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Genetic variability, heritability and genetic advance for seed yield and yield associated traits in White seeded sesame (*Sesamum indicum* L.)

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Abstract
Thirty white seeded sesame genotypes were evaluated in a Randomized Block Design (RBD) at the ORARS, Kayamkulam, during 2019-2020 to determine genetic variability, heritability and genetic advance for twelve biometric and quality characters. Analysis of variance showed that significant variation was present in the germplasm for the characters studied. The phenotypic coefficient of variation was found to be higher than the genotypic coefficient of variation for all the traits. High level of GCV and PCV was recorded in seed yield per plant followed by primary branches per plant, number of capsule leaf per axil, and number of capsules per plant. Heritability was high for all the characters except days to maturity (49.48%) which possessed only moderate heritability. GA (% mean) was high for all the characters except 1000 seed weight, days to 50% flowering, capsule length (cm), protein content (%), oil content (%) and days to maturity. High heritability coupled with high genetic advance as per cent of mean was recorded for seed yield per plant, number of capsule leaf per axil, number of capsules per plant, primary branches per plant, number of seeds per capsule and plant height.

Keywords: Sesame, genetic parameters, genetic advance, heritability

1. Introduction

Sesame (*Sesamum indicum* L., 2n=2x=26) belonging to the family Pedaliaceae is an annual herbaceous species cultivated for its edible seed and oil. It is commonly known by the names Sesamum, Til, Gingelly, Simsim, benniseed, Gergelim etc. Sesame is considered as 'Queen of Oilseeds' due to its stabilized keeping quality contributed by high degree of resistance to oxidation and rancidity (Bedigian and Harlan, 1986) [3]. The seed oil content of sesame varies from 41% to 60%, the highest value compared to other oil seed crops (Wei *et al*. 2015; Dossa *et al*. 2018;) [25, 5]. It is a rich source of protein (≈24%), vitamins (e.g. A and E), lignans (sesamin and sesamolin), γ-tocopherol, phytosterols, policosanols and lipids (Anastasi *et al*. 2017; Gharby *et al*. 2017) [2, 6]. Besides these, sesame seed is an excellent source of phosphorus, iron, magnesium, calcium, manganese, copper and zinc. Sesame seed is industrially processed for the supply of cooking oil, halvah, tahini, and cosmetic oils, while the seed cake is used for livestock feed. White coloured sesame is mostly preferred for making confectionary and bakery products. Furthermore, white or light coloured seeded sesame is known to possess higher oil, protein, linoleic acid and moisture ratios as compared to black seeded sesame (Kanu, 2011; Dossa *et al.* 2018) [11, 5].

Assessment of genetic variability is necessary to evaluate the cultivar performance and permits the estimation of coefficient of variability of the polygenic traits and the effect of environment on it. Nature and magnitude of variability, heritability and genetic advance estimates helps in getting higher seed yield and oil yielding genotypes via further breeding programmes. Keeping these aspects in view, the present study will be taken up to evaluate white seeded sesame genotypes for seed yield and oil content.

2. Materials and Methods

The present study was conducted at Onattukara Regional Agricultural Research Station, Kayamkulam, Kerala, India, during summer season 2019-20. The experiment was laid out with thirty white seeded sesame genotypes in a Randomized Block Design (RBD) with three replications. Recommended agronomic practices were followed during crop growth period as per the "Package of Practices recommendations" of Kerala Agricultural University (KAU, 2016).

The genotypes were evaluated for the following traits: days to 50% flowering, days to maturity, plant height, primary branches per plant, number of capsule leaf per axil, number of capsules per plant, capsule length (cm), number of seeds per capsule, 1000 seed weight, seed yield per plant, oil content (%) and protein content (%).

The data on various parameters were analysed statistically as per methods suggested by Panse and Sukhatme (1985) [19] for analysis of variance, Johnson *et al.,* (1955) [8] for heritability and genetic advance in per cent of mean.

