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RESEARCH PAPER

Genetic correlation and path coefficient analysis studies in advanced breeding lines of sesame (*Sesamum indicum* L.)

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Abstract: A total of thirty-four advanced breeding lines of sesame were evaluated in a randomized block design with two replications for fifteen traits during summer 2022 along with four checks *viz.,* DS-5, DSS-9, JTS-8, TKG-22 to study the genetic correlation and path analysis for yield and its component traits in sesame. Character association studies revealed that seed yield exhibited highly significant positive association with number of capsules on main stem, oil content and yield per plant at phenotypic level, where as significant negative association with days to fifty per cent flowering and days to maturity. These characteristics were used as selection criteria for higher yield. However, there was a negative significant association between oil content with days to 50 per cent flowering and days to maturity. Number of productive capsules per plant exhibited highly significant positive association with number of primary branches per plant, number of secondary branches per plant and number of productive branches per plant. The path coefficient analysis exhibited that seed yield per plant had highest direct effect on seed yield.The traits *viz.* number of productive capsules per plant followed by days to maturity, number of secondary branches per plant, days to fifty per cent flowering, internodal lengthand capsule length showed negative direct effect on seed yield. As a result, direct selection for this trait would be successful.

Key words: Correlation coefficient, Path analysis, Seed yield, Seed yield per plant, Thousand seed weight

Introduction

Sesame (*Sesamum indicum* L.) is a member of the Pedaliaceae family and is one of the most ancient oil seed crops. The species deserves its reputation as "queen of the oil seeds" due to its resistance to oxidative deterioration and a high, unsaturated fatty acid content of nearly 85 %. In addition, polyunsaturated fatty acids constitute more than half of the unsaturated fatty acid fraction in seeds. The excellent stability of sesame oil is attributed to the presence of antioxidant lignans such as sesamin, sesamolin and sesaminol. Seeds contain 44-57 per cent oil, 18-25 per cent protein, 13-14 per cent carbohydrate. Its worldwide production ranks fifth among annual oil seed crops and eighth among all consumable oil crops (Wongyai, 2007). The health benefits of these compounds include - antioxidant, antiaging, antihy pertensive, anticancer, cholesterol lowering and anti mutagenic properties (Anila kumar *et al*., 2010). India holds a premier position in the global oilseed's scenario accounting for 29 per cent of the total area and 26 per cent of production. Sesame has up surged as a silver line with a contribution of about 40 per cent to export earning among the edible oil seeds of the country (FAOSTAT, 2020).

The success of crop improvement programme depends on the selection of parents having high variability, so that desired character combination may be selected to enhance the yield. Yield is a complex quantitative trait, greatly influenced by environmental fluctuations. Hence, selection based on yield performance alone may give a biased result and leads to ambiguity. A study of nature and degree of association of component characters with yield assumes greater importance for fixing up characters that play a decisive role in influencing yield. Selection would be more effective, if it is based on component characters rather than directly on yield. The study of correlation and path analysis concept reveals different ways in which component attributes influence complex traits, revealing clear information of contribution of each trait to the final expression of the character. The information on strength and direction of association of component characters with seed yield and also inter association among them would be very useful in formulating an effective breeding programme for improvement of seed yield. Simple correlation will not provide any reliable basis for selection themselves, so partitioning it into direct and indirect components through path analysis becomes essential. Keeping in view of the above, the present investigation was undertaken to gather the information on character association, direct and indirect effect of component characters on yield of sesame.

Material and methods

The experiment was conducted during summer 2022 at AICRP on Sesame and Niger, Main Agricultural Research Station, UAS, Dharwad with the thirty-four advanced breeding lines (F_6 generation) derived from cross DS-5 × RMT-496 along with checks *viz.,* DS-5 and DSS-9 as local check, JTS-8 as zonal check and TKG-22 as national check (Table 1) were evaluated in randomized complete block design with two replications. Each breeding lines were sown two rows each in 3- meter bed by providing 60 × 7.5 cm spacing. Recommended agronomic and plant protection measures were adopted to conduct the experiment. Five random plants per genotype per replication were sampled for recording observations and their mean values were used. Phenotypic correlation coefficients were calculated as suggested by Burton and Devane (1953). Path coefficient analysis was done as suggested by Dewey and Lu (1959).

