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Original article

Correlation, path analysis and genetic variability for economical characteristics in F_2 and F_3 generations of the cross AVT 3 × TC 25 in Sesamum (*Sesamum indicum* L.)

Siva Prasad Y. V. N.[a], Krishna M.S.R.[b] and Venkateswarlu Yadavalli[c,*]

[a]Department of Agricultural Botany, College of Agriculture, Pune, Maharashtra, India -411 005.
[b]Department of Biotechnology, K.L. University, Guntur, Andra Pradesh, India -522 502
[c]Department of Biotechnology, Government Degree College (Men), Anantapur, Andra Pradesh, India-515 001.

***Corresponding author:** venkibiotech@gmail.com

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Abstract:

Economic yield attributing characters were studied in sesame for crop improvement for selecting high yielding characters. Path analyses were carried out to estimate the direct and indirect effects of the cross AVT 3 × TC 25 in sesamum yield components. High values for genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was recorded for number of branches per plant followed by seed oil content (%) and seed yield per plant (g). The differences between GCV and PCV estimates were high indicating the role of environment in the character expression. Heritability estimates in broad sense were of high magnitude for number of branches per plant in F_2. Seed oil content in F_2 had higher values of genetic advance. Number of capsules per plant and seed oil content had high genetic advance as well as heritability indicating the fact that by making selection it is possible to make progress in the advanced generations.

1. INTRODUCTION

Sesamum (*Sesamum indicum* L.) is an ancient indigenous oil crop of India with the highest area, production and export in the world. Sesamum seeds are excellent food. They are nutritious, edible oil providing good health care as biomedicine. However, the productivity of this crop is a prime need. Yield of any crop is a complex character, which depends upon many independent contributing characters. Knowledge of the magnitude and type of association between yield and its components themselves greatly help in evaluating the contribution of different components towards yield. Yield being a polygenic character is highly influenced by the fluctuations in environment. Hence, selection of plants based directly on yield would not be very reliable (Mahajan et al., 2011).

Improvement in sesamum yield depends on the nature and extent of genetic variability, heritability and genetic advance in the base population. The appropriate knowledge of interrelationships between seed yield and its contributing components can significantly improve the efficiency of breeding programme through the use of appropriate selection indices (Mohammadia et al., 2003, Rafiq et al., 2010). The nature of association between seed yield and its components determine the appropriate traits to be used in indirect selection for improvement in seed yield. The correlation studies simply measure the associations between yield and other traits. Path coefficient analysis permits the separation of correlation coefficient into direct and indirect effects (effects exerted through other variables). Such information provides realistic basis for allocation of appropriate weightage to various yield components (Mahajan et al., 2011). Rafiq et al. (2010) and Mahajan et al. (2011) studied different traits in sorghum, which attributes to the yield. Similarly, Chakraborty et al. (2010) also studied in boro rice. Since sesamum is one of the important oil yielding crop, we have undertaken to study the different traits which are associated with the yield. The knowledge on the nature and magnitude of genetic variation in respect of quantitative characters like yield and its components is essential for effecting for crop improvement. Hence an attempt has been made in F_2 and F_3 generations of the cross AVT 3 × TC 25 in sesamum to study the genetic variability in the crop and to know the selection criteria for higher seed yield so that breeding strategies for yield improvement could be worked out.

2. MATERIALS AND METHODS

2.1 Growing of F_2 and F_3 generations

Selfed seeds of the cross namely AVT 3 × TC 25 of sesamum from College of Agriculture, Pune were used to raise F_2 generation. The seed obtained from this cross were planted to advance the generations (*i.e.*, F_2 to F_3) during summer 2004 by keeping 50 per cent F_2 seed as remnant. The remnants of F_2 seed along with 60 single plant selections as F_3 lines and parents were raised at college form in a randomized block design with three replications used as experimental material during *Kharif*, 2004. Each entry was represented by single row of 4.5 m length. Between and within row spacing of 45 x 15 cm was followed. Observations were recorded from ten competitive plants for each row on eight characters; days to 50 per cent flowering, Plant height at harvest, number of branches per plant, number of internodes per plant, number of capsules per plant, number of seeds per capsules, seed oil content and seed yield per plant.

2.2 Statistical analysis

Mean values of the characters for each genotype per replication were used for analysis of variance and covariance as per Singh and Chaudhary (1999). Heritability estimates were calculated according to Lush (1949) and genetic advance according to Johnson et al. (1955). Genotypic and phenotypic correlation coefficients were calculated according to the formula suggested by Johnson et al. (1955) and Singh and Chaudhary (1999). Path coefficients were estimated by following Dewey and Lu (1959).

