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Full Length Research Paper

Correlation, path analysis and genetic variability in F_2 and F_3 generations of cross Padma × JLSV 4 in sesamum (*Sesamum indicum* L.)

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Economic yield attributing characters were studied in sesame for crop improvement for selecting high yielding genotypes. Path analyses were carried out to estimate the direct and indirect effects of the progenies of the cross Padma × JSLV 4 in sesamum yield components. High values for genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were recorded for number of branches per plant followed by seed oil content (%) and seed yield per plant (g). Number of capsules per plant in F_2 and plant height at harvest in F_3 recorded the highest magnitude of genetic advance. The number of capsules per plant had the highest positive direct effect on seed yield per plant indicating that one can rely upon this trait for selection of high yielding genotypes in segregating generations of sesamum.

Key words: Correlation, heritability, sesamum, variability.

INTRODUCTION

Sesame (*Sesamum indicum L.*) is an ancient indigenous oil crop of India with the highest area, production and export in the world. Sesamum seed is an excellent food. It is 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 population under improvement. 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 (Ashoka et al., 2001). The correlation studies simply measure the associations between yield and other traits. Path coefficient analysis permits to separate 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.

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The knowledge on the nature and magnitude of genetic variation in respect of quantitative characters like yield and its components is essential for crop improvement. Hence an attempt has been made to study the genetic variability in F_2 and F_3 generations of the cross Padma × JLSV 4 in sesamum and to know the selection criteria for higher seed yield so that breeding strategies for yield improvement could be worked out.

MATERIALS AND METHODS

Growing of F_2 and F_3 generations

Selfed seeds of the F_1 generation of Padma × JLSV 4 of sesamum from College of Agriculture, Pune (India) were used to raise F_2 generation. The local climatic conditions of the experimental area during the growing time are mean temperature 33°C, total precipitation 348 mm, mean relative humidity is 22%. The seed obtained from this cross were planted to advance the generations (that is, F_2 to F_3) during summer 2004 as solo crop by keeping 50% 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 complete 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 × 15 cm was followed. Observations were recorded from ten competitive plants for each row on eight characters; days to 50% 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.

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).

RESULTS AND DISCUSSION

The mean squares due to treatments were highly significant for all the characters studied (p value is < 0.05) indicating presence of good amount of variation in F_2 and F_3 generations of cross Padma × JLSV 4 in sesamum. All characters studied showed wide range for individual genotype. Genotypic coefficient of variation (GCV) was maximum for seed yield per plant (9.15) and its difference from 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 plant height at harvest (cm), number of internodes per plant, and number of capsules per plant 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 associated traits have been reported in sesamum by Ashoka et al. (2001) 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 77 and 87 cm in F_2 and 78 and 95 cm in F_3 generation (Table 1). Likewise the characters number of branches per plant (1.6 to 2.2, 1.6 to 2.8), number of internodes per plant (20 to 25, 18.0 to 26.0), number of capsules per plant (40 to 50, 38 to 52), number of seeds per capsule (59 to 61, 59 to 65), seed oil content (45 to 49, 45 to 52) and seed yield per plant (11 to 16, 12 to 17), exhibited sufficient variation for various characters.

The data related to genotypic and phenotypic coefficient of variation of the character including number of branches per plant was exhibited highest magnitudes of GCV and PCV in F_2 and F_3 generations, indicating high amount of variation in this trait in both the generations. Similar results were reported by Kumar et al. (2002) and Krishnaiah et al. (2002). 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 number of internodes per plant, number of branches per plant and seed yield per plant; however the difference was low for days to maturity.