Results and discussion

Sesame has clearly out-performed other edible oilseed crops due to its greater adaptability to different agro-climatic conditions, higher oil production per unit area and short duration. All the breeding efforts so far have been targeted towards enhancing sesame production either by increasing the production or by increasing oil content.

In the present investigation, thirty-four genotypes of sesame were evaluated to assess their genetic potential. Correlation coefficient analysis measures the mutual relationship between various characters and is used to determine the component character on which selection can be done for improvement in yield. Seed yield exhibited significant positive association with number of capsules on main stem, oil content and seed yield per plant suggesting that the selection for these traits would be effective (Table 2). The results are supported by the findings of previous researchers *viz.,* Singh *et al.* (2000), Ibrahim and Khidir (2012), Lal *et al.* (2016) and Saravanan *et al.* (2020). There were significant negative associations between days to 50 per cent flowering and days to maturity with seed yield and the results are supported by the findings of Navaneetha *et al.* (2019), Saravanan *et al.* (2020) and Sasipriya *et al.* (2022). Association of oil content was significantly positive with capsule length and internodal lengthand is in confirmation with results of Sumathi and Muralidharan (2010) and Saravanan *et al.* (2020). The negative significant association betweenoil content with days to 50 per cent flowering and days to maturity was recorded in sesame genotypes. Similar results were reported by Kindeya (2017) and Kehie *et al.* (2020).

Table 1. List of advanced breeding lines of sesame of cross DS-5 × RMT-496

Genotypes	Genotypes
(DS-5 × RMT-496)-1-1-1-1	(DS-5 × RMT-496)-3-2-1-2
(DS-5 × RMT-496)-1-1-1-2	(DS-5 × RMT-496)-3-2-3-1
(DS-5 × RMT-496)-1-1-1-3	(DS-5 × RMT-496)-3-2-3-2
(DS-5 × RMT-496)-1-2-1-1	(DS-5 × RMT-496)-3-2-3-3
(DS-5 × RMT-496)-1-2-1-2	(DS-5 × RMT-496)-3-3-1-1
(DS-5 × RMT-496)-1-3-1-1	(DS-5 × RMT-496)-3-3-1-2
(DS-5 × RMT-496)-1-3-1-2	(DS-5 × RMT-496)-3-3-1-3
(DS-5 × RMT-496)-1-3-1-3	(DS-5 × RMT-496)-3-3-2-1
(DS-5 × RMT-496)-1-3-3-1	(DS-5 × RMT-496)-3-3-2-2
(DS-5 × RMT-496)-1-3-3-2	(DS-5 × RMT-496)-3-3-3-1
(DS-5 × RMT-496)-1-3-3-3	(DS-5 × RMT-496)-3-3-3-2
(DS-5 × RMT-496)-3-1-1-1	(DS-5 × RMT-496)-3-3-3-3
(DS-5 × RMT-496)-3-1-1-2	(DS-5 × RMT-496)-3-3-4-1
(DS-5 × RMT-496)-3-1-1-3	(DS-5 × RMT-496)-3-3-4-2
(DS-5 × RMT-496)-3-1-2-1	(DS-5 × RMT-496)-3-3-4-3
(DS-5 × RMT-496)-3-1-2-2	DS-5 (local check)
(DS-5 × RMT-496)-3-1-3-1	DSS-9 (local check)
(DS-5 × RMT-496)-3-1-3-2	JTS-8 (zonal check)
(DS-5 × RMT-496)-3-2-1-1	TKG-22 (national check)

However, days to 50 per cent flowering exhibited highly significant positive association with days to maturity. These results are in consonance with the results of Sumathi and Muralidharan (2010), Ibrahim and Khidir (2012), Kindeya (2017) and Kehie *et al.* (2020).There was negative significant correlation of thousand seed weight with plant height. Similar results were reported by. Number of productive capsules per plant exhibited highly significant positive association with number of primary branches per plant, number of secondary branches per plant and number of productive branches per plant.Similar results findings by Sumathi and Muralidharan (2010), Ibrahim and Khidir (2012) and Kindeya (2017).