3. Results and Discussion

The analysis of variance showed significant differences among the genotypes for all the traits *viz*., days to 50% flowering, days to maturity, plant height, primary branches per plant, number of capsule leaf per axil, number of capsules per plant, capsule length (cm), number of seeds per capsule, 1000 seed weight, seed yield per plant, oil content (%) and protein content (%) indicating the presence of considerable genetic variability among the experimental material under study (Table 1).

The value of Genotypic Coefficient of Variation (GCV) ranged from 2.79 for days to maturity to 43.59 for seed yield per plant. High GCV was observed for seed yield per plant (43.59), number of capsule leaf per axil (35.17), primary branches per plant (33.30), and number of capsules per plant (30.08). Mohan *et al.*, (2018) also reported higher estimates of GCV for number of capsules per plant, number of branches per plant and seed yield per plant. Characters like plant height (12.34), number of seeds per capsule (12.13), days to 50% flowering (12.06) and 1000 seed weight (10.16) showed moderate genotypic coefficient of variation. Low GCV was observed for capsule length (9.29cm) protein content (8.25%) oil content (6.17%) and days to maturity (2.79). Mohan *et al*., (2018) reported moderate GCV values for number of seeds per capsule and low GCV for days to maturity oil content and protein content. The Phenotypic Coefficient of Variation (PCV) was found high for seed yield per plant (49.72), primary branches per plant (42.26), number of capsule leaf per axil (36.27), and number of capsules per plant (34.10). Kiruthika *et al*., (2017) also reported similar findings for seed yield and primary branches per plant. Moderate PCV was observed for days to 50% flowering (15.09), plant height (14.07), number of seeds per capsule (13.50), and 1000 seed weight (10.68). Capsule length (9.87), protein content (8.38%) oil content (6.43%) and days to maturity (3.97) had low phenotypic coefficient of variation. The estimates of PCV were higher than GCV for all the traits studied which is an indicator of additive effect of the environment on the expression of the trait. These finding indicates that selection may be effective based on these characters and their phenotypic expression would be a good indication of their genetic potential. The results of GCV and PCV was in accordance of the results obtained by Kalairasi *et al*. (2019), Kehie *et al.* (2020) [12], Aboelkassem *et al.* (2021) [1] Vamshi *et al*. (2021) [24], Kumar *et al*. (2022) [14] and Sasipriya *et al.*, (2022) [21]. Kumari *et al*. (2020) [14] found moderate GCV and PCV values for days to 50% flowering, oil content, plant height and protein content. According to Pavani *et al*. (2020) [20] days to maturity, oil content and seed yield per plant showed low genotypic and phenotypic coefficient of variation.

High heritability was obtained for protein content (96.94%) followed by number of capsule leaf per axil (94.02%), oil content (92.06%), 1000 seed weight (90.48%), capsule length (88.61%) number of seeds per capsule (80.76%), number of capsules per plant (77.81%), plant height (cm) (77.00%), seed yield per plant (76.88%), days to 50% flowering (63.9%) and primary branches per plant (62.10%). Mohan *et al.*, (2018) also got similar findings. Moderate heritability was observed for days to maturity (49.48%). But Teklu *et al*. (2021) [22] and Kadvani *et al.* (2020) [9] got high values of heritability estimates for days to maturity. Low heritability.is not found in any of the character.

