

Original Research Article

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Study of Genetic Variability, Heritability and Genetic Advance in Sesame (*Sesamum indicum* L.) Genotypes

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ABSTRACT

The investigation was carried out to access the analysis of variance, genetic variability, heritability and genetic advance with 30 genotypes including a check namely Krishna. The genotypes were grown in randomised block design with three replications during *Kharif* 2018 at research farm of Tirhut College of Agriculture, Dholi. Analysis of variance revealed highly significant variation among the genotypes for all the characters. The variability study indicated high to moderate phenotypic and genotypic coefficient of variation accompanied by high heritability and high to moderate genetic advance as per cent of mean for traits like plant height(cm), days to first flowering, days to 50% flowering, days to maturity, number of productive branches/plant, height of 1st capsule(cm), number of productive capsules per plant, number of seeds per capsule, biological yield per plant, harvest index(%), 1000 seed weight(g), stearic acid(%), linolenic acid(%), linoleic acid(%), oleic acid(%), palmitic acid(%), oil content (%), oil yield per plant(g) and seed yield per plant(g). This study indicates preponderance of additive gene effect, which will help to make selection in early segregating generation. The genetic advance as per cent mean suggesting still there is scope for further improvement of genotypes for these characters. Therefore, these characters can be considered as a criterion for improving seed yield in breeding programs of sesame.

Keywords

Sesame, Genetic variability, Heritability, Genetic advance

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Introduction

Sesame (*Sesamum indicum* L.) is one of the prehistoric oilseed crop, dates back to 3050-3500 BC and has been cultivated from ancient

times, (Bedigian and Harlan, 1986). It is extensively cultivated worldwide and naturalized in dry habitats of tropical and subtropical regions of the old world, the major sesame producing regions of world

belongs to the developing nations of Asia and Africa i.e. Myanmar, India, China, Sudan, Ethiopia, Uganda, and Nigeria. It is generally known as gingelly, til, benniseed and simsin in different parts of the world (Prajapat *et al.*, 2014).

India holds a premier position in the global oilseeds scenario accounting for 29 per cent of the total area and 26 per cent of production. Globally, China and India are the major sesame producers. Rajasthan, Gujarat, Madhya Pradesh, Andhra Pradesh, West Bengal and Tamil Nadu put together constitutes nearly 72 per cent of total area and 58 per cent of total production of sesame in the country.

Sesame is designated as the “Queen of oilseed crops” because of its high nutritive quality (rich in carbohydrate, protein, calcium, iron and phosphorous) and quantity of oil (40 to 63%).

Sesame oil has highest antioxidant content and contains several fatty acids such as oleic acid (43 %), linoleic acid (35%), palmitic acid (11 %) and stearic acid (7%) and stability against oxidative rancidity owing to the occurrence of the natural antioxidants namely, lignans (sesamin, sesamol and sesamol), and γ -tocopherol, which offers long shelf life to the sesame oil (Ashri, 1989; Anilakumar *et al.*, 2010).

Sesame has a relatively superior oil quantity as well as quality in comparison to many major oil crops. Sesame is a plant breeder's dream because it has high variability. The presence of variability in crop is important for genetic studies and consequently used for improvement and selection. Assessment of variability forms the basis for any crop improvement programme.

A study of the manner in which a particular

character behaves in relation to others contributing to seed yield will be great significance in planning successful breeding strategies in any crop improvement programme. Yield being a complex character is influenced by various component characters, which are polygenetically inherited and highly subjected to environmental variation.

More emphasis, therefore, needs to be placed on the selection of yield attributes which are less influenced by the environment. Besides, genotypic and phenotypic coefficient of variation, heritability and genetic advance, a study of correlation among yield and its components and their relative contribution to yield is of great value in the breeding programmes.

Materials and Methods

A field experiment for present investigation was conducted during *Kharif* 2018 under rainfed condition on the Research Farm of Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar. The field selected for experiment is uniform with typical medium soil having medium fertility and fairly good drainage.