3. RESULTS AND DISCUSSION

The mean sum of squares due to treatments were highly significant for all the characters studied indicating presence of good amount of variation in F_2 and F_3 generations of the cross AVT 3 × TC 25 in sesamum. All characters studied showed wide range for individual character. Genotypic coefficient of variation (GCV) was maximum for number of branches per plant (10.32) and its difference with phenotypic coefficient of variation (PCV) was found less. Differences between GCV and PCV for other traits were also found to be less indicating that these traits were less affected by environmental fluctuations (Table 1). The high values of GCV and PCV suggested that there is a possibility of improvement through direct selection for the traits. High heritability coupled with high genetic advance was observed for seed oil content (%), number of capsules per plant, and seed yield per plant (g) indicating that these characters are controlled by additive gene action and phenotypic selection for these characters will be effective. Similarly, high heritability and high genetic advance for economically important yield traits have been reported in sorghum by Wankhede et al. (1985), Rao and Patil (1996), and Mahajan et al. (2011).

Presence of variability was also confirmed through the range of variation for various characters in F_2 and F_3 generations. The variation per plant height ranged between 74 and 84 cm in F_2 and 73 and 96 cm in F_3 generation (Table 1). Likewise the characters number of branches per plant (1.7 – 2.4, 1.6 – 2.4), number of internodes per plant (20.6 – 24.13, 19.0 – 25.0), number of capsules per plant (40.4 - 49.3, 38.6 – 50.0), number of seeds per capsule (55.3 – 59.90, 57.2 – 61.9), seed oil content (43.8 – 55.8, 42.8 – 52.4) and seed yield per plant (12.5 – 15.97, 12.1 – 15.9), exhibited sufficient variation for various characters.

Looking to the data on genotypic and phenotypic coefficient of variation it was observed that the character number of branches per plant exhibited highest magnitudes of GCV and PCV in F_2 and F_3 generations indicating high amount of variation in number of branches per plant in both the generations. Similar results were reported by Kumar et al. (2002) and Krishnaiah et al. (2002). In one of our previous study in the cross Padma × JSLV 4 sesamum, high values for GCV and PCV were recorded for number of branches per plant followed by seed oil content (%) and seed yield per plant (g) (Sivaprasad and Yadavalli, 2012). These findings suggests that number of branched per plant plays a major role in GCV and PCV components. The GCV and PCV magnitudes were also high for seed yield per plant, seed oil content, number of capsules per plant, plant height and number of internodes per plant, suggesting presence of sufficient variation for respective characters in F_2 and F_3 generations. The results of Ashoka et al. (2001) for plant height were similar to results of present findings.

The magnitudinal differences between GCV and PCV estimates were high for all the characters studied in F_2 and F_3 generations except F_2 of days to 50 per cent flowering indicating the role of environment in the expression of these characters. Heritability estimates were also of high magnitude for number of branches (60%), days to 50 per cent flowering (53%), seed oil content (52%), number of capsules per plant (43%), and seed yield per

Table 1. Components of genetic variation, heritability and genetic advance for different characters in F_2 and F3 generations of cross (AVT 3 × TC 25) in sesamum

Characters		Range of variation	Population Mean	Coefficient of variation		Heritability (b.s) (%)	Genetic advance (%)
				Genotypic	Phenotypic		
Days to 50% flowering	F_2	38.20-39.30	38.54	1.12	1.54	53	65
	F_3	37.00-39.13	38.16	0.73	1.83	15	22
Plant height at harvest (cm)	F_2	74.20-83.97	79.13	1.99	8.33	05	76
	F_3	73.47-96.00	80.60	4.24	7.47	32	401
No. of branches per Plant	F_2	1.73-2.40	2.01	10.32	13.25	60	33
	F_3	1.67-2.40	1.93	8.18	12.80	40	20
No. of internodes per plant	F_2	20.67-24.13	21.97	3.64	6.69	30	89
	F_3	19.00-25.07	21.35	4.16	8.95	21	85
No. of capsules per plant	F_2	40.40-49.27	44.47	5.47	8.33	43	329
	F_3	38.60-50.00	43.29	4.80	9.39	26	219
No. of seeds per Capsule	F_2	55.37-59.90	58.27	1.68	2.84	35	119
	F_3	57.19-61.85	60.15	1.50	3.03	24	92
Seed oil content (%)	F_2	43.77-55.81	47.05	6.70	9.30	52	468
	F_3	42.83-52.41	47.27	3.58	6.82	27	183
Seed yield per plant (g)	F_2	12.54-15.97	13.68	6.68	10.14	43	124
	F_3	12.13-15.90	13.53	6.46	9.86	42	118

Table 2. Simple correlation coefficients between 8 characters of cross (AVT 3 × TC 25) in sesamum

Characters	Days to 50% flowering	Plant height at harvest (cm)	Number of branches per plant	Number of internodes per plant	Number of capsules per plant	Number of seeds per capsules	Seed oil content (%)	Seed yield per plant (g)
Days to 50% flowering	1.0000	-0.0809	0.1817	0.0728	0.0604	-0.2154	-0.0219	-0.0308
Plant height at harvest (cm)		1.0000	0.5119**	-0.0530	-0.0607	-0.2465*	-0.0416	0.0050
No. of branches per Plant			1.0000	0.1876	0.1183	-0.304**	-0.0779	0.0969
No. of internodes per plant				1.0000	0.8236**	0.0195	0.1819	0.6560**
No. of capsules per plant					1.0000	0.0082	0.0692	0.8295**
No. of seeds per Capsule						1.0000	0.1907	0.0691
Seed oil content (%)							1.0000	0.0636
Seed yield per plant (g)								1.0000