Consequently, a correlation analysis along with the path analysis is more successful in the study of yield attributing traits.The path coefficient analysis can provide a more realistic picture of relationships between these traits, as it takes into consideration direct as well as indirect effects of the different yield component traits. Seed yield per plant had highest positive

Table 2.Phenotypic correlation coefficient for fifteen quantitative traits in advanced breeding lines of sesame cross DS-5 × RMT-496

	DM	PH	NPB	NSB	NPBP	NPCP	NCMS	CL	NSPC	INL	TSW	OC	YPP	SY
DFF	0.490**	0.172	-0.016	0.256*	-0.084	-0.033	-0.225	-0.036	0.041	-0.229*	0.070	-0.310**	-0.261*	-0.366**
DM		-0.010	0.161	-0.033	0.131	-0.046	-0.296**	0.073	-0.119	-0.078	0.056	-0.260*	-0.115	-0.309**
PH			0.029	-0.220	0.093	0.017	0.140	0.016	-0.079	0.252*	-0.231*	0.185	-0.202	0.074
NPB				0.349**	0.648**	0.416**	-0.003	0.206	-0.131	-0.097	0.089	-0.152	0.259*	0.105
NSB					0.275*	0.364**	0.086	-0.056	-0.160	-0.271*	-0.012	-0.124	0.235*	0.068
NPBP						0.409**	0.111	0.261*	-0.068	-0.034	0.025	-0.100	0.290*	0.199
NPCP							0.436**	0.071	-0.084	-0.357**	-0.130	-0.003	0.401**	0.059
NCMS								0.100	0.112	-0.054	-0.161	0.140	0.244*	0.238*
CL									0.114	0.027	0.107	0.262*	0.118	0.128
NSPC										-0.113	-0.087	-0.204	0.055	0.216
INL											0.207	0.232*	0.037	0.142
TSW												0.132	0.089	0.062
OC													0.162	0.311**
YPP														0.576**

*- Significant at 5 % probability level **- Significant at 1 % probability level

DFF-Days to 50 % flowering; DM- Days to maturity; PH: Plant height (cm); NPB- Number of primary branches; NSB- Number of secondary branches; NPBP- Number of productive branches per plant; NPCP- Number of productive capsules per plant; NCMS- Number of capsules on main stem; CL- Capsule length (cm); NSPC- Number of seed per capsule; INL- Internodal length (cm); TSW-Thousand seed weight (g); OC-Oil content (%); YPP- Yield per plant (g); SY- Seed yield (kg/ha).

Table 3.Phenotypic path coefficient analysis for seed yield in advanced breeding lines of sesame cross DS-5 × RMT-496