Agro climatically University Farm is situated between 25.980 N latitude and 85.670E longitudes at 51.8m above mean sea level. The experimental material consisted of 30 sesame genotypes laid out in a Randomized

Block Design with three replications. Each genotype in each replication was sown in three row plot of 4.0m length, adopting a spacing of 30 cm between rows and 20 cm between the hills. The observations were recorded on plant height (cm), days to first flowering, days to 50% flowering, days to maturity, number of productive branches per plant, height of 1st capsule (cm), number of

productive capsules per plant, number of seeds per capsule, biological yield per plant (g), harvest index (%), 1000 seed weight (g), stearic acid (%), linolenic acid (%), linoleic acid (%), oleic acid (%), palmitic acid (%), oil content (%), oil yield per plant (g) and seed yield per plant (g). The data were subjected to statistical analysis

Statistical analysis

Mean values of the characters for each genotype per replication were used for analysis of variance as per methodology advocated by Panse and Sukhatme (1967). Heritability in broad sense estimates were calculated according to formula suggested by Johnson *et al.* (1955) and the estimates of genetic advance were obtained by the formula given by Lush (1949).

Results and Discussion

In the present investigation, thirty sesame genotypes were studied to assess their performance in terms of traits implicated to yield. The analysis of variance revealed significant difference among the genotypes for all traits *viz.*, plant height (cm), days to first flowering, days to 50% flowering, days to maturity, no of productive branches/plant, height of 1st capsule (cm), number of productive capsules per plant, number of seeds per capsule, biological yield per plant, harvest index (%), 1000 seed weight (g), stearic acid (%), linolenic acid (%), linoleic acid (%), oleic acid (%), palmitic acid (%), oil content (%), oil yield per plant (g) and seed yield per plant (g), exhibited highly significant mean sum of square.

This indicates that sufficient variability is present for most of the important characters among different genotypes and thus suggested a substantial scope of selection. This result was in accordance with report of Rao *et al.*

(2014) days to 50% flowering, days to maturity, plant height (cm), number of branches per plant, number of capsules per branch, number of seeds per capsule, test weight and seed yield per plant.; Parameshwarappa *et al.* (2009) for days to 50% flowering, number of branches per plant, plant height, number of capsules per plant, capsule length, number of seeds per capsule, 1000-seed weight, seed yield per plant and oil content.

Examination of the components of variance revealed that the phenotypic variances for almost all the traits under studied were higher than the genotypic variances this may be due to the non-genetic factor which played an important role in the manifestation of these characters.

The maximum phenotypic and genotypic variance exhibited by the traits *viz.*, biological yield per plant, number of productive capsules per plant, plant height, number of seeds per capsule, oil content, harvest index. These findings were in accordance of Suvarna *et al.* (2008), Manjunatha *et al.* (2008) who also observed high variance for yield and yield component traits among sesame genotypes. The height of 1st capsule exhibited high genotypic variance than phenotypic variance.

Coefficient of variation gives the idea about up to what extent variation is present in a population. Estimates of genetic parameters in the present study indicated that the phenotypic coefficient of variation (PCV) were invariably higher than their corresponding genotypic coefficient of variation (GCV) for all the characters with a narrow difference indicates that environmental influence was least and preponderance of genetic factors controlling variability in these traits. High magnitude of PCV and GCV were observed for the traits *viz.*, biological yield per plant, harvest index,

productive capsules per plant, oil yield per plant, seed yield per plant, linolenic acid and productive branches per plant. Results indicated greater scope for selection of these traits for further breeding work.

Similar results have been reported by Patil and Sheriff (1996) for seed yield per plant, oil yield per plant and number of capsules per plant, Subrata and Maity (1997) for seed yield per plant, number of branches per plant, Babu *et al.* (2004) for oil yield per plant and seed yield per plant, Sumathi and Muralidharan (2010) for number of branches per plant, number of capsules per plant and seed yield per plant, Gidey *et al.* (2013) for harvest index and seed yield per plant, Hika *et al.* (2015) for biological yield per plant, Kiruthika *et al.* (2018) for number of capsules per plant and oil content.

Moderate values of PCV were noticed for characters *viz.*, height of 1st capsule, plant height, number of seeds per capsule, oil content and 1000 seed weight. Similar results have been recorded by Tripathi *et al.* (2013), Vanishree *et al.* (2013), Ahadu (2012), Sumathi and Murlidharan (2010) and Parameshwarappa *et al.* (2009) for plant height, Gangadhara *et al.* (2012) for 1000-seed weight and number of seeds per capsule.

