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Genetic variation in sesame (*Sesamum indicum L.*) landraces of North East India

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Abstract
The analysis of variance revealed significant differences among genotypes indicating high degree of variability in the material taken into account for the investigation. Highest PCV and GCV were recorded for no of capsules per plant, seed yield and test weight and no of primary branches indicating the presence of ample variations for these traits. High estimates of heritability with genetic advance was accounted for 50% flowering, no of primary branches, no of capsules per plant, test weight, oil content and seed yield. Therefore, selection of these traits is likely to accumulate more additive genes leading to further improvements of their performance and these traits maybe used as selection criteria in sesame breeding programme. For seed yield significant positive correlation were observed between, no of primary branches, no of capsules per plant, test weight and oil content indicating relative utility of these traits for selection. Path coefficient analysis revealed that test weight contributed maximum positive direct effect on yield followed by no of capsules per plant, 50% flowering and oil content and also exhibited significant positive correlation with yield indicating the true relationship between the traits suggesting that direct selection of these traits would likely be effective in increasing seed yield.

Keywords: Genetic variability, heritability, genetic advance, correlation coefficient, path coefficient, sesame

Introduction

Sesame (*Sesamum indicum L.*) is diploid (2n= 26) belongs to Pedaliaceae family. Sesame commonly known as Gingelly, Gergelim, Til (Hindi) is one of the oldest cultivated oilseed crop grown extensively in India, cultivated more than 5000 years ago and originated in South-Western Africa. It is a short duration crop grown throughout the year. Sesame seed is highly nutritive (oil 50%, protein 25%) and its oil contains an anti-oxidant called sesamol which imparts to it a high degree of resistance against oxidative rancidity (Ashri, 1989). Due to the presence of potent antioxidant, sesame seeds are known as “the seed of immortality”. It has been found to be a good protector of ultra violet light, wind, and radiation, and therefore, it is used in various cosmetics, and in baby skin care. It is grown as a *kharif* and *rabi* crop. It is grown in areas with annual rainfall of 625-1100mm and temperature of more than 27 ^{0}C.

The crop is able to grow where other crops failed but it is not tolerant to water logging and excessive rainfall. Sesame is also considered as drought tolerant crop. The crop thrives best on moderately fertile, well-drained soils with a pH ranging from 5.5 to 8.0 and is sensitive to salinity (Kafiriti and Mponda, 2008) [13]. Sesame is well adapted to a wide range of soils, but requires deep, well-drained, fertile sandy loams (Terefe *et al*., 2012) [19].

In global scenario, the area under sesame cultivation is more than 7 million hectare with annual production of 4 million hectare and yield of about 535 kg/ha {Anonymous, 2014} [5]. China, Myanmar and Sudan account for 40% of the world’s sesame production. India is the second largest producer of sesame in the world after Myanmar {Anonymous, 2012} [4]. Sesame is grown in an area of 1.71 million hectares with a production of 0.76 million tonnes and with a yield of 422 kg/ha {Anonymous, 2014}[5]. In Nagaland, sesame is cultivated over an area of 3.5 hectares producing 2.1 tonnes and yield of about 600.0 kg/ha {Anonymous, 2012} [4].

Since the cultivated area cannot be increased, efforts are to be intensified to increase the productivity per unit area. In North East an array of local genotypes are in cultivation since long. Though many of them are low yielding but they are valuable with reference to many rare physiological and quantitative traits. Systematic attempts have not been made on the collection of information on genotypes with reference to quantitative traits. To increase the production and productivity in these ecosystems, an alternative is to improve the local variety with regard to yield potential, insect pest resistant, nutrient responsiveness, adaptability etc through breeding programs. Thus proper planning and execution of a breeding programme for the improvement of the various quantitative attributes depend to a great extent upon the magnitude of genetic variability existing in the population. Keeping these in view, the present study was undertaken to assess the nature and magnitude of genetic variability present in different indigenous collections of sesame. An attempt has also been made to study the correlation and path coefficient which are helpful in selecting the desirable traits.