Heritability estimates were also of high magnitude for plant height at harvest (71%) followed by capsule length (58%), number of internodes per plant (55%) and number of capsules per plant (54%) in F_2 generation. Where as in F_3 generation number of branches per plant (26%) recorded highest heritability estimate and was followed by seed yield per plant (18%), number of seeds per capsule (18%), capsule length (17%) and number of capsule per plant (16%). Kamala (1999) reported the similar results earlier. All these characters with high

Table 1. Components of genetic variability, Heritability and Genetic advance for different characters in F_2 and F_3 generations of cross (Padma×JLSV-4) in sesamum

Characters	Range of variation	General Mean	Best single plant selections	Coefficient of variation		Heritability (b.s)	Genetic advance
				GCV	PCV		
Days to 50% flowering	F_2 37.4-39.53 F_3 37.4-39.60	38.51, 38.47	166-2, 160-2, 169-3, 546-1, 570-1, 638-4, 662-4, 171-3, 176-2, 219-2, 637-1, 175-3	1.24, 0.65	2.00, 1.75	0.38, 0.14	0.60, 0.19
Days to maturity	F_2 87.6-89.2 F_3 87.4-89-47	88.67, 88.51	169-3, 638-4, 644-3, 160-2, 543-5, 552-4, 180-3, 194-5, 217-2, 171-3, 178-3, 194-3, 201-5	0.37, 0.29	0.64, 0.79	0.33, 0.13	0.39, 0.19
Plant height at harvest (cm)	F_2 76.8-87.2 F_3 77.93-95.2	81.95, 84.82	552-4, 546-1, 670-1, 168-3, 557-4, 641-4, 686-1, 544-4, 216-1, 615-3, 542-3	3.01, 2.83	3.55, 7.73	0.71, 0.13	4.30, 1.81
No. of branches per Plant	F_2 1.60-2.20 F_3 1.67-2.73	1.83, 1.89	166-2, 160-2, 163-3, 168-3, 169-3, 546-1, 172-2, 176-2, 184-2, 205-4, 207-2, 226-4	8.77, 6.94	14.25,, 13.55	0.38, 0.26	0.20, 0.13
No. of internodes per plant	F_2 20.13-25.47 F_3 18.40 26.47	22.41, 21.28	169-3, 160-2,160-4, 163-3, 166-2, 652-4, 172-2, 176-2, 184-2, 205-4, 207-2, 226-4	7.64, 4.34	10.30, 11.02	0.55, 0.15	2.61, 0.75
No. of Capsules per plant	F_2 40.8-50.73 F_3 37.67-51.87	44.65, 43.02	160-2, 169-3, 160-4, 168-3, 568-2, 630-3, 176-2, 178-3, 182-4, 194-5, 205-4, 172-2	7.44, 3.87	10.04, 9.99	0.54, 0.15	5.07, 1.33S
Capsule length	F_2 2.79-3.16 F_3 2.71-3.29	2.95, 3.00	163-3, 166-2, 169-3, 644-3, 552-4, 160-2, 199-3, 178-3, 180-3, 228-2, 556-4, 607-4, 637-1	4.72, 2.71	6.20, 6.54	0.58, 0.17	0.21, 0.06
No. of seeds per Capsule	F_2 59.40-61.45 F_3 58.88-64.39	60.22, 60.71	570-1, 160-2, 552-4, 638-4, 166-2, 630-3, 175-3, 199-3, 226-4, 564-3, 544-4, 574-2, 566-2	1.10, 0.97	2.16, 2.26	0.25, 0.18	0.69, 0.52
Seed oil content (%)	F_2 45.12-49.37 F_3 44.45-51.69	47.52, 47.57	670-1, 166-2, 160-2, 160-4, 570-1, 630-3, 192-3, 194-5, 205-4, 577-2, 580-4, 178-3, 544-4	2.28, 1.77	4.17, 5.13	0.29, 0.12	1.22, 0.59
Seed yield per plant (g)	F_2 11.68-15.79 F_3 11.50-16.01	13.61, 13.00	166-2, 552-4, 630-3, 163-3, 546-1, 652-4 544-4, 178-3, 184-2, 172-2, 577-2, 615-3	9.15, 4.74	13.74, 11.00	0.44, 0.18	1.71, 0.54

Table 2. Simple correlation coefficients between 10 characters of cross (Padma × JLSV-4) in sesamum.