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

Table 3. Direct (diagonal) and indirect (above and below diagonal) path effects of different characters towards yield in F_2 and F_3 generations of cross (AVT 3 × TC 25) of sesamum

Characters	Days to 50% flowering	Plant height at harvest (cm)	Number of branches per plant	Number of internodes per plant	Number of capsules per plant	Number of seeds per capsules	Seed oil content (%)	Seed yield per plant (g)
Days to 50% flowering	**-0.0878**	-0.0048	-0.0036	-0.0014	0.0518	-0.0150	0.0000	-0.0308
Plant height at harvest (cm)	0.0071	**0.0593**	-0.0102	0.0010	-0.0520	-0.0171	0.0001	0.0050
No. of branches per Plant	-0.0160	0.0304	**-0.0198**	-0.0037	0.1014	-0.0212	0.0001	0.0969
No. of internodes per plant	-0.0064	-0.0031	-0.0037	**-0.0196**	0.7057	0.0014	-0.0002	0.6560**
No. of capsules per plant	-0.0053	-0.0036	-0.0023	-0.0161	**0.8568**	0.0006	-0.0001	0.8295**
No. of seeds per Capsule	0.0189	-0.0146	0.0061	-0.0004	0.0070	**0.0695**	-0.0002	0.0691
Seed oil content (%)	0.019	-0.0025	0.0015	-0.0036	0.0593	0.0133	**-0.0013**	0.0636

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

plant (43%) in F_2 generation. Whereas in F_3 generation seed yield per plant recorded highest (42%) heritability estimate and was followed by branches per plant, plant height, seed oil content, number of capsules per plant, number of seeds per capsule and number of internodes per plant, where the heritability estimates were more than 20 per cent. Kamala (1999) reported the similar results earlier. All these characters with high heritability estimates were accompanied by high genetic advance indicating the fact that by making simple selections it is possible to make progress in the advanced generations. According to Panse (1957) where high genetic advance is associated with high heritability, heritability could be attributed to additive gene effects.

Looking to the data on simple correlation coefficients (Table 2) it was observed that seed yield per plant was positively and significantly correlated with number of capsules per plant (0.8295) and number of internodes per plant (0.6560) indicating the association between these characters with seed yield. Alam et al. (1999) and Ramireddy and Sundaram (2002) reported the similar results. Likewise, among the component characters plant height was significantly and positively correlated with number of branches per plant, number of internodes per plant with number of capsules per plant. Like the present study, yield/plant was reported to be positively correlated with plant height and panicles/plant by Singh et al. (1979); with panicle length by Sarma and Dwivedi (1980); with grains/panicle and 100 grain weight by Sharma and Sharma (2007). Positive correlation of harvest index with panicles/plant, panicle length, grains/panicle and 100 grain weight was observed by Ganesan et al. (1998). Whereas the association between plant height and number of internodes per plant with number of seeds per capsule was negatively significant suggesting the fact that they may not go together. These results were in agreement with the earlier findings of Alam et al. (1999). Negative genotypic correlation of yield/plant was reported with panicle length by Saini and Gag-neja (1975); with harvest index by Kishor et al. (2008).

Yield is a complex resultant character and influenced by several components and environment. Due to internal adjustments among the components, increase in one component results in a decrease in other component(s) and hence does not affect the resultant like yield. Path analysis is very useful in such complex situation to analyze the direct effect of each character and the indirect effects via other characters on yield. Looking to the data in Table 3 in respect of direct and indirect effects it was observed that the character number of capsules per plant recorded the highest magnitude of direct effect (0.8568), its correlation with seed yield was also highly significant and of the same magnitude indicating the perfect association between these two characters and one can rely upon number of capsule per plant to select high seed yielding types in segregating generations of sesamum. Similar results were reported by Deepasankar and Anandakumar (2003). Similar results of harvest index on yield/plant were reported by Ganesan et al. (1998) and Chaturvedi et al. (2008); of panicle length on yield/plant by Kishor et al. (2008); of grain weight on yield/plant by Chaturvedi et al. (2008) and Luzi Kihupi (1998).

However though the association between number of internodes per plant with seed yield was highly significant its direct effect was negative and of low magnitude indicating the fact that this character is contributing indirectly through number of capsules per plant. As the indirect contributions for various characters were of low magnitude, not considered worth to be described. The residual effect (0.5184) was quite large, indicating that some other factors which have not been considered here, need to be included in this analysis to account fully for the variation in yield.

4. CONCLUSION

Seed yield per plant (g), number of capsules per plant and number of internodes per plant influenced yield in the cross AVT 3 × TC 25 in sesamum either directly or indirectly control the sesame yield. Path analysis revealed that number of capsules per plant was the most important character that one can rely upon this character in selecting the superior genotypes in segregating generations of sesamum.

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