Low values of PCV were noticed for stearic acid, days to first flowering, days to 50% flowering, palmitic acid, oleic acid, linoleic acid and days to maturity. Similar results have been reported by Tripathi *et al.* (2013), Vanishree *et al.* (2013), Parameshwarappa *et al.* (2009) and Sudhakar *et al.* (2007) for days to maturity, Chandra Mohan (2014) and Thirumalarao (2013) for days to 50% flowering.

Heritability plays a vital role in deciding the suitability and strategy for selection of a particular character. The highest heritability

was exhibited by linolenic acid followed by oil content, biological yield per plant, number of productive capsules per plant, stearic acid, palmitic acid, days to 50% flowering, harvest index, days to first flowering, oil yield per plant, seed yield per plant, oleic acid, height of 1st capsule, linoleic acid, number of productive branches per plant, plant height, number of seeds per capsule.

Medium heritability was recorded for Days to maturity and 1000 seed weight. Similar results have been obtained by Desawi *et al.* (2014), Rani (2014), Vanishree *et al.* (2013), Shekhawat *et al.* (2013) and Gangadhara *et al.* (2012) for no of productive capsules per plant, Abate and Mekbib (2015), Desawi *et al.* (2014), Tripathi *et al.* (2013), Gidey *et al.* (2013), Gangarde *et al.* (2009), Sudhakar *et al.* (2007) for days to 50% flowering, Bindu *et al.* (2014) and Sudhakar *et al.* (2007), for oil content, Tamina Begum and Dasgupta (2003) for seed yield, number of capsules per plant, number of branches per plant and plant height, Alake *et al.* (2010) reported for height of 1st capsule.

Heritability estimates would be reliable if accompanied by a high estimated genetic advance. High heritability coupled with high genetic advance was exhibited by linolenic acid followed by oil content, biological yield per plant, and number of productive capsules per plant, harvest index, seed yield per plant, height of 1st capsule and plant height. Hence these traits might be governed by additive genes; indicating that direct selection would be effective from present genotypes.

These results were in accordance with the findings of Vanishree *et al.* (2013), Shekhawat *et al.* (2013), Gangadhara *et al.* (2012) for number of productive capsules per plant.; Anil Kumar (1999) and Velu and Shunmugavalli (2005) for number of capsules per plant and seed yield per plant. High

heritability coupled with moderate genetic advance was recorded for stearic acid, days to 50% flowering, days to first flowering and number of seeds per capsule suggesting that there is a effect of additive and non-additive gene action. Similar results were reported by Gangadhara *et al.* (2012), Gidey *et al.* (2012),

Tripathi *et al.* (2013) and Abate and Mekbib (2015) for days to 50% flowering. Palmitic acid, oleic acid and linoleic acid were high heritability coupled with low genetic advance as per cent of mean indicating presence of non-additive gene action.

Table.1 Analysis of variance (ANOVA) for design of experiment for nineteen quantitative characters of sesame

SL NO.	Source of Variation Characters	Mean sum of square		
		Replication (df=2)	Treatment (df=29)	Error (df=58)
1	Plant height (cm)	576.68	1946.37**	191.52
2	Days to first flowering	0.14	44.16**	1.45
3	Days to 50% flowering	0.13	51.45**	1.39
4	Days to maturity	5.67	17.58**	3.52
5	No of Productive Branches per Plant	0.04	5.89**	0.52
6	Height of 1 st capsule (cm)	36.27	917.91**	59.60
7	No of productive capsules per plant	48.14	4890.66**	67.69
8	No of seeds per capsule	35.23	233.93**	41.71
9	Biological yield per plant (g)	248.10	14875.70**	112.78
10	Harvest index (%)	0.37	71.61**	2.16
11	1000 seed weight(g)	0.04	0.46**	0.09
12	Stearic acid (%)	0.01	0.54**	0.006
13	Linolenic acid (%)	0.00	0.03**	0.00
14	Linoleic acid (%)	1.04	6.52**	0.46
15	Oleic acid (%)	0.11	7.97**	0.34
16	Palmitic acid (%)	0,03	0,48**	0,01
17	Oil content (%)	0.47	92.90**	0.30
18	Oil yield per plant (%)	0.72	40.30**	1.76
19	Seed yield per plant (g)	0.02	6.37**	0.25