The highest estimate of genetic advance as percent of mean obtained was 78.74% (seed yield per plant), followed by 70.26% (number of capsule leaf per axil), 54.66% (number of capsules per plant), 54.06% (primary branches per plant), 22.45% (number of seeds per capsule), and 22.31 (plant height in cm). Kumar *et al*. (2022) [15] also observed high genetic advance for seed yield. In this study moderate genetic advance was recorded for 1000 seed weight (19.91%), days to 50% flowering (19.86%), capsule length (18.01%), protein content (16.74%) and oil content (12.19%). Low genetic advance was observed for days to maturity (4.04%). High heritability coupled with high genetic advance as per cent of mean was recorded for seed yield per plant, number of capsule leaf per axil, number of capsules per plant, primary branches per plant, number of seeds per capsule and plant height (cm) showed that these traits were controlled by additive genetic influences. Gogoi and Sarma (2019) [7], Kalaiyarasi *et al.* (2019) [10] Mourad *et al*., (2019) [18] Umamaheswari *et al.* (2019) [23] Kadvani *et al.* (2020) [9] Manje et *et al*. (2020) [16], Aboelkassem *et al*. (2021) [1] and Teklu *et al*. (2021) [22] supported the present findings. Pavani *et al.* (2020) [20] estimated low heritability and genetic advance as per cent over mean on the traits *viz*., capsule length, 1000 seed weight, days to maturity, oil content, and seed yield per plant, which don't support the current findings. Kumari *et al*. (2020) [14] reported high heritability coupled with high genetic advance as percent of mean for test weight, number of capsules per plant, seed yield per plant, days to 50% flowering, oil content, protein content, number of primary branches per plant and plant height indicating lesser influence of environment in expression of these traits which is also a contradictory to the present study. Vamshi *et al*. (2021) [24] also found high heritability with high genetic advance on oil content. In the current study 1000 seed weight, number of capsules per plant, seed yield per plant, days to 50% flowering, oil content, protein content, number of primary branches per plant and plant height has high heritability coupled with moderate genetic advance only.

Table 1: Analysis of variance for yield and yield components in white seeded sesame (*Sesamum indicum* L.)

Sl. No.	Characters	Mean square		
		Replication	Treatment	Error
1.	Days to 50% flowering	22.011	65.419**	10.367
2	Days to Maturity	12.211	20.885**	5.303
3	Plant height (cm)	202.809	781.538**	70.779
4	Primary branches per plant	0.217	3.635**	0.615
5	Number of capsule leaf per axil	0.012	0.489**	0.010
6	Number of capsules per plant	162.192	673.998**	58.51
7	Capsule length (cm)	0.001	0.193**	0.008
8	Number of seeds per capsule	30.900	213.411**	15.705
9	1000 seed weight	0.025	0.295**	0.010
10	Seed yield per plant	6.408	29.130**	2.653
11	Oil content (%)	2.011	29.184**	0.816
12	Protein content (%)	1.076	10.903**	0.113

** Significant at 1 percent level

Table 2: Genetic estimates for various biometric and quality traits in white seeded sesame

Sl. No.	Traits	Range	GCV	PCV	Heritability (%)	GA as % mean
1	Days to 50% flowering	28.67-48.67	12.06	15.09	63.90	19.86
2	Days to Maturity	77.67-87	2.79	3.97	49.48	4.04
3	Plant height (cm)	89.07-155.73	12.34	14.07	77.00	22.31
4	Primary branches per plant	0.80-6.07	33.30	42.26	62.10	54.06
5	Number of capsule leaf per axil	1.00-2.73	35.17	36.27	94.02	70.26
6	Number of capsules per plant	28.27-83.33	30.08	34.10	77.81	54.66
7	Capsule length (cm)	2.20-3.17	9.29	9.87	88.61	18.01
8	Number of seeds per capsule	52.67-84.33	12.13	13.50	80.76	22.45
9	1000 seed weight	2.51-3.54	10.16	10.68	90.48	19.91
10	Seed yield per plant	2.97-15.27	43.59	49.72	76.88	78.74
11	Oil content (%)	43.66-55.33	6.17	6.43	92.06	12.19
12	Protein content (%)	19.54-26.66	8.25	8.38	96.94	16.74

4. Conclusions

Greater genetic variability increases the chances for selection of better genotypes. High estimates of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) on seed yield per plant, primary branches per plant, number of capsule leaf per axil, and number of capsules per plant gives an idea about the magnitude of variability present in these characters in a genetic population. High heritability along with high genetic advance in the traits, seed yield per plant, number of capsule leaf per axil, number of capsules per plant, primary branches per plant, number of seeds per capsule and plant height indicated additive gene action predicting genetic gain under selection than heritability estimates alone. Therefore plant breeding efforts should aim at the manipulation of available genetic diversity in the desired direction through suitable crop improvement programmes for developing white seeded sesame with seed yield and oil content.

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