

# Evaluation of Parents for Seed Yield and Its Components in Sesame (*Sesamum indicum* L.)

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**Abstract:** Combining ability for seed yield and its component characters was studied in sesame by using line x tester mating design. The experimental material included eight lines, four testers and 32 hybrids obtained by crossing eight lines with each of the four testers. The analysis of variance for all the nine characters under study was highly significant which specified wide variability amid parents and hybrids for these traits. The greater degree of SCA variance than GCA variance indicated the role of non-additive genes meant for all the nine characters studied. DORG 37-11, CT-51 and IC 129908 among lines and Phule Til-1 as well as RT-125 among testers were found to be good general combiners for seed yield per plant. Seed yield per plant was maximum for CT-50(14.26 g) among lines and RT-125(14.52g) among testers. Selection of parents based on *per se* performance as well as *gca* effects together showed that the parent IC 129908 can be adjudged as the best parent and can be included in further breeding programmes.

**Key words:** sesame, line x tester, GCA variance, SCA variance

## I. Introduction

Sesame (*Sesamum indicum* L.) popularly known as Til, Sesmin or Gingelly is an ancient cultivated oilseed crop of the world. Sesamum belongs to the order Tubiflorae and family Pedaliaceae. Although the crop originated in Africa, India is reflected to be the major centre of genetic diversity (Maiti *et al.*, 2018). The plant yields rich edible oil owing to the presence of powerful antioxidants sesaminol and sesamol. Sesame seeds are rich in minerals such as calcium, phosphorous, magnesium, and potassium in large quantities and similarly have vitamins such as Niacin, Thiamin, Riboflavin and vitamin B-6 (USDA Nutrient Database, 2015). Sesame meal is an excellent high quality protein (40 per cent) feed for poultry and livestock. In spite of its short life cycle, suitability to different cropping systems, land types adaptation, tolerance to moisture stress and low input management conditions, sesame's contribution to the country's oilseed production remains sadly left much to be desired. Combining ability analysis concept provides the data regarding the nature and magnitude of gene effects governing quantitative traits which sequentially helps in identifying parents with good *gca* effects and hybrids with good *sca* effects (Kumari *et al.*, 2015). The present study was therefore taken up to identify parents with good *gca* effects and hybrids with good *sca* effects.

## II. Materials and Methods

The study was taken up during December 2021 to September 2022 at the students' farm, Loyola Academy, Alwal, Secunderabad. All parents were grown in four rows of 5 m length consisting of 15 plants per row at spacing of 30 cm x 15 cm. The recommended agronomic practices were followed to raise a healthy crop. The eight lines EVC-122, CT-50, IC 500393, IC 129908, DORG 37-11, EC 346829, EC 301961 and CT-51 were crossed with every single tester viz., JLT-408, Phule Til-1, Swetha and RT-125 in

Line x tester mating design following Kempthorne (1957) and a total of 32 cross combinations have been obtained following hand emasculation and pollination. The 44 genotypes comprising of 32 F<sub>1</sub> hybrids and 12 parents (8 lines and 4 testers) including one check variety were assessed in Randomized Block Design with three replications during June to September 2022. Observations were noted on five randomly selected plants in each genotype from every replication for the following traits viz., days to 50 per cent flowering, plant height (cm), number of branches per plant, number of capsules per plant, capsule length (cm), number of seeds per capsule, 1000 seed weight (g), oil content (%) and seed yield per plant(g).

## Statistical analysis

Data was analyzed by the methods defined by Panse and Sukhatme (1967) using the mean values of five randomly selected plants in each replication from all treatments to find out the significance of treatment effect. The significance was verified by referring to the values of F table (Fisher and Yates, 1963).

$$Y_{ij} = \mu + g_i + r_j + e_i$$

The variation amongst the hybrids was further divided into genetic components attributed to general combining ability (GCA) and specific combining ability (SCA) following the method recommended by Kempthorne (1957).

The importance of general and specific combining ability was measured by estimating the components of variance and expressed in the following ratio  $\frac{2\sigma^2_{gca}}{(2\sigma^2_{gca} + \sigma^2_{sca})}$  (Baker, 1978).

## III. Results and Discussion

The analysis of variance showed significant differences among the lines, testers and their interaction effect L x T, for all the nine traits (Table1). The combining ability variances for different traits are presented in Table 2. The greater magnitude of SCA variance than GCA variance indicated the role of non-additive genes for all the nine characters studied. The estimates of additive

and dominance variance revealed that dominance variance ( $\sigma^2D$ ) was greater than the additive genetic variance ( $\sigma^2A$ ) for the characters days to 50 per cent flowering, plant height, number of seeds per capsule, 1000 seed weight and oil content. Additive variance ( $\sigma^2A$ ) was greater than dominance variance ( $\sigma^2D$ ) for the characters number of branches per plant, number of capsules per plant, capsule length and seed yield per plant.

