates of GCV, PCV, heritability and genetic advance in F_2 population of the cross OMT 21 A × JLSC 96 of Sesame

Characters	Mean	Range	PCV (%)	GCV (%)	Heritability (h^2)	Heritability (%)	GA as per cent of mean (%)
Days to first flowering (Days)	47.508	43-51	4.859	3.035	0.390	39.016	3.906
Plant height (cm)	76.183	39.2-110.5	17.334	12.061	0.484	48.411	17.287
No. of branches per plant	4.54	0-11	43.417	40.835	0.884	88.457	79.116
No. of capsules per plant	34.310	17-133	45.934	32.681	0.506	50.619	47.898
No. of seeds per capsule	51.794	32-72	14.527	11.448	0.621	62.108	18.586
1000 seed weight (g)	2.047	1.1-3.1	17.836	14.721	0.681	68.113	25.027
Yield per plant (g)	2.747	0.93-14.55	68.969	45.683	0.439	43.873	62.333

Higher PCV and GCV values were observed for the traits yield per plant, the number of branches per plant and the number of capsules per plant (Table 1). Similar results had been reported by Kalaiyarasi *et al.* (2019 a.), Sumathi and Muralidharan (2010), Bharathi *et al.* (2014) and Gogoi and Sarma (2019). High PCV and GCV were also reported by Parameshwarappa *et al.* (2009), Gidey *et al.* (2013), Patil and Lokesha (2018) and Sudhakar *et al.* (2007) for yield per plant, Parameshwarappa *et al.* (2009), Gidey *et al.* (2013) and Dash *et al.* (2018) for the number of capsules per plant and Sudhakar *et al.* (2007) for the number of branches per plant. It indicated that these traits had a greater diversity. Hence, the selection for these characters would be effective in crop improvement.

The traits plant height, the number of seeds per capsule and 1000 seed weight showed moderate PCV and GCV estimates. The magnitude of PCV and GCV values were low for the trait days to first flowering. Therefore, these characters have a less scope for the improvement through selection.

In the present study, high heritability was noticed for the trait number of branches per plant followed by 1000 seed weight and the number of seeds per capsule (Table 1). Kalaiyarasi *et al.* (2019 a.) and Patil and Lokesha (2018) also reported the same. Bharathi *et al.* (2014) and Sumathi and Muralidharan (2010) reported a high heritability for the number of seeds per capsule. Hence, the direct

Table 2. Correlation analysis for yield and yield related traits in F_2 population of the cross OMT 21 A × JLSC 96 of Sesame

Characters	Days to first flowering	Plant height	No. of branches per plant	No. of capsules per plant	No. of seeds per capsule	1000 seed weight	Yield per plant
Days to first flowering	1.000	-0.0731	0.0051	-0.2054*	0.0184	-0.0979	-0.2057*
Plant height		1.000	0.5529**	0.3680**	0.3179**	0.3182**	0.4642**
No. of branches per plant			1.000	0.3075**	0.2950**	0.1538	0.3720**
No. of capsules per plant				1.000	-0.0768	0.2643**	0.9052**
No. of seeds per capsule					1.000	0.0905	0.1244
1000 seed weight						1.000	0.4694**
Yield per plant							1.000

*Correlation is significant at the 0.05 level
**Correlation is significant at the 0.01 level

selection of these traits would give the best results in crop improvement. Heritability estimates would be reliable if accompanied by a high estimated genetic advance. High heritability combined with high genetic advance as per cent of mean was recorded for the number of branches per plant (Bharathi *et al.* 2014, Kalaiyarasi *et al*, 2019 a. and Patil and Lokesha, 2018) and 1000 seed weight (Kalaiyarasi *et al*. 2019 a., Gogoi and Sarma, 2019, Patil and Lokesha, 2018, Gidey *et al.* 2013*)* indicating that these traits were governed by an additive gene action and have better scope for crop improvement. The traits such as the number of capsules per plant and yield per plant exhibited moderate heritability along with high genetic advance.