Materials and methods

The present experiment was carried out at experimental farm of SASRD, Nagaland University, Medziphema campus following randomized block design with three replications and twenty genotypes (Table- 1).

Table 1: List of genotypes along with their local names

S. No.	Treatments	Genotype name	Place of collection
1	T1	Pubjab Til no 1	Punjab
2	T2	AST – 1	Assam
3	T3	Salulemang Local	Salulemang
4	T4	Yisemyong local	Yisemyong
5	T5	Yoangyimsen Local	Yoangyimsen
6	T6	Longsa Local	Longsa
7	T7	Kashanyu Local	Kashanyu
8	T8	Zunheboto Local	Zunheboto
9	T9	Longkong Local	Longkong
10	T10	Wameken Local	Wameken
11	T11	Kensa Local	Kensa
12	T12	Lungsha Local	Lungsha
13	T13	Chuchuyimlang Local	Chuchuyimlang
14	T14	Merangkong Local	Merangkong
15	T15	Akhoya Local	Akhoya
16	T16	Mopongchuket Local	Mopongchuket
17	T17	Mongsenyimti Local	Mongsenyimti
18	T18	Meghalaya Local - 1	Meghalaya
19	T19	Meghalaya Local - 2	Meghalaya
20	T20	Manipur Local	Manipur

The sesame seeds were sown on 20th of June 2016. One-two healthy seeds were dibbled in lines with the help of a small spade manually at 30 cm row to row and 20 cm plant to plant distance. Total plant population of 25 plants per plot was maintained for all the 20 genotypes. All the recommended agronomic practices were followed for raising a good crop. The data were recorded on five randomly sampled plants in each plot for nine quantitative characters *viz.* days to 50% flowering, 80% maturity, plant height, no of primary branches, no of capsules per plant, no of seeds per capsules, test weight, oil content and seed yield. The mean values were subjected to statistical analysis to work out analysis of variance for all the characters as suggested Panse and Sukhatme (1957) [15]. Heritability (broad sense) was estimated according to Allard (1960). Genotypic and phenotypic coefficients of variation were estimated as per Burton and De Vane (1953) [9]. Genetic advance as per cent of mean was estimated according to Johnson *et al.* (1955) [12]. Genotypic and phenotypic correlation coefficients for all possible comparisons were computed as per formulae suggested by Al-Jibouri *et al.* (1958) [2].The partitioning of genotypic correlation coefficient of traits into direct and indirect effects was carried out using the procedure suggested by Dewey and Lu (1959) [10].

Results and Discussion

The analysis of variance (Table- 2) revealed significant differences among the genotypes for all the characters studied indicating high degree of variability present in the material.

Table 2: Analysis for variance for yield and component characters in sesame

Source of variance	DF	Plant height	No of primary branches per plant	No of capsules per plant	No of seeds per capsules	50% flowering	80% maturity	Test weight	Oil content (%)	Seed yield (g)
Replication	2	12.38	2.07	163.69	0.37	70.82	4.47	0.07	3.04	8.47
Treatment	19	1338.87**	10.72**	14757.13**	72.99**	185.19**	140.46**	0.35**	67.02**	200.54**
Error	38	24.06	0.96	23.01	30.08	7.31	16.89	0.1	1.1	1.84
Total	59	1375.31	13.75	14943.83	76.44	263.32	161.82	0.52	71.16	3896.93

**significant at 1%, *significant at 5%

Table 3: Estimates of mean, range, coefficient of variation, heritability and genetic advance for nine characters in Sesame