The mean performance of the eight lines and four testers for nine traits are presented in Table 3. The least number of days to 50% flowering was recorded by EVC-122(37.67) among lines and JLT-408(37.33) among testers. For the character plant height, IC 500393(119.63 cm) recorded highest plant height among lines and Swetha (117.37cm) recorded highest among testers. CT-51(6.93) recorded highest number of branches among lines and RT-125(5.6) recorded highest among testers. Number of capsules per plant was maximum in CT-51(107.10) among lines and in RT-125(115.37) among testers. Maximum capsule length was expressed by CT-50 (3.15cm) among lines and by RT-125(2.74cm) among testers. The number of seeds per capsule was highest in IC 500393(78.97) among lines and in RT-125 among testers (70.37). CT-50 recorded maximum 1000 seed weight among lines (77.2g) and Phule Til-1(3.47g) among testers. Oil content was maximum for EVC 122(51.99%) among lines and for JLT-408(49.32%) among testers. Seed yield per plant was maximum for CT-50(14.26 g) among lines and RT-125(14.52g) among testers.

The *per se* performance of parents can be measured as one of the important criterion for selection of parents (Karthikeyan *et al.*, 2019). Parents with high general combining ability are preferred as *gca* is due to additive gene effects and is fixed. Selection of parents based on *per se* performance alone is not reliable as it may result in poor yielding hybrids. Therefore, selection of parents based on high *per se* performance coupled with high *gca* value would fetch promising hybrids for heterosis breeding. Similar observations were made by Ghule *et al*(2021) and Ramya *et al*(2023).

The *gca* effects of the parents are presented in Table 4. The *gca* effects of parents for days to 50% flowering was lowest in the parent EC 346829(-2.135). Highest positive *gca* effects for plant height was recorded by CT-51 (14.13). RT-125 recorded highest positive *gca* effects (1.006) for number of branches. Highest positive *gca* effects for number of capsules per plant were recorded by DORG 37-11(17.428). Highest positive *gca* effects for capsule length was recorded by CT-51(0.286). Highest positive *gca* effects for number of seeds per capsule was recorded by CT-51(5.176) whereas highest positive *gca* effects for 1000 seed weight was recorded by Phule Til-1 (0.207). Highest positive *gca* effects for oil content was recorded by

IC 500393(1.174) whereas for yield per plant, highest positive *gca* effects were recorded by DORG 37-11 (2.455).

In the present investigation, significant superior *gca* effects were recorded by five parents. DORG 37-11 exhibited significant superior *gca* effects for the traits viz., plant height, number of branches per plant, number of capsules per plant, capsule length, number of seeds per capsule, 1000 seed weight, oil content and seed yield per plant. The parent CT-51 exhibited significant superior *gca* effects for the characters viz., plant height, capsule length, number of seeds per capsule, 1000 seed weight, oil content and seed yield per plant. The parent IC 500393 presented significant superior *gca* effects for the characters viz., plant height, number of branches, number of capsules per plant, 1000 seed weight and oil content. The parent IC 129908 exhibited significant superior *gca* effects for the characters namely plant height, number of branches, number of capsules per plant, capsule length and seed yield per plant. The parent RT-125 expressed significant superior *gca* effects for the characters viz., plant height, number of branches, number of capsules per plant and oil content. The line CT-50 showed significant superior *gca* effects for the traits viz., capsule length, number of seeds per capsule and oil content. The tester JLT-408 showed significant superior *gca* effects for days to 50 per cent flowering and oil content. The tester Phule Til-1 showed significant superior *gca* effects for the characters viz., capsule length, number of seeds per capsule, 1000 seed weight, oil content and seed yield per plant. Raikwar (2018) reported that parent ES-230 showed highly significant and positive *gca* effects for seed yield per plant and parent SI-1147 was good general combiner for number of primary branches per plant, number of capsules per plant, days to maturity and seed yield per plant.

A study of the *gca* effects of the parents revealed that DORG 37-11, CT-51 and IC 129908 among lines and Phule Til-1 as well as RT-125 among testers were found to be good general combiners for seed yield per plant. These parents can be used in development of high yielding varieties (Sikarwar *et al*, 2021). Hybridization involving these parents might yield better transgressive segregants (Gore *et al*, 2024).

