RESEARCH ARTICLE

**“Genetic Variability and Correlation Coefficient Analysis in Black Sesame [*Sesamum indicum* L*.*]”**

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|  | ABSTRACT The study was conducted using forty genotypes of sesame with Randomized Block Design withthree replications at Junagadh Agricultural University, during the *kharif*-2020 growing season.. The analysis of variance revealed highly significance for all characters studied. The phenotypic coefficient of variation was slightly higher than that of genotypic coefficient of variation for all the traits studied. Estimate of high heritability for all characters studied except days to maturity and oil content, which exhibited medium heritability. In correlation studies of the characters, seed yield per plant was found to be significantly and positively correlated with length of capsule followed by number of capsules per plant and number of branches per plant at both the genotypic and phenotypic levels. Thus, these characters were the most important traits and may contribute considerably towards higher seed yield. |

**Keywords:** Sesame, Variability, Heritability, Genetic advance, Correlation coefficient.

**INTRODUCTION**

Sesame (*Sesamum indicum* L.) is one of the world’s oldest oil seed crop and has been cultivated in Asia from ancient times. It is popularly known as Til, Baniseed and Gingelly. It is a diploid species (2n = 26), a member of the family Pedaliaceae. Its oil content generally varies from 46 to 52 per cent and protein from 18 to 20 per cent. Nearly 73 per cent of the oil is used for edible purposes, 14.5 per cent for domestic uses including preparation of sweet candies as condiments, culinary and confectionary purposes, whereas 8.3 per cent for hydrogenization and 4.2 per cent for industrial purposes in the manufacture of paints, perfumed oils, pharmaceuticals and insecticides. It has anti-bacterial, anti-viral, anti-fungal and anti-oxidant properties. Since, sesame oil is cholesterol free, it is also used in food industries and recommended for heart patients.

The primary objective of any crop improvement programme is to increase crop yield. The gene action in the character seed yield is complex. Many factors that influence yield must be considered and evaluated in terms of their contribution to yield. A successful breeding programme for yield improvement through phenotypic selection is primarily determined by the nature and magnitude of variation available the genetic material, as well as the role of the environment in the expression of plant characters, i.e. phenotype. This requires the partitioning of the overall variability into its heritable and non-heritable components with the help of suitable genetic parameters such as genetic coefficient of variation, heritability and genetic advance.

Correlation provides information about the relative contribution of various component traits towards economic yield. Genotypic correlations provide a measure of genetic association between characters and are generally used in selecting for one character as means for improving another. Correlation among traits may result from pleiotropy, linkage or physiological associations among characters. Correlation measures the mutual relationship among various plant characters and helps in determining the yield components on which indirect selection can be based for improvement in yield.

**MATERIAL AND METHODS**

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The current study was carried out at the Sagdividi Farm, Department of Seed Science and Technology, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif* 2020-21.

The experimental material consisted of 40 diverse genotypes of sesame [*Sesamum indicum* L.]. Each genotype was sown in a single row plot of 3.0 m length with a spacing of 45 cm × 15 cm. Five competitive plants per genotype in each replication were randomly selected to record observations for different characters (except days to 50% flowering and days to maturity) and their averages were used in the statistical analysis. Days to 50% flowering and days to maturity was measured on plot basis. The observation recorded on 14 characters *viz*., days to 50% flowering, days to maturity, plant height, number of branches per plant, number of capsules per plant, height to first capsule, length of capsule, width of capsule, number of internodes per plant, seed yield per plant, 1000 seed weight, number of capsules per leaf axil, number of seeds per capsule and oil content. Oil content in seed sample of each genotype was estimated by using Nuclear Infrared Reflectance (NRI). The analysis of variance for randomized block design (RBD) was done for each character as per Panse and Sukhatme (1985). The genotypic (GCV) and phenotypic (PCV) coefficients of variation were estimated according to the formula suggested by Burton and De Vane (1953). Heritability (h2) in broad sense and genetic advance as % of the mean (GA %) were calculated as per the formula suggested by Allard (1960).

The phenotypic and genotypic correlation coefficients of all the pairs of characters were worked out as per Al-Jibouri *et al*. (1958).

**RESULTS AND DISCUSSION**

The analysis of variance revealed that mean square due to genotypes was highly significant for all the 14 characters indicating the presence of sufficient amount of variability in the experimental material used.

**Genotypic and phenotypic coefficients of variation**

The better index for measuring the genetic variation is genetic coefficient of variation (GCV) as described by Burton and De Vane (1953) for comparing the genetic variability present in different traits. Close relationship between genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) was observed for all the characters. The magnitude of PCV was slightly greater than GCV which revealed a very little influence of environmental variation for their expression. This indicated that phenotypic variability may be considered as reliable measure of genotypic variability.

