Original Research Article

Evaluation of Sesame (*Sesamum indicum* L.) Genotypes to the Shaded Uplands of Southern Region

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**Abstract**

The sesame germplasm consisting of thirty three accessions were assessed for the extent of variability, degree and direction of character association among yield and its contributing traits and the direct and indirect effects of various components on yield. Analysis of variance showed significant differences among the genotypes for almost all the characters studied. High and moderate phenotypic and genotypic coefficients of variation (PCV and GCV) were noticed for most of the yield contributing characters. Highest and lowest PCV and GCV were recorded for number of capsules per unit length and 1000-seed weight respectively. High estimates of heritability coupled with high to moderate genetic advance as per cent over mean was recorded for all the yield associated traits except for days to maturity, oil content and 1000-seed weight. Yield had positive and significant association with the yield contributing characters such as plant height, number of primary branches, number of capsules per plant, length of capsule and number of seeds per capsule, signifying that selection based on these characters may improve yield. The highest genotypic and phenotypic correlation with yield was observed for number of capsules per plant. Path analysis revealed that number of capsules per plant had the highest positive direct effect on seed yield per plant followed by number of seeds per capsule. Number of primary branches per plant and days to maturity had the maximum positive indirect effect on seed yield per plant through number of capsules per plant.

**Keywords**
Sesame, Shade tolerance, Variability, GCV, Correlation analysis.

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**Introduction**

Sesame (*Sesamum indicum* L., 2n=2x=26) commonly known as *gingelly*, *til*, and *tila* in Sanskrit, is a member of the order Tubiflorae and family Pedaliaceae. Sesame is highly valued for its cooking quality, medicinal value of its oil, high seed oil content (50-60%), protein (18-25%), calcium, phosphorous, oxalic acid and excellent qualities of the seed oil and oil cake. Sesame crop has many agricultural advantages. It is grown on residual soil moisture with low inputs, and is a good crop for rotations with an extensive tap root system (Ashri, 1998). India is considered to be the major centre of genetic diversity even though the crop originated in Africa (Maiti *et al.*, 2012). In India, sesame is cultivated in an area of 1.94 m ha with 0.755 m ton production (Gayathri, 2011). However, the average productivity of sesame in India (453 kg ha⁻¹) is far below the
average productivity in China (1127 kg ha$^{-1}$) and Egypt (1211 kg ha$^{-1}$). In Kerala, sesame is mainly cultivated in summer rice fallows. During 1990-91, 5.59 lakh hectares were under paddy; however during 2009-10 it was only 2.34 lakhs ha. Thus within two decades, there was a decline of 3.25 lakh hectares (Kumari, 2011).

Shrinking lowlands, shortage of labour and unprecedented summer showers resulting in crop failure, are the major reasons for the dwindling sesame cultivation in the state. Upland sesame cultivation is gaining importance in this scenario. Coconut gardens are the potential areas where we can intervene for upland sesame cultivation in the state since there has been a 28 per cent increased area under coconut over a period of twenty years (Govt. of Kerala, 2006). This highlights the need to enhance the productivity of the crop by developing high yielding genotypes. A thorough screening of the available germplasm for genetic variability for yield and its component traits will help in identifying elite genotypes.

**Materials and Methods**

The experiment was conducted in the field of Instructional Farm, College of Agriculture, Vellayani, during rabi season, 2012-13 in a Randomized Block Design in a coconut garden. A spacing of 30 cm x 15 cm between plants was adopted. The material for study comprised of thirty three genotypes of sesame collected from various research stations including the varieties from Kerala Agricultural University. Observations were recorded on five random competitive plants in each replication for following traits viz., days to 50 per cent flowering, plant height, days to maturity, number of capsules per unit length, number of primary branches per plant, number of capsules per plant, length of the capsule, number of seeds per capsule, seed yield per plant, 1000-seed weight, root length and oil content.