The phenotypic correlation coefficient was estimated to assess the strength and direction of the relationship between yield and yield contributing traits. The present study revealed that the yield per plant had a highly significant positive correlation with the number of capsules per plant (Singh and Bisen, 2018 and Lalpantluangi and Shah, 2018) followed by 1000 seed weight (Lalpantluangi and Shah, 2018), plant height (Kalaiyarasi *et al*, 2019 b.) and the number of branches per plant (Singh and Bisen, 2018) which indicated that these characters were vital yield components (Table 2). Patil and Lokesha (2018) and Sumathi and Muralidharan (2010) reported that the number of capsules per plant, the number of branches per plant, plant height and 1000 seed weight had a significant positive correlation with yield. Days to first flowering possessed a significant negative correlation with yield per plant. Inter correlation among these traits showed that days to first flowering had a highly significant negative correlation with the number of capsules per plant. From the above discussion, it might be concluded that an intense selection of the number of capsules per plant, 1000 seed weight, plant height and the number of branches per plant in a positive manner might increase the yield.

Table 3. Path coefficient analysis of yield and yield related traits in F_2 population of the cross OMT 21 A × JLSC 96 of Sesame

Characters	Days to first flowering	Plant height	No. of branches per plant	No. of capsules per plant	No. of seeds per capsule	1000 seed weight	Yield per plant
Days to first flowering	**-0.0125**	-0.0016	0.0001	-0.1729	0.0029	-0.0217	-0.2057
Plant height	0.0009	**0.0218**	0.0117	0.3097	0.0496	0.0705	0.4642
No. of branches per plant	-0.0001	0.0121	**0.0211**	0.2588	0.0460	0.0341	0.3720
No. of capsules per plant	0.0026	0.0080	0.0065	**0.8416**	-0.0120	0.0585	0.9052
No. of seeds per capsule	-0.0002	0.0069	0.0062	-0.0646	**0.1560**	0.0200	0.1244
1000 seed weight	0.0012	0.0069	0.0033	0.2224	0.0141	**0.2214**	0.4694

Residual effect = 0.3070
Note: Diagonal bold figure are the direct effects and the off diagonal are indirect effects.

Path analysis revealed that the number of capsules per plant had a high positive direct effect on yield per plant. The traits *viz*., plant height, the number of branches per plant, the number of seeds per capsule and 1000 seed weight also exerted positive direct effect on seed yield per plant (Table 3). High positive direct effect on yield per plant was reported by Singh and Bisen (2018) for the number of capsules per plant; Sumathi and Muralidharan (2010)

for the number of capsules per plant, plant height and 100 seed weight and Gogoi and Sarma (2019) for 1000 seed weight. Therefore, these traits might be considered as principal traits while selecting the plant for seed yield.
Thus, from the above study, the traits *viz.,* the number of capsules per plant, plant height, 1000 seed weight and the number of branches per plant had a positive direct association and significant positive correlation with the yield per plant. Therefore, the selection of these traits would be advantageous for the improvement of yield in sesame.

REFERENCES

Bedigian, D. 2004. History and lore of sesame in Southwest Asia. *Economic botany*, **58**(3): 329-353. [Cross Ref]

Bharathi, D. Rao, T.V. Mohan, C. Bhadru, D. and Venkanna, V. 2014. Genetic variability studies in sesame (*Sesamum indicum L.). Int. J. of App. Bio. and Pharma. Tech.*, **5**(4): 31-33.

Burton, G.W. 1952. Quantitative inheritance of grasses. Proceedings of 6th International Grassland Congress, **1**: 227-283.

Dash, M. Imran, M. Kabi, M. Baisakh, B. and Lenka, D. 2018. Assessment of genetic variability for capsule shattering characters in Indian sesame. *Elec. J. of Pl. Breed.*, **9**(2): 490-501. [Cross Ref]

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J., **51**: 515-518. [Cross Ref]

Gidey, Y.T. Kebede, S.A. and Gashawbeza, G.T. 2013. Assessment of genetic variability, genetic advance, correlation and path analysis for morphological traits in sesame genotypes. *Int. J. of Plnt. Breed. and Genet.*, **7**(1): 21-34. [Cross Ref]

Gogoi, L.R. and Sarma, R.N. (2019). Variability and Path Coefficient Analysis in Sesame (*Sesamum indicum* L.). *Int. J. Curr. Microbiol. App. Sci.*, **8**(7): 229-237. [Cross Ref]

Goulden, C.H. 1952. Methods of Statistical Analysis. John Wiley and sons, New York.