Highest genotypic coefficient of variation and phenotypic coefficient of variation was observed for number of branches per plant followed by number of capsule per leaf axil and seed yield per plant. High estimates of genotypic and phenotypic coefficient of variation in sesame for number of branches per plant was also supported by Gupta *et al*. (2020). High estimates of GCV and PCV for seed yield per plant were reported by Takele *et al.* (2019) and Saravanan *et al*. (2020).

The moderate values of genotypic and phenotypic coefficient of variation were exhibited for height to first capsule followed by number of capsules per plant, length of capsule, number of internodes per plant and 1000-seed weight. This finding is in accordance with Prithviraj and Parameshwarappa(2017) for height to first capsule and 1000-seed weight and for number of internodes per plant by Patidar *et al*. (2020).

Days to 50% flowering, days to maturity and oil content exhibited low magnitude of both genotypic and phenotypic coefficient of variation. These results were in close harmony with Prithviraj and Parameshwarappa (2017), while low GCV and PCV reported for days to maturity and oil content were supported by Pavani *et al.* (2020).

Heritability

The genotypic coefficient of variation (GCV %) does not reflect the amount of heritable variation. Thus, the knowledge of heritability of a character helps the plant breeders in predicting the genetic advance for any quantitative characters and aids in exercising necessary selection procedure. High estimates of heritability were observed for all the characters as shown in Table 1. *viz.,* length of capsule (98.03%) followed by number of internodes per plant (97.85), number of capsules per plant (97.62%), 1000-seed weight (97.05%), seed yield per plant (94.42%), number of branches per plant (91.77%), number of capsules per leaf axil (91.31%), number of seeds per capsule (91.23), height to first capsule (90.73%), days to 50% flowering (88.72%), width of capsule (80.94) and plant height (79.48). Moderate heritability reported for days to maturity (48.84%) and oil content (37.55%).

High magnitude of heritability reported for number of internodes per plant by Jadhav and Mohrir (2012). Similar results for number of capsules per plant and number of branches per plant were obtained by Gupta *et al*. (2020). Similar result for 1000-seed weight reported by Gogoi and Sharma (2019), Gupta *et al*. (2020) and Saravanan *et al*. (2020). Similar result for seed yield per plant were supported by Prithviraj and Parameshwarappa (2017), Gogoi and Sharma (2019), Gupta *et al.* (2020) and Manjeet *et al*. (2020). Similar result for number of seeds per capsule and plant height reported by Alake *et al.* (2010) and Prithviraj and Parameshwarappa (2017). For height to first capsule reported by Gidey *et al*. (2013), Patil and Lokesha (2018) and Pavani *et al.* (2020)**.** For days to 50% flowering reported by Saxena and Rajani (2017) and Singh *et al*. (2018). Moderate heritability for days to maturity reported by Ahmed and Ahmed (2013) and low heritability for oil content has been reported by Pavani *et al*. (2020).

Genetic advance expressed as % of mean:

The genetic advance expressed as per cent of mean was highest for number of branches per plant (49.74%) followed by number of capsules per leaf axil (47.14%), seed yield per plant (42.49%), height to first capsule (36.68%), number of capsules per plant (36.50%), length of capsule (32.78%), number of internodes per plant (31.37%) and 1000-seed weight (26.93%). Moderate values of genetic advance expressed as percentage of mean was recorded for number of seeds per capsule (18.11%) followed by plant height (16.82%), days to 50% flowering (15.96%) and width of capsule (11.69%). On the other hand, low value of genetic advance expressed as per cent of mean was observed for days to maturity (3.36%) and oil content (0.69%).

High values of genetic advance expressed as per cent of mean have been reported in sesame for number of branches per plant and number of capsules per plant by Takele *et al.* (2019), Gupta *et al*. (2020), Kadvani *et al.* (2020) and Manjeet *et al*. (2020). Similar result for seed yield per plant reported by Gogoi and Sharma (2019), Gupta *et al.* (2020), Takele *et al.* (2019) and Manjeet *et al.* (2020). Similar result for height to first capsule supported by Prithviraj and Parameshwarappa (2017), Patil and Lokesha (2018) and Pavani *et al*. (2020). Similar result for length of capsule reported by Saxena and Rajani (2017) and Kiruthika *et al*. (2018). For number of internodes per plant same result reported by Jadhav and Mohrir (2012). For 1000-seed weight similar result reported by Gogoi and Sharma (2019), Gupta *et al.* (2020), Kadvani *et al.* (2020) and Saravanan *et al*. (2020). Moderate value of genetic advance expressed as percent of mean was reported by Singh *et al.* (2018) for days to 50% flowering and number of seeds per capsule moderate result reported by Toprope *et al*. (2009). Low value genetic advance expressed as per cent of mean was reported for oil content by Prithviraj and Parameshwarappa (2017) and Pavani *et al*. (2020) and also low value was reported for days to maturity and supported by Prithviraj and Parameshwarappa (2017) and Pavani *et al*. (2020).