Taking into consideration the *per se* performance and *gca* effects together, it was observed that parents that showed superior *per se* performance for seed yield and its component characters could not express high *gca* effects for the respective character. Poor association between the *per se* performance and the *gca* effects may be due to the presence of epistatic interactions (Saxena and Bisen, 2017).

Considering these two criteria together, none of the parents showed superior performance for all the characters studied. The parents evaluated for both *per se* and *gca* effects together led to the identification of the parent IC 129908 which recorded superior *per se* and *gca* effects for four characters viz., plant height, number of capsules per plant, capsule length and seed yield per plant. The line CT-50 as well as the testers JLT-408, Phule Til-1 and RT-125 recorded superior *per se* and *gca* effects for two characters. Hence, the above parents may be considered for utilization in further breeding programmes for obtaining desirable segregants leading to increased seed yield per plant (Table 5). These results were supported by the findings of Disowja *et al.* (2021) and Jeeva *et al.* (2020).

#### IV. Conclusion

However, the parent IC 129908 alone was found to score best for both *per se* and *gca* effects. Hence the line IC 129908 can be judged as the best parent based on *per se* and *gca* effects.

**Table1: ANOVA for combining ability**

|                    | DF | Days to 50 per cent flowering | Plant height | Number of branches per plant | Number of capsules per plant | Capsule length | Number of seeds per capsule | 1000 seed weight | Oil content | Seed yield per plant |
|--------------------|----|-------------------------------|--------------|------------------------------|------------------------------|----------------|-----------------------------|------------------|-------------|----------------------|
| Replicates         | 2  | 1.010                         | 2.256        | 0.003                        | 24.428                       | 0.001          | 5.341                       | 0.003            | 0.038       | 0.159                |
| Crosses            | 31 | 12.029*                       | 768.611**    | 3.641**                      | 664.316**                    | 0.330**        | 82.138*                     | 0.204**          | 9.973**     | 9.644**              |
| Line Effect        | 7  | 20.213**                      | 1579.052**   | 3.993**                      | 848.522**                    | 0.607*         | 130.569**                   | 0.198**          | 10.484*     | 21.771*              |
| Tester Effect      | 3  | 16.594**                      | 158.668**    | 11.222**                     | 2277.723**                   | 0.603**        | 85.779*                     | 0.698**          | 9.804**     | 102.928**            |
| Line * Tester Eff. | 21 | 8.649**                       | 585.598**    | 2.440**                      | 372.428**                    | 0.199**        | 65.474                      | 0.135**          | 9.827**     | 5.418**              |
| Error              | 62 | 0.247                         | 4.686        | 0.032                        | 17.221                       | 0.005          | 2.464                       | 0.015            | 0.076       | 0.086                |
| Total              | 95 | 4.108                         | 253.916      | 1.209                        | 228.530                      | 0.111          | 28.524                      | 0.076            | 3.305       | 3.207                |

**Table 2: Combining ability variance and gene action for various traits**

| Source            | Days to 50 per cent flowering | Plant height | Number of branches per plant | Number of capsules per plant | Capsule length | Number of seeds per capsule | 1000 seed weight | Oil content | Seed yield per plant |
|-------------------|-------------------------------|--------------|------------------------------|------------------------------|----------------|-----------------------------|------------------|-------------|----------------------|
| $s^2$ GCA         | 1.009**                       | 48.010*      | 0.421**                      | 85.883**                     | 0.033**        | 5.873*                      | 0.024**          | 0.559       | 0.903**              |
| $s^2$ SCA         | 2.801**                       | 193.637**    | 0.803**                      | 118.402**                    | 0.064**        | 21.003**                    | 0.040**          | 3.251**     | 1.777**              |
| $s^2$ A(F = 1)    | 2.017                         | 96.019       | 0.842                        | 171.767                      | 0.067          | 23.491                      | 0.096            | 1.119       | 1.807                |
| $s^2$ D(F = 1)    | 2.801                         | 193.637      | 0.803                        | 118.402                      | 0.064          | 84.012                      | 0.161            | 3.251       | 1.777                |
| $s^2$ A / $s^2$ D | 0.720                         | 0.496        | 1.049                        | 1.451                        | 1.033          | 0.559                       | 1.198            | 0.344       | 1.017                |
| GA (5%)           | 1.877                         | 11.591       | 1.348                        | 20.569                       | 0.376          | 4.176                       | 0.325            | 1.099       | 1.958                |