	DFF	DM	PH	NPB	NSB	NPBP	NPCP	NCMS	CL	NSPC	INL	TSW	OC	YPP	SY
DFF	-0.136	-0.053	-0.022	0.010	0.017	-0.001	0.009	-0.019	0.002	0.007	0.024	0.002	-0.058	-0.148	-0.366**
DM	-0.043	-0.168	-0.001	0.018	0.005	0.022	0.013	-0.025	-0.005	-0.021	0.008	0.002	-0.049	-0.065	-0.309**
PH	0.026	0.001	0.115	0.003	0.036	0.015	-0.004	0.012	-0.001	-0.014	-0.027	-0.008	0.034	-0.115	0.074
NPB	-0.012	-0.027	0.003	0.117	-0.057	0.109	-0.121	0.000	-0.014	-0.024	0.010	0.003	-0.028	0.147	0.105
NSB	0.014	0.005	-0.025	0.040	-0.164	0.046	-0.106	0.075	0.003	-0.029	0.029	0.000	-0.023	0.201	0.068
NPBP	0.001	-0.022	0.010	0.075	-0.045	0.168	-0.119	0.009	-0.018	-0.012	0.003	0.000	-0.018	0.164	0.199
NPCP	0.004	0.007	0.001	0.048	-0.059	0.068	-0.291	0.037	-0.004	-0.015	0.038	-0.004	0.000	0.227	0.059
NCMS	0.030	0.049	0.016	0.000	-0.014	0.018	-0.127	0.086	-0.007	0.020	0.005	-0.005	0.026	0.138	0.238*
CL	0.004	-0.012	0.001	0.024	0.009	0.043	-0.020	0.008	-0.070	0.020	-0.002	0.003	0.049	0.067	0.128
NSPC	-0.005	0.019	-0.009	-0.015	0.026	-0.011	0.024	0.009	-0.008	0.182	0.012	-0.003	-0.038	0.031	0.216
INL	0.031	0.013	0.029	-0.011	0.044	-0.005	0.103	-0.004	-0.001	-0.020	-0.108	0.007	0.043	0.021	0.142
TSW	-0.009	-0.009	-0.026	0.010	0.001	0.004	0.038	-0.013	-0.007	-0.015	-0.022	0.037	0.024	0.050	0.062
OC	0.042	0.043	0.021	-0.017	0.020	-0.016	0.000	0.012	-0.018	-0.037	-0.025	0.004	0.188	0.092	0.311**
YPP	0.035	0.019	-0.023	0.030	-0.038	0.048	-0.116	0.021	-0.008	0.010	-0.004	0.003	0.030	0.568	0.576**

DFF-Days to 50 % flowering; DM- Days to maturity; PH: Plant height (cm); NPB- Number of primary branches; NSB- Number of secondary branches; NPBP- Number of productive branches per plant; NPCP- Number of productive capsules per plant; NCMS- Number of capsules on main stem; CL- Capsule length (cm); NSPC- Number of seed per capsule; INL- Internodal length (cm); TSW-Thousand seed weight (g); OC-Oil content (%); YPP- Yield per plant (g); SY- Seed yield (kg/ha).

direct effect on seed yield followed by oil content, number of seed per capsule, number of productive branches per plant, number of primary branches, plant height, number of capsules on main stem and thousand seed weight (Table 3). Hence, selection based on these traits would be effective in increasing yield. The seed yield per plant is reported to be prominent yield component in sesame as reported by Kumar and Vivekanandan (2009), Ibrahim and Khidir (2012) and Lal *et al.* (2016).

The traits *viz.,*number of productive capsules per plant followed by days to maturity, number of secondary branches per plant, days to 50 per cent flowering, internodal lengthand capsule length shown negative direct effect on seed yield, whereas the number of secondary branches per plant contributed to seed yield through yield per plant indirectly. These results are in consonance with the results of Ibrahim and Khidir (2012) and Kehie *et al.* (2020). The direct effect of number of productive capsules per plant was highly negative, it contributed positively through indirect effect through yield per plantand is in confirmation with results of Sumathi and Muralidharan (2010). The oil content had positive direct effect on seed yield in genotypes of sesame at phenotypic level. Similar results being reported by Sankar and Kumar (2003), Vidhyavathi *et al.* (2005), Sumathi and Muralidharan (2010) and Kehie *et al.* (2020). Hence, a direct selection for these traits would be effective.

Conclusion

From the thirty-four advanced breeding lines of sesame along with four checks DS-5, DSS-9, JTS-8 and TKG-22. Seed yield exhibited highly significant positive association with oil content and seed yield per plant and significant negative associations between days to 50 per cent flowering and days to maturity. Seed yield per plant exerted maximum direct effect on seed yield. However, days to 50 per cent flowering exhibited highly significant positive association with days to maturity. The path coefficient analysis exhibited seed yield per plant and highest direct effect on seed yield of sesame. The oil content had positive direct effect on seed yield at phenotypic level.

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