Character	Mean ± S.E	Range	Coefficient of variation			Heritability h^2 (broad sense)	Genetic advance % of mean
			Genotypic GCV	Phenotypic PCV	Environmental ECV		
50% flowering	71.03 ± 1.56	45 - 81	10.84	11.49	3.81	89.03	21.07
80% maturity	78.67 ± 2.37	66.7 - 88.3	8.16	9.69	5.22	70.92	14.15
Plant height	232.66 ± 2.83	176.3 - 272.7	9.00	9.24	2.11	94.80	18.04
No of primary branches	10.53 ± 0.57	8.1 - 16.5	17.12	19.49	9.31	77.19	30.99
No of capsules per plant	168.40 ± 2.77	101.9 - 322.8	41.62	41.71	2.85	99.53	85.52
No of seeds per capsules	80.44 ± 1.01	69.07 - 87.2	6.00	6.38	2.18	88.34	11.61
Test weight	1.61 ± 0.07	1.3 - 2.5	20.76	22.08	7.50	88.47	40.23
Oil content	44.61 ± 0.61	35.8 - 52.7	10.51	10.77	2.39	95.10	21.10
Seed yield	29.13 ± 8.40	19.3 - 43.3	27.94	28.32	4.65	97.30	16.54

Genetic variability

Variability is considered to be insignificant if its coefficient does not exceed 10%, moderate if the coefficient range is from 10 to 20% and significant if coefficient exceed 20% (Guzhov, 1989). The estimates of phenotypic coefficient of variation PCV were higher than those of GCV (Table- 3) for all the traits indicating environmental factors influencing the characters. The highest PCV and GCV were recorded for no of capsules per plant, seed yield, test weight and no of primary branches indicating the presence of ample variations for these traits in the present material. Similar findings have also been reported by Ahadu Menzir (2012) [1], Zhimomi *et al.* (2019) [20] and Soniasabanam and Chaturvedi (2019) [17].

Heritability and Genetic advance

A fair measure of efficiency of selection for any quantitative traits can be derived from the estimates of heritability for the characters under consideration because heritability in broad sense is the ratio of genotypic variance to the phenotypic variance. But reliability of selection depends not only on heritability but it should also be accomplished by high genetic advance as well (Johnsen *et al.* 1955). High heritability

coupled with genetic advance shows that progress can be made through selection. Heritability usually consider being low if it is less than 30%, moderate between 30% to 60% and high if it is more than 60% (Johnsen *et al*. 1955). The range of genetic advance as percent of mean is classified as low if it is less than 10%, moderate between 10 to 20% and high if more than 20% (Johnsen *et al*. 1955). In the present study (Table-3), high estimates of heritability and genetic advance were obtained for 50% flowering, no of primary branches, no of capsules per plant, test weight, oil content and seed yield. The selection for these traits is likely to accumulate more additive genes leading to further improvement of their performance and these traits maybe used as selection criteria in sesame breeding programme. Similar observation was reported by Reedy *et al*. (2001), Zhimomi *et al*. (2019) [20] and Soniasabanam and Chaturvedi (2019) [17].
High heritability accompanied with moderate genetic advance as percent of mean were found in respect of 80% maturity, plant height and no of seeds per capsules indicating non-additive gene action. The heritability is being exhibited due to favourable influence of environment rather than genotypic and selection for such traits may not be rewarding. Similar findings have also been reported by Bamrotiya *et al*. (2016) [8].

Correlation coefficient

Yield is a complex character which is highly variable because of greater influence of the environment. It is also influenced directly and indirectly by set of other characters. It is in this context that the study of the nature and magnitude of association between yield and its component characters are of particular interest and n essential pre-requisite in a sound breeding programme. Such study helps the breeder to decide the characters to be considered for improvement in overall breeding programme. To utilize various quantitative characters in breeding programme, interrelationship between the characters are of immense value. Therefore, in the present study, correlations between 9 characters were studied in all possible combinations at phenotypic and genotypic level. In general magnitude, genotypic correlation tends to be higher than phenotypic correlation (Table- 4 and 5). This suggested a strong genetic association between the traits and the phenotypic expression was suppressed due to environmental influence. For seed yield significant positive correlation were observed between number of primary branches, number of capsules per plant, test weight and oil content indicating relative utility of these traits for selection. Similar results were also recorded by Kumhar *et al*. (2008) [14].

