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Variability and character association in sesame (*Sesamum indicum* L.)

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Abstract
A field study was carried out to study the genetic parameters, correlation and path analysis for yield and its component traits in sesame. Among the various quantitative characters studied, the trait 1000 seed weight exhibited higher genotypic and phenotypic coefficient of variation and it exhibited the scope of genetic improvement through direct selection. Moderate estimates of genotypic and phenotypic coefficients of variation were observed for the characters *viz*., days to 50% flowering, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule and seed yield per plant. It indicating the accountable utility of these traits in selection programme. Heritability estimates were observed to be high for all the and reveals that these traits are governed by additive gene action. Genetic advance as per cent of mean was high for all the traits except capsule length suggesting the scope of improvement for these traits through simple selection. Seed yield per plant had positive association with number of capsules per plant, 1000 seed weight, number of branches per plant and number of seeds per capsule at genotypic and phenotypic level. Path coefficient analysis reveals the considerable positive direct effect on seed yield which was exerted by number of capsules per plant, 1000 seed weight, number of branches per plant and number of seeds per capsule. These characters can be considered as a criterion in breeding programmes for improving seed yield in sesame.

Keywords: sesame, variability, correlation, path analysis

Introduction

Sesame is considered as queen of oilseed crops because of its high nutritional value and health benefits. Sesame seed is used for a wide range of edible products and also for industrial uses (Bedigian, 2011) [4]. It contains 40 to 63 per cent oil, which contains significant amount of oleic and linoleic acids (Abate and Mekbib, 2015) [1]. Development of high yielding varieties coupled with tolerant to biotic and abiotic stresses could be viable alternative to increase area under cultivation. 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. Heritability provides information on the transmissibility of character from one generation to another. Johnson *et al*. (1955) [17] advised that heritability estimates along with genetic advance would be more useful in predicting grain yield under phenotypic selection than heritability estimates alone.

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 (Jogdhande *et al*., 2017 and Manisha *et al*., 2018) [16, 20]. 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 variability parameters, character association, direct and indirect effect of component characters on yield of sesame.

Material and Methods

The field experiment was conducted at Seed Research and Technology Centre, Rajendranagar, Hyderabad by using 51 sesame genotypes which were evaluated during late *Kharif*, 2017 to study the variability, correlation and path coefficients for yield and its components. The trial was laid out in randomized block design with two replications by adapting a spacing of 30 cm between rows and 10 cm between plants. Recommended package of practices was followed along with necessary plant protection measures to raise a good crop. Five plants from each genotype in each replication were selected to collect data on plant height (cm), number of branches per plant, number of capsules per plant, capsule length (cm), number of seeds per capsule, 1000-seed weight (g) and seed yield per plant (g) whereas data on days to 50% flowering was recorded on plot basis. The mean data were subjected for statistical analysis to estimate the genetic parameters, correlation coefficients and path coefficients for yield and its components. Heritability in broad sense and genetic advance as percent of mean were estimated as per the formula given by Hanson *et al*. (1956) [13] and Johnson *et al*. (1955) [17]. Genotypic and phenotypic correlation coefficients were calculated as suggested by Burton and Devane (1953) [7]. Path coefficients analysis was done as suggested by Dewey and Lu (1959) [10].

Results and Discussion

Analysis of variance for yield contributing characters revealed the presence of significant differences among the genotypes for all the characters under study. The genotypic and phenotypic coefficient of variation, heritability and genetic advance as per cent of mean were estimated for fifty-one genotypes and presented in Table-1. The magnitude of phenotypic coefficient of variation (PCV) was found to be slightly higher than genotypic coefficient of variation (GCV) for all the characters studied indicated the influence of environment on the expression of these characters. The estimates of genotypic and phenotypic coefficients of variation were found to be moderate for the characters *viz*., days to 50% flowering, plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule and seed yield per plant. It indicates that there is scope for improvement of this character. Bharathi *et al*. (2014) [6], Desawi *et al.* (2014) [9] and Kiruthika *et al*. (2017) [19] reported the moderate genotypic and phenotypic coefficients of variation for the characters such as plant height, capsule length, number of capsules per plant, number of seeds per capsule and seed yield per plant. The trait, 1000 seed weight exhibited high genotypic (21.77) and phenotypic (24.24) coefficient of variation. It reveals the presence of large amount of variation in the genotypes under study for this trait.