Johnson, H.W. Robinson, H.F. and Comstock, R.E. 1955. Estimates of genetic and environmental variability in soybeans. Agr. J., **47**: 314-318. [Cross Ref]

Kalaiyarasi, R. Venmuhil, R. Malaiarasi, M. Dinesh, S. and Abinaya, N. 2019 a. Genetic Variability, Heritability and Genetic Advance in Sesame (*Sesamum indicum* L) Genotypes. *Int. J. Curr. Microbiol. App. Sci.*, **8**(7): 1976-1983. [Cross Ref]

Kalaiyarasi, R. Rajasekar, R. Lokeshkumar, K. Priyadharshini, A. and Mohanraj, M. 2019 b. Correlation and Path Analysis for Yield and Yield Traits in Sesame (*Sesamum indicum* L.) Genotypes. *Int. J. Curr. Microbiol. App. Sci.*, **8(**11): 1251-1257. [Cross Ref]

Lalpantluangi, P.C. and Shah, P. 2018. Character association and path coefficient analysis in sesame (*Sesamum indicum* L.) genotypes under foothill condition of Nagaland. *The Pharma Innvn.*, **7**(5): p.82.

Lush, J.L. 1949. Heritability Of Quantitative Characters In Farm Animals. Proc. VIJ. Int. Congo Genet. Suppl. Heriditas, **36**: 356-375. [Cross Ref]

Mensah, J.K. Obadoni, B.O. Eruotor, P.G. and Onome-Irieguna, F. 2006. Simulated flooding and drought effects on germination, growth, and yield parameters of sesame (*Sesamum indicum* L.). *Afri. J. of Biotech.*, **5**(13): 1249-1253

Parameshwarappa, S.G. Palakshappa, M.G. Salimath, P.M. and Parameshwarappa, K.G. 2009. Studies on genetic variability and character association in germplasm collection of sesame (*Sesamum indicum* L.). *Karnataka J. of Agri. Sci.*, **22**(2): 252-254.

Patil, M.K. and Lokesha, R. 2018. Estimation of genetic variability, heritability, genetic advance, correlations and path analysis in advanced mutant breeding lines of sesame (*Sesamum indicum* L.). *J. Pharmacogn. Nat. Prod.*, **4**: 1-4. [Cross Ref]

Ranganatha, A.R.G. Lokesha, R. Tripathi, A. Tabassum, A. Paroha, S. and Shrivastava, M.K. 2012. Sesame Improvement-Present Status and Future Strategies. *J. of Oilseeds Research*, **29**: 1-26.

Rao, K.R. Kishor, P.K. and Vaidyanath, K. 2002. Biotechnology of sesame-an oil seed crop. *Plant Cell Biotech. and Mol. Bio.*, **3**(3-4): 101-110.

Singh, B. and Bisen, R. 2018. Association and Path Analysis of Yield and Yield Attributing Traits in Sesame (*Sesamum indicum* L.). *Int. J. Curr. Microbiol. App. Sci.*, **7**(7): 4041-4048. [Cross Ref]

Sivasubramanian, S. and Madhavamenon, P. 1973. Genotypic and phenotypic variability in rice. *Madras Agric. J.*, **60**(9-13): 1093-1096.

Sudhakar, N. Sridevi, O. and Salimath, P.M. 2007. Variability and character association analysis in sesame, *Sesamum indicum* L. *J. of Oilseeds Research*, **24**(1): 56-58.

Sumathi, P. and Muralidharan, V. 2010. Inheritance of branching and important biometrical traits in sesame (*Sesamum indicum* L). Indian J. Genet., **70**: 97-101.