** Significant at P = 0.01

Table.2 Range and mean performance for nineteen different quantitative characters in sesame

SL. No.	Characters	Range		MEAN
		Min	Max	
1	Plant height(cm)	109.66	225.16	171.35
2	Days to first flowering	39.33	55.66	46.00
3	Days to 50% flowering	42.00	60.33	52.00
4	Days to maturity	92.66	101.66	97.00
5	No of Productive Branches per Plant	4.33	10.00	6.67
6	Height of 1 st capsule(cm)	85.13	154.00	110.02
7	No of productive capsules per plant	67.33	271.33	120.97
8	No of seeds per capsule	52.00	95.33	65.66
9	Biological yield per plant (g)	46.11	369.83	136.52
10	Harvest index (%)	4.72	26.98	11.20
11	1000 seed weight(g)	2.66	4.46	3.59
12	Stearic acid (%)	3.56	5.36	4.63
13	Linolenic acid (%)	0.28	0.85	0.40
14	Linoleic acid (%)	39.94	47.41	43.87
15	Oleic acid (%)	38.65	45.69	41.71
16	Palmitic acid (%)	8.62	10.40	9.36
17	Oil content (%)	25.00	47.11	36.15
18	Oil yield per plant (%)	7.63	20.98	4.70
19	Seed yield per plant (g)	2.26	7.61	13.01

Table.3 Genotypic (σ^2_g) and phenotypic (σ^2_p) variance and other genetic parameter for nineteen different quantitative characters in sesame

Sl. No.	Characters	Genotypic variance (σ^2_g)	Phenotypic variance (σ^2_p)	GCV(%)	PCV(%)	h^2 (bs.) %	Genetic advance	Genetic advance as % of mean
1	Plant height (cm)	584.95	776.48	14.18	16.34	75	43.24	25.35
2	Days to first flowering	14.24	15.69	8.24	8.65	91	7.40	16.17
3	Days to 50% flowering	16.69	18.08	7.87	8.19	92	8.08	15.57
4	Days to maturity	4.68	8.21	2.32	2.96	57	3.37	3.47
5	No of Productive Branches per Plant	1.79	2.32	20.03	22.79	77	2.42	36.27
6	Height of 1 st capsule (cm)	286.11	34.70	15.26	16.78	83	31.70	28.60
7	No of productive capsules per plant	1607.66	1675.35	33.14	33.83	96	80.91	66.88
8	No of seeds per capsule	64.07	105.79	12.19	15.66	60	12.83	19.54
9	Biological yield per plant (g)	4920.97	5033.76	51.38	51.97	97	142.88	104.65
10	Harvest index (%)	23.15	25.31	42.93	44.89	91	9.48	84.57
11	1000 seed weight (g)	0.12	0.22	9.67	13.01	55	0.53	14.81
12	Stearic acid (%)	0.18	0.18	9.09	9.26	96	0.85	18.41
13	Linolenic acid (%)	0.01	0.01	25.81	25.93	99	0.21	52.95
14	Linoleic acid (%)	2.02	2.49	3.24	3.59	81	2.64	6.02
15	Oleic acid (%)	2.54	2.88	3.82	4.07	88	3.09	7.40
16	Palmitic acid (%)	0.16	0.17	4.25	4.42	93	0.79	8.43
17	Oil content (%)	30.87	31.17	15.37	15.44	99	11.39	31.50
18	Oil yield per plant (%)	12.84	14.61	27.53	29.36	88	6.92	53.16
19	Seed yield per plant (g)	2.04	2.30	30.34	32.19	89	2.77	58.91

Classes of Heritability (%): High > 60 %, Medium 30-60%, Low < 30 %

Classes of Genetic Advance (%): High >20%, Medium 10-20%, Low < 10 %

Analysis of variance revealed highly significant differences among the genotypes for all the nineteen parameters, indicating the presence of considerable genetic variation in the experimental material. The phenotypic variance was found higher than the corresponding genotypic variances for all the traits under study.

In the present study, high heritability and genetic advance as % mean were recorded for linolenic acid while, high PCV, GCV recorded for biological yield per plant this character could be relied upon for selection. Selection of such genotypes based on various

quantitative yields attributes leads to genetic improvement in sesame especially for seed yield. In future, such traits may be considered for the development of high yielding with good quality sesame varieties.

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