The heritability estimates were found to be high for all the traits studied. The heritability along with genetic advance as per cent of mean were found to be high for all the traits studied except for capsule length which reveals the role of additive gene action in inheritance of these traits. Hence, these traits could be effectively improved by simple and direct selection. The characters such as days to 50% flowering (23.16%), plant height (26.15%), number of branches per plant (31.49%), number of capsules per plant (26.16%), number of seeds per capsule (27.04%), 1000 seed weight (40.28%) and seed yield per plant (36.89%) expressed high genetic advance as percent of mean. The similar findings were observed by Gangadhara *et al.* (2012) [11] and Vanishree *et al*. (2013) [24] for plant height; Bharathi *et al.* (2014) [6], Hika *et al.* (2015) 1[4], Abhijatha *et al*. (2017) [2] and Begum *et al.* (2017) [5] for number of branches per plant; Chandramohan (2014) [8], Bharathi *et al.* (2014) [6], Iqbal *et al*. (2016) [15], Abhijatha *et al*. (2017) [2] and Begum *et al.* (2017) [5] for number of capsules per plant; Gidey *et al*. (2012) [12] and Vanishree *et al.* (2013) [24] for number of seeds per capsule; Tripathi *et al.* (2013) [2], Hika *et al.* (2015) [14] and Abhijatha *et al*. (2017) [2] for seed yield per plant. High heritability (88.41%) coupled with moderate genetic advance as per cent of mean (14.43%) was observed for capsule length. Hence, there is a good scope of improvement for this trait through simple selection. Vanishree *et al*. (2013) [24], Chandramohan (2014) [8] and Abate and Mekbib (2015) [1] also noticed high heritability coupled with moderate genetic advance as per cent of mean for this character.

Phenotypic and genotypic correlations between yield and its contributing traits were estimated and presented in Table-2. In this study, the genotypic correlation coefficients were in general higher than corresponding phenotypic correlation coefficients revealed that the observed relationships among various characters were due to genetic causes. Shekhawat *et al*. (2013) [22] and Kalaiyarasi *et al*. (2019) [18] also reported higher genotypic correlation coefficients than the respective phenotypic correlation coefficients for yield and its component characters. Seed yield per plant had positive correlation with number of capsules per plant, 1000 seed weight, number of branches per plant and number of seeds per capsule and desirable association with days to 50% flowering at both phenotypic and genotypic level indicating the importance of these characters for yield improvement. Akbar *et al*. (2011) [3] reported the contribution of number of capsules per plant on seed yield. Inter relationship among the traits showed that days to 50% flowering exhibited significant positive association with plant height, number of branches per plant and number of seeds per capsule at phenotypic level only. The trait plant height had significant positive relation with number of branches per plant and capsule length. The characters such as number of branches per plant and capsule length showed significant positive association with number of seeds per capsule. Number of capsules per plant exhibited significant positive association with 1000 seed weight. The correlation studies revealed that number of capsules per plant, 1000 seed weight, number of branches per plant and number of seeds per capsule were the important characters and may be selected to improve the seed yield. The study also revealed that by making selection for a particular character, simultaneous improvement in the associated character may be achieved.

Path coefficient analysis revealed that considerable positive direct effect on seed yield was exerted by number of capsules per plant (0.7849 & 0.6755) followed by 1000 seed weight (0.2721 & 0.2767), number of branches per plant (0.1503 & 0.1367) and number of seeds per capsule (0.1573 & 0.0167) whereas negative direct effect was exhibited by days to 50% flowering at both genotypic and phenotypic level (Table-3). This indicating that the selection for these characters was likely to bring about an overall improvement in seed yield per plant directly. Menzir (2008) [21] also reported the positive direct effect of number of capsules per plant and 1000 seed weight on seed yield. Indirect effect of number of seeds per capsule on seed yield per plant was exerted by plant height, number of branches per plant and capsule length. The trait number of capsules per plant exhibited positive indirect effect on seed yield through 1000 seed weight. Number of branches per plant had positive indirect effect on seed yield through plant height, capsule length and number of seeds per capsule. Therefore, importance should be given for these characters in the selection programme to get high seed yield.

From the study it can be conclude that the traits particularly, number of capsules per plant, number of seeds per capsule, 1000 seed weight and number of branches per plant may be used as selection criteria in future breeding programs for the development of high yielding varieties in sesame.