**Table 3: Per se performance of parents**

| Parents   | Days to 50 per cent flowering | Plant height (cm) | Number of branches per plant | Number of capsules per plant | Capsule length (cm) | Number of seeds per capsule | 1000 seed weight(g) | Oil content (per cent) | Seed yield per plant (g) |
|-----------|-------------------------------|-------------------|------------------------------|------------------------------|---------------------|-----------------------------|---------------------|------------------------|--------------------------|
| Lines     |                               |                   |                              |                              |                     |                             |                     |                        |                          |
| EVC-122   | 37.67**                       | 93.13             | 4.03                         | 93.83                        | 3.10**              | 76.53**                     | 3.36                | 51.99**                | 13.30**                  |
| CT-50     | 38.67**                       | 96.30**           | 3.53                         | 91.03                        | 3.15**              | 77.20**                     | 3.64**              | 46.05                  | 14.26**                  |
| IC 500393 | 40.33                         | 119.63**          | 3.67                         | 95.90                        | 3.14**              | 78.97**                     | 3.24                | 46.31                  | 13.30**                  |
| IC 129908 | 38.67**                       | 111.87**          | 4.00                         | 101.23**                     | 3.13**              | 78.47**                     | 3.33                | 46.33                  | 13.81**                  |

|                    |         |          |        |          |        |         |        |         |         |
|--------------------|---------|----------|--------|----------|--------|---------|--------|---------|---------|
| <b>DORG-37-11</b>  | 40.00   | 78.93    | 4.60** | 94.47    | 2.33   | 65.93   | 3.23   | 45.10   | 12.55   |
| <b>EC 346829</b>   | 40.67   | 77.00    | 4.47   | 90.23    | 2.64   | 67.17   | 3.46** | 46.60   | 10.30   |
| <b>EC 301961</b>   | 42.00   | 76.60    | 4.33   | 97.10    | 2.44   | 63.53   | 3.17   | 45.82   | 13.52** |
| <b>CT-51</b>       | 40.00   | 88.77    | 6.93** | 107.10** | 2.14   | 63.17   | 3.28   | 46.85   | 12.29   |
| <b>Mean</b>        | 39.75   | 92.78    | 4.45   | 96.36    | 2.76   | 71.37   | 3.34   | 46.88   | 12.92   |
| <b>SED</b>         | 0.143   | 0.624    | 0.051  | 1.198    | 0.021  | 0.453   | 0.035  | 0.079   | 0.085   |
| <b>CD(0.05)</b>    | 0.287   | 1.250    | 0.103  | 2.395    | 0.042  | 0.906   | 0.070  | 0.159   | 0.170   |
| <b>CD(0.01)</b>    | 0.381   | 1.660    | 0.137  | 3.183    | 0.056  | 1.204   | 0.093  | 0.211   | 0.225   |
| <b>Testers</b>     |         |          |        |          |        |         |        |         |         |
| <b>JLT-408</b>     | 37.33** | 100.77   | 3.33   | 91.4     | 2.54   | 67.53   | 3.19   | 49.32** | 13.08   |
| <b>Phule Til-1</b> | 39.33   | 104.70   | 3.20   | 93.3     | 2.72** | 66.10   | 3.47** | 46.47   | 12.45   |
| <b>Swetha</b>      | 40.33   | 117.37** | 3.33   | 104.07** | 2.48   | 65.83   | 2.91   | 46.33   | 12.38   |
| <b>RT-125</b>      | 38.67*  | 107.33   | 5.60** | 115.37** | 2.74** | 70.30** | 3.32** | 45.78   | 14.52** |
| <b>Mean</b>        | 38.92   | 107.54   | 3.87   | 101.03   | 2.62   | 67.44   | 3.22   | 46.98   | 13.11   |
| <b>SED</b>         | 0.101   | 0.441    | 0.036  | 0.847    | 0.015  | 0.320   | 0.025  | 0.056   | 0.060   |
| <b>CD(0.05)</b>    | 0.203   | 0.883    | 0.073  | 1.693    | 0.030  | 0.641   | 0.049  | 0.112   | 0.120   |
| <b>CD(0.01)</b>    | 0.270   | 1.174    | 0.097  | 2.251    | 0.040  | 0.852   | 0.066  | 0.149   | 0.159   |

\*significant at 5 per cent level    \*\*significant at 1 per cent level

**Table 4: General combining ability effects of various traits in parents**

| Parents           | Days to 50 per cent flowering | Plant height | Number of branches per plant | Number of capsules per plant | Capsule length | Number