Character	Days to 50% flowering	Days to maturity	Plant height at harvest (cm)	Number of branches per plant	Number of Internodes per plant	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsules	Seed oil content (%)	Seed yield per plant (g)
Days to 50% flowering	1.0000	0.0693	-0.0798	0.0860	0.1119	0.0498	0.1511	-0.1498	0.0397	0.0175
Days to maturity		1.0000	-0.1533	0.1010	0.1027	0.1396	-0.1915	-0.0488	0.2119	0.1472
Plant height at harvest (cm)			1.0000	0.4606**	-0.1191	-0.0600	0.1892	-0.0766	0.1240	-0.1065
No. of branches per Plant				1.0000	0.2991**	0.3672**	0.1174	-0.1108	0.2698*	0.3759**
No. of Internodes per plant					1.0000	0.9400**	-0.2013	-0.0622	0.2525*	0.7148**
No. of capsules per plant						1.0000	-0.1692	-0.0698	0.2904**	0.7749**
Capsule length							1.0000	-0.0617	0.0902	-0.1747
No. of seeds per capsule								1.0000	0.1311	0.0833
Seed oil content (%)									1.0000	0.2494
Seed yield per plant (g)										1.0000

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

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 number of capsules per plant was positively and significantly correlated with number of internodes per plant (0.7148) and number of branches per plant (0.3759) indicating the association between these characters with seed yield. Likewise, among the component characters plant height was significantly and positively correlated with number of branches per plant. The association between plant height and number of capsules per plant with number of internodes per plant were significantly and positively correlated. These results were in agreement with the earlier findings of Alam et al. (1999).

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

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 (Padma x JLSV-4) of sesamum.

Characters	Days to 50% flowering	Days to maturity	Plant height at harvest (cm)	Number of branches per plant	Number of Internodes per plant	Number of capsules per plant	Capsule length (cm)	Number of seeds per capsules	Seed oil content (%)	Seed yield per plant (g)
Days to 50% flowering	-0.0097	0.0002	0.0118	0.0178	-0.0147	0.0407	-0.0072	-0.0210	-0.0003	0.0175
Days to maturity	0.0007	0.0028	0.0227	0.0209	-0.0135	0.1141	0.0092	-0.0069	-0.0014	0.1472
Plant height at harvest (cm)	0.0008	-0.0004	-0.1481	0.0952	0.0157	-0.0490	-0.0090	-0.0108	-0.0008	-0.1065
No. of branches per plant	-0.0008	0.0003	-0.0682	0.2068	-0.0394	0.3002	-0.0056	-0.0155	-0.0018	0.3759**
No. of Internodes per plant	-0.0011	0.0003	0.0176	0.0618	-0.1317	0.7686	0.0096	-0.0087	-0.0017	0.7148**
No. of Capsules per plant	-0.0005	0.0004	0.0089	0.0759	-0.1238	0.8176	0.0081	-0.0098	-0.0019	0.7749
Capsule length	-0.0015	-0.0005	-0.0280	0.0243	0.0265	-0.01384	-0.0478	-0.0087	-0.0006	-0.1747
No. of seeds per capsule	0.0015	-0.0001	0.0113	-0.0229	0.0082	-0.0571	0.0029	0.1403	-0.0009	0.0833
Seed oil content (%)	-0.0004	0.0006	-0.0184	0.0558	-0.0332	0.2374	-0.0043	0.0184	**-0.0066**	0.2494

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

hence does not affect the resultant like yield. Path analysis is very useful in such complex situation to analyse 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 (0.8176), 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).

However days to maturity (0.0028) exhibited positive direct effect of low magnitude on seed yield per plant. Whereas the traits number of inter nodes per plant and seed oil content recorded negative direct effect on seed yield per plant and significant positive correlation with seed yield per plant. The trait number of internodes per plant positively and indirectly contributed to seed yield through number of capsules per plant (0.7686).

The results of the present study suggested that the characters number of internodes per plant and number of branches per plant influenced yield in progenies of the cross Padma × JLSV-4 in sesamum either directly or indirectly. 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. Hence, due consideration should be given to these characters while planning a breeding strategy for increased seed yield/ plant.

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