The biometric observations recorded were subjected to ANOVA (Panse and Sukhatme, 1985) for comparison among various treatments and to estimate variance components. The phenotypic and genotypic variances were calculated by utilizing the respective mean square values (Johnson et al., 1955).

The genotypic and phenotypic coefficients of variation were calculated by following Burton (1952). Categorization of the range of variation was effected as proposed by Sivasubramanian and Menon (1973).

Both heritability percentage ($h^2$) in broad sense and genetic advance (GA) as percentage of mean was estimated and categorized for various characters as per the formulae suggested by Johnson et al., (1955).

**Results and Discussion**

The analysis of variance revealed highly significant differences among the thirty three genotypes for all the traits studied except for 1000-seed weight, indicating the presence of substantial amount of variability and selection could be effective for improvement of those characters (Table 1).

Similar results have also been reported by Valarmathi et al., (2004) and Raghuwanshi (2005).

**Phenotypic and genotypic coefficients of variation**

High GCV was shown by characters number of capsules per unit length, number of primary branches, seed yield per plant, root length and number of capsules per plant, clearly indicating that selection will be
rewarding (Fig. 1). These results are in agreement with those of Valarmathi et al., (2004). The estimates of PCV and GCV were high for the characters number of primary branches per plant, number of capsules per plant and seed yield per plant. Similar results were reported by Mandal et al., (2010) and Gayathri (2011). Low estimates of GCV for days to 50 per cent flowering, days to maturity, number of seeds per capsule, oil content and 1000-seed weight indicated limited scope for improvement of these characters through selection due to low magnitude of heritable variation.

Thangavel et al., (2000) published comparable results on estimates of GCV and PCV. The genotypes exhibited significant variation for oil content. The highest oil content noticed was 50.16 per cent and the lowest was 45.52 per cent with a mean of 48.59 per cent. Similar results were earlier reported by Shadakshri et al., (1995).

**Heritability and genetic advance**

High heritability combined with high genetic advance (as per cent of mean) was observed for number of capsules per unit length, seed yield per plant, number of primary branches, plant height, root length and number of capsules per plant indicating these characters were controlled by additive gene effects and phenotypic selection for these characters is likely to be effective (Fig. 2).

**Table 1** Analysis of variance for various characters of sesame genotypes

| Characters                  | Mean sum of squares |
|-----------------------------|---------------------|
|                             | Replication | Genotypes | Error |
| Days to 50% flowering       | 3.363       | 21.017**  | 0.645 |
| Plant height (cm)           | 293.011     | 130.88**  | 5.364 |
| Days to maturity            | 26.250      | 57.332**  | 1.420 |
| No. primary branches        | 0.010       | 5.911**   | 0.020 |
| No. capsules/plant          | 4.859       | 55.224**  | 0.120 |
| No. capsules/unit length    | 0.007       | 0.041*    | 0.001 |
| Length of capsule (cm)      | 0.023       | 0.185*    | 0.003 |
| No. seeds/capsule           | 4.734       | 55.022**  | 0.977 |
| Root length (cm)            | 1.149       | 13.704**  | 0.027 |
| Oil content (%)             | 0.016       | 4.299**   | 0.001 |
| 1000-seed weight (g)        | 0.001       | 0.001     | 0.001 |
| Seed yield/plant (g)        | 0.207       | 1.449*    | 0.004 |

*Significant at 5% level; **Significant at 1% level
### Table 2: Genotypic correlation among various characters of sesame