Path coefficient analysis

The path analysis (Table- 6) revealed that test weight (0.8732) contributed maximum positive direct effect on yield followed by no of capsules per plant (0.7613), 50% flowering (0.3025) and oil content (0.1829). No of capsules per plant, test weight and oil content exerted positive direct effect and also exhibited significant positive correlation with yield indicating the true relationship between the traits suggested that the direct selection for no of capsules per plant, test weight and oil content would likely be effective in increasing seed yield. Similar results were reported by Zhimomi et.al (2019) [20] for test weight and Shitiri *et al* (2018) [18] for days to 50% flowering and 100 seed weight. The residual effect estimated was (0.3826) indicating that the traits under study are not sufficient to account for variability and there might be few or more important characters other than those studied in the present investigation and thus solicits inclusion of some more characters. Inclusion of some physiological characters like LAI, Chlorophyll content, Harvest index etc could be considered important in order to derive a much clear picture of the casual relationship. The present study suggests that while selection, emphasis should be given on no of capsules per plant, test weight and oil content for improvement in seed yield.

Table 4: Estimates of Genotypic correlation coefficient between different characters in sesame

	50% flowering	**80% maturity**	**Plant height**	**No of primary branches**	**No of capsules per plant**	**No of seeds per capsules**	**Test weight**	**Oil content**	**Seed yield**
50% flowering		0.2412	0.6433**	0.0146	0.7620**	-0.0539	0.3104*	-0.1891	0.0183
80% maturity			-0.3116*	0.0579	0.1015	-0.4576*	0.4176*	0.1061	0.1597
Plant height				0.0519	0.0151	0.1380	0.0633	-0.2200	-0.2361
No of primary branches					0.8278**	0.1323	0.3456*	0.0640	0.3140*
No of capsules per plant						0.1327	0.1140	-0.1004	0.3005*
No of seeds per capsules							-0.2557	-0.1211	-0.1986
Test weight								0.4962*	0.7074**
Oil content									0.5336**
Seed yield									

*-significant at 5%, **-significant at 1%

Table 5: Estimates of phenotypic correlation coefficient between different characters in sesame

	50% flowering	**80% maturity**	**Plant height**	**No of primary branches**	**No of capsules per plant**	**No of seeds per capsules**	**Test weight**	**Oil content**	**Seed yield**
50% flowering		0.1684	0.6014**	0.0252	0.1920	-0.0620	0.2833	-0.1659	0.0437
80% maturity			-0.2508	0.0783	0.0911	-0.3239*	0.3073*	0.0690	0.1227
Plant height				0.0791	0.0175	0.1406	0.0872	-0.2086	-0.1989
No of primary branches					0.7300**	0.1188	0.2500	0.0820	0.2330
No of capsules per plant						0.1247	0.1086	-0.0995	0.2786
No of seeds per capsules							-0.2135	-0.1222	-0.1625
Test weight								0.4463*	0.6453**
Oil content									0.4727*
Seed yield									

*-significant at 5%, **-significant at 1%

Table 6: Direct and indirect effects of different characters at genotypic level in sesame on yield/plant

Characters	50% flowering	80% maturity	Plant height	No of primary branches	No of capsules per plant	No of seeds per capsules	Test weight	Oil content	r_g for yield/plant (g)
50% flowering	0.3025	0.0730	0.1946	0.0044	0.0023	-0.0163	0.0939	-0.0572	0.0183
80% maturity	-0.1449	-0.6006	0.1872	-0.0348	-0.0610	0.2749	-0.2508	-0.0637	0.1597
Plant height	-0.3822	0.1851	-0.5941	-0.0308	-0.0089	-0.0820	-0.0376	0.1307	-0.2361
No of primary branches	-0.0080	-0.0317	-0.0284	-0.5476	-0.4533	-0.0725	-0.1893	-0.0351	0.3140
No of capsules per plant	0.0058	0.0773	0.0115	0.6302	0.7613	0.1010	0.0868	-0.0764	0.3005
No of seeds per capsules	0.0085	0.0725	-0.0219	-0.0210	-0.0210	-0.1584	0.0405	0.0192	-0.1986
Test weight	0.2711	0.3647	0.0553	0.3018	0.0996	-0.2233	0.8732	0.4333	0.7074
Oil content	-0.0346	0.0194	-0.0402	0.0117	-0.0184	-0.0222	0.0908	0.1829	0.5336

Residual effect: 0.3826

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