Table 1: Estimation of components of genetic parameters for yield and its components in sesame

Character	Mean	Range			Coefficient of variation	Heritability (%)	Genetic advance as per cent of mean
		Min.	Max.	Genotypic	Phenotypic		
Days to 50% flowering	36.94	29.00	43.50	11.47	11.72	95.91	23.16
Plant height (cm)	100.78	75.50	126.25	13.59	14.55	87.23	26.15
No. of branches per plant	3.29	1.75	4.45	17.87	20.89	73.15	31.49
Capsule length (cm)	2.53	2.08	2.90	7.45	7.92	88.41	14.43
No. of capsules per plant	49.39	28.15	60.70	14.96	17.64	71.98	26.16
No. of seeds per capsule	51.27	36.00	70.50	13.99	14.90	88.21	27.04
1000 seed weight (g)	2.30	1.58	4.29	21.77	24.24	80.67	40.28
Seed yield per plant (g)	4.14	2.39	5.46	18.83	19.81	90.41	36.89

Table 2: Phenotypic and genotypic correlation coefficients for yield and its components in sesame

Character		Days to 50% flowering	Plant height	No. of branches per plant	Capsule length	No. of capsules per plant	No. of seeds per capsule	1000 seed weight	Seed yield per plant
Days to 50% flowering	G P	1.0000 1.0000	0.5576 0.5144**	0.4068 0.3273**	0.1533 0.1575	-0.3393 -0.2779**	0.3757 0.3463**	-0.3403 -0.0339	-0.1773 -0.1646
Plant height	G P		1.0000 1.0000	0.3593 0.2777**	0.4177 0.3844**	-0.2494 -0.2148*	0.2085 0.1903	-0.2021 -0.1284	-0.2051 -0.1745
No. of branches per plant	G P			1.0000 1.0000	0.2131 0.1409	-0.0065 -0.0466	0.5458 0.3984**	0.0258 -0.0234	0.2174 0.1341
Capsule length	G P				1.0000 1.0000	-0.4369 -0.3792**	0.3643 0.3353**	-0.0385 -0.0262**	-0.3397 -0.2881
No. of capsules per plant	G P					1.0000 1.0000	-0.0676 -0.0247	0.3527 0.3004**	0.9046 0.7981
No. of seeds per capsule	G P						1.0000 1.0000	-0.0441 -0.0288	0.1441 0.1466
1000 seed weight	G P							1.0000 1.0000	0.5504 0.4759

* & ** Significant at 5% and 1% level respectively

P -Phenotypic correlation coefficient G- Genotypic correlation coefficient

Table 3: Estimates of direct and indirect effect at phenotypic and genotypic level for yield and its components in sesame

Character		Days to 50% flowering	Plant height	No. of branches per plant	Capsule length	No. of capsules per plant	No. of seeds per capsule	1000 seed weight	Seed yield per plant
Days to 50% flowering	G P	-0.0068 -0.0556	-0.0038 -0.0286	-0.0028 -0.0182	-0.0010 -0.0088	0.0023 0.0155	-0.0026 -0.0193	0.0002 0.0019	-0.1773 -0.1646
Plant height	G P	-0.0042 0.0000	-0.0075 0.0001	-0.0027 0.0000	-0.0031 0.0000	0.0019 0.0000	-0.0016 0.0000	0.0015 0.0000	-0.2051 -0.1745
No. of branches per plant	G P	0.0612 0.0448	0.0540 0.0380	0.1503 0.1367	0.0320 0.0193	-0.0010 -0.0064	0.0821 0.0545	0.0039 -0.0032	0.2174 0.1341
Capsule length	G P	-0.0110 -0.0143	-0.0299 -0.0350	-0.0152 -0.0128	-0.0715 -0.0911	0.0312 0.0345	-0.0260 -0.0305	0.0028 0.0024	-0.3397 -0.2881
No. of capsules per plant	G P	-0.2663 -0.1877	-0.1958 -0.1451	0.0051 -0.0315	-0.3429 -0.2562	0.7849 0.6755	-0.0530 -0.0167	0.2768 0.2029	0.9046 0.7981
No. of seeds per capsule	G P	0.0591 0.0577	0.0328 0.0170	0.0859 0.0663	0.0573 0.0558	-0.0106 -0.0041	0.1573 0.0167	-0.0069 -0.0048	0.1441 0.1466
1000 seed weight	G P	-0.0093 -0.0094	-0.0550 -0.0355	0.0070 -0.0065	-0.0105 -0.0072	0.0960 0.0831	-0.0120 -0.0080	0.2721 0.2767	0.5504 0.4759

Genotypic residual effect = 0.2405, Phenotypic residual effect = 0.5011, Bold values are direct effects

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