|        | DFF     | PH      | DM      | NPB     | NCP     | LC      | NSC     | RL      | OC      | TSW     | SYP     | NCL     |
|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| DFF    | 1.0000  |         |         |         |         |         |         |         |         |         |         |         |
| PH     | -0.1199 | 1.0000  |         |         |         |         |         |         |         |         |         |         |
| DM     | -0.0331 | -0.0478 | 1.0000  |         |         |         |         |         |         |         |         |         |
| NPB    | -0.3086*| -0.0122 | 0.1760  | 1.0000  |         |         |         |         |         |         |         |         |
| NCP    | -0.0482 | 0.2308  | 0.3809**| 0.3953**| 1.0000  |         |         |         |         |         |         |         |
| LC     | 0.2117  | 0.1329  | 0.4481**| -0.1191 | 0.0911  | 1.0000  |         |         |         |         |         |         |
| NSC    | 0.2258  | 0.1583  | 0.4208**| -0.1730 | 0.0444  | 0.9847**| 1.0000  |         |         |         |         |         |
| RL     | 0.1239  | 0.0231  | -0.0327 | -0.1896 | 0.1109  | 0.1465  | 0.2310  | 1.0000  |         |         |         |         |
| OC     | 0.1899  | -0.1529 | -0.0838 | -0.2048 | -0.2293 | 0.1196  | 0.1613  | 0.2073  | 1.0000  |         |         |         |
| TSW    | 0.1061  | -0.0958 | -0.2436*| 0.0741  | -0.2233 | -0.1867 | -0.0534 | 0.0985  | 1.0000  |         |         |         |
| SYP    | 0.0357  | 0.2720* | 0.4864**| 0.2959* | 0.9415**| 0.4083**| 0.3698**| 0.1811  |         |         |         |         |
| NCL    | 0.3523**| -0.2855*| 0.1052  | -       | 0.0499  | 0.1290  | 0.1414  | 0.2658* | 0.1927  | -0.1828 | 0.1042  | 1.0000  |

| DFF  | Days to first flowering |
| PH   | Plant height (cm)       |
| DM   | Days to maturity        |
| NPB  | Number of primary branches/plant |
| NCP  | Number of capsules/plant |
| LC   | Length of capsule (cm)  |
| NSC  | Number of seeds/capsule |
| RL   | Root length (cm)        |
| OC   | Oil content (%)         |
| TSW  | 1000 seed weight (g)    |
| SYP  | Seed yield/plant (g)    |
| NCL  | Number of capsules/unit length |

* Significant at 5% level

** Significant at 5% level
**Fig. 1** PCV (%) and GCV (%) for various characters of sesame genotypes

PCV: Phenotypic coefficient of variation  
GCV: Genotypic coefficient of variation

**Fig. 2** Heritability (%) and genetic advance (%) for various characters of sesame genotypes

GA: Genetic advance
Fig. 3 Path diagram

X1: Plant height (cm)  
X2: Days to maturity  
X3: Number of primary branches/plant  
X4: Number of capsules/plant  
X5: Length of capsule (cm)  
X6: Number of seeds/capsule  
X7: Oil content (%)
The path analysis revealed that seed yield per plant was positively and directly affected by the number of capsules per plant followed by number of seeds per capsule. All these had positive genotypic correlations with seed yield (Table 1 and Fig. 3). The greater influence of these traits reflects their importance as seed yield components. Similar results were reported by Mothilal (2005), Shajan (2002) and Kurdistani et al., (2011) reported that number of capsules per plant had the highest positive direct effect on seed yield which is in conformity with the present observation. Plant height, number of capsules per plant, length of capsule, number of seeds per capsule and oil content showed positive direct effect on yield similar to the earlier report by Vidhyavati et al., (2005) and Mohan (2011). The direct negative effect of days to maturity and number of primary branches per plant were in analogous to the reports of Siddiqui et al., (2005). The indirect effect of number of capsules per plant on seed yield through plant height, days to maturity, number of primary branches, length of capsule and number of seeds per capsule. Sumathi et al., (2007) and Georgiev et al., (2012) confirmed equivalent outcomes for plant height, days to maturity and number of primary branches and Gnanasekaran et al., (2008) for number of primary branches. Path analysis revealed that number of capsules per plant recorded the highest positive direct effect with seed yield per plant followed by number of seeds per capsule and plant height. However, number of primary branches per plant and days to maturity expressed negative direct effect. Similar reports have been given by Manjunatha et al., (2008), Parmeswarappa et al., (2009) and Gayathri (2011).

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