In the present study, high estimate of heritability coupled with high genetic advance expressed as percentage of mean for number of branches per plant followed by number of capsules per leaf axil, seed yield per plant, height to first capsule, number of capsules per plant, length of capsule, number of internodes per plant and 1000-seed weight which may be attributed to the preponderance of additive gene action and possess high selective value thus, selection pressure could be profitably applied on these character for improvement.

**CORRELATION COEFFICIENTS**

The correlation coefficients were worked out among 14 characters to find out association of seed yield per plant with its components at genotypic (rg) and phenotypic (rp) levels. The data given in Table 2 revealed that, in general, the genotypic correlation coefficients were relatively higher than their corresponding phenotypic correlation coefficients.

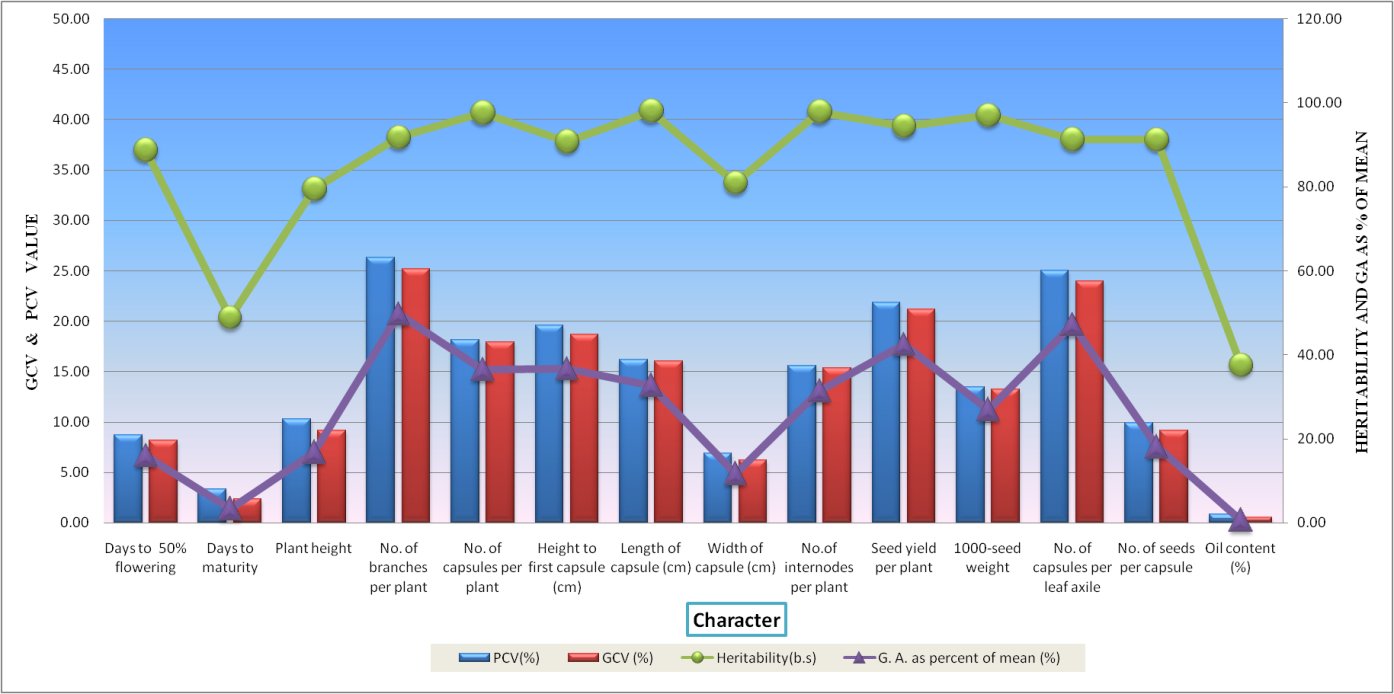
In the present study, seed yield per plant was found to be significantly and positively correlated with length of capsule, number of capsules per plant, days to maturity and number of branches per plant at both the genotypic and phenotypic levels. Such positive interrelationship between seed yield per plant and these attributes had also been reported in sesame by several researchers. The positive genotypic and phenotypic association had been reported for number of branches per plant and number of capsules per plant with seed yield per plant by Manjeet *et al*. (2019), Navaneetha *et al.* (2019), Navneet *et al*. (2019) and Saravanan *et al.* (2020). For length of capsule by Shekhawat *et al.* (2013) and Navneet *et al*. (2019). For days to maturity by Bamrotiya *et al*. (2016), Lal *et al*. (2016) and Agrawal *et al*. (2017). Seed yield had negative correlation with 1000-seed weight which was in accordance with the reports of Alake *et al.* (2010).

**Table 1: Phenotypic and genotypic coefficients of variation, heritability and genetic advance for various characters in sesame.**

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| **Sr.**  **No.** | **Traits** | **Phenotypic coefficients of variation (PCV %)** | **Genotypic coefficients of variation (GCV %)** | **Heritability in broad sense (%)** | **Genetic advance** | **G. A. expressed as per cent of mean (%)** |
| 1 | **DFF** | 8.73 | 8.22 | 88.72 | 6.47 | 15.96 |
| 2 | **DM** | 3.34 | 2.33 | 48.84 | 2.65 | 3.36 |
| 3 | **PH** | 10.27 | 9.16 | 79.48 | 12.53 | 16.82 |
| 4 | **NBP** | 26.31 | 25.20 | 91.77 | 1.16 | 49.74 |
| 5 | **NCP** | 18.15 | 17.93 | 97.62 | 15.90 | 36.50 |
| 6 | **HFC** | 19.62 | 18.69 | 90.73 | 9.17 | 36.68 |
| 7 | **LC** | 16.23 | 16.07 | 98.03 | 79.40 | 32.78 |
| 8 | **WC** | 6.88 | 6.19 | 80.94 | 0.07 | 11.69 |
| 9 | **NIP** | 15.56 | 15.39 | 97.85 | 2.13 | 31.37 |
| 10 | **SYP** | 21.84 | 21.22 | 94.42 | 2.40 | 42.49 |
| 11 | **1000-SW** | 13.47 | 13.27 | 97.05 | 0.80 | 26.93 |
| 12 | **NCLA** | 25.06 | 23.95 | 91.31 | 0.62 | 47.14 |
| 13 | **NSPC** | 9.94 | 9.20 | 91.23 | 8.92 | 18.11 |
| 14 | **OC** | 0.89 | 0.54 | 37.55 | 0.32 | 0.69 |

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| **Correlated Traits** | | **DFF** | **DM** | **PH** | **NBP** | **NCP** | **HFC** | **LC** | **WC** | **NIP** | **1000-SW** | **NCLA** | **NSPC** | **OC (%)** |
| **SYP** | rg | 0.0584 | 0.5097\*\* | 0.3261\* | 0.6690\*\* | 0.7633\*\* | -0.1441 | 0.8864\*\* | 0.2780 | 0.1034 | -0.1560 | 0.2008 | 0.0935 | -0.4532\*\* |
| rp | 0.0527 | 0.3255\* | 0.2818 | 0.6522\*\* | 0.7377\*\* | -0.1373 | 0.8533\*\* | 0.2517 | 0.1049 | -0.1530 | 0.1759 | 0.0872 | -0.2610 |
| **DFF** | rg |  | 0.6034\*\* | 0.2054 | 0.1367 | -0.0671 | 0.2317 | 0.0477 | -0.1953 | 0.1809 | 0.0460 | -0.0520 | -0.1197 | 0.0172 |
| rp |  | 0.4281\*\* | 0.1780 | 0.1384 | -0.0633 | 0.2113 | 0.0351 | -0.1663 | 0.1705 | 0.0397 | -0.0391 | -0.1134 | 0.0488 |
| **DM** | rg |  |  | 0.2198 | 0.5129\*\* | 0.2258 | 0.0086 | 0.3800\* | -0.1215 | 0.2945 | 0.0850 | -0.2180 | -0.1885 | 0.0676 |
| rp |  |  | 0.1298 | 0.3261\* | 0.1448 | 0.0160 | 0.2473 | -0.0424 | 0.2145 | 0.0578 | -0.1582 | -0.1964 | -0.0182 |
| **PH** | rg |  |  |  | 0.0417 | 0.2940 | 0.4129\*\* | 0.1251 | 0.0482 | 0.7059\*\* | 0.1237 | 0.4115\*\* | 0.1323 | 0.1223 |
| rp |  |  |  | 0.0412 | 0.2576 | 0.3822\* | 0.1111 | 0.0511 | 0.6337\*\* | 0.0988 | 0.3272\* | 0.0848 | 0.0463 |
| **NBP** | rg |  |  |  |  | 0.5273\*\* | -0.2448 | 0.7273\*\* | 0.0849 | 0.0299 | 0.0323 | 0.0654 | -0.1466 | -0.4149\*\* |
| rp |  |  |  |  | 0.5037\*\* | -0.2151 | 0.6822\*\* | 0.0787 | 0.0248 | 0.0313 | 0.0506 | -0.1228 | -0.2042 |
| **NCP** | rg |  |  |  |  |  | -0.0826 | 0.6504\*\* | -0.0139 | -0.0068 | -0.0099 | 0.2504 | -0.0033 | -0.1933 |
| rp |  |  |  |  |  | -0.0866 | 0.6375\*\* | -0.0056 | -0.0076 | -0.0087 | 0.2364 | 0.0070 | -0.1234 |
| **HFC** | rg |  |  |  |  |  |  | -0.1274 | 0.0465 | -0.0270 | 0.0242 | 0.0437 | -0.0603 | 0.3183\* |
| rp |  |  |  |  |  |  | -0.1155 | 0.0293 | -0.0219 | 0.0252 | 0.0484 | -0.0540 | 0.2101 |
| **LC** | rg |  |  |  |  |  |  |  | 0.3157\* | 0.0139 | -0.2114 | 0.1802 | 0.1276 | -0.5641\*\* |
| rp |  |  |  |  |  |  |  | 0.2730 | 0.0158 | -0.2106 | 0.1710 | 0.1245 | -0.3236\* |
| **WC** | rg |  |  |  |  |  |  |  |  | 0.0971 | -0.0712 | 0.0815 | 0.3230\* | 0.1052 |
| rp |  |  |  |  |  |  |  |  | 0.0878 | -0.0428 | 0.0658 | 0.2889 | 0.0122 |
| **NIP** | rg |  |  |  |  |  |  |  |  |  | 0.2047 | 0.1152 | 0.0725 | 0.0391 |
| rp |  |  |  |  |  |  |  |  |  | 0.1970 | 0.1050 | 0.0656 | 0.0187 |
| **1000-SW** | rg |  |  |  |  |  |  |  |  |  |  | 0.2143 | 0.0130 | 0.0469 |
| rp |  |  |  |  |  |  |  |  |  |  | 0.2032 | 0.0133 | 0.0457 |
| **NCLA** | rg |  |  |  |  |  |  |  |  |  |  |  | 0.1109 | -0.6085\*\* |
| rp |  |  |  |  |  |  |  |  |  |  |  | 0.1167 | -0.3325\* |
| **NSPC** | rg |  |  |  |  |  |  |  |  |  |  |  |  | -0.0955 |
| rp |  |  |  |  |  |  |  |  |  |  |  |  | -0.0414 |

**Table 2: Genotypic(rg) and phenotypic(rp) correlation coefficient among fourteen character in 40 genotypes of sesame**



**Fig. 1**. **Graphical representation of GCV, PCV, heritability and genetic advance as percent of mean (%) for fourteen characters in sesame**

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### *Abbreviations*

|  |  |
| --- | --- |
| DFF = Days to 50% flowering | DM = Days to maturity |
| PH = Plant height | NBP = Number of branches per plant |
| NCP = Number of capsules per plant | HFC = Height to first capsule |
| LC = Length of capsule | WC =Width of capsule |
| NIP = Number of internodes per plant | SYP = Seed yield per plant |
| 1000-SW = 1000- seed weight | NCLA = Number of capsule per leaf axile |
| NSPC = Number of seeds per capsule | OC = Oil content |

**Conclusion**

The analysis of variance revealed highly significant difference for all characters suggesting the presence of sufficient amount of variability among the genotypes studied.The values of phenotypic coefficient of variation were slightly higher than that of genotypic coefficient of variation for all the traits studied. The high values of GCV and PCV were recorded for number of branches per plant followed by seed yield per plant and number of capsules per leaf axil indicated the presence of wide genetic variation for these characters.The high heritability (broad sense) values were observed for all characters except days to maturity and oil content which indicated that heritability may be due to higher contribution of genotypic component in these traits. High estimates of heritability coupled with high genetic advance expressed as percentage of mean were observed for number of branches per plant, number of capsules per plant, height to first capsule, length of capsule, number of internodes per plant, seed yield per plant, 1000-seed weight and number of capsules per leaf axil which may be attributed to the preponderance of additive gene action and possessed high selective value and thus, selection pressure could profitably be applied on these characters for their rationale improvement.

The results on correlation coefficients revealed that length of capsule, number of capsules per plant, number of branches per plant and days to maturity were the most important traits and may contribute considerably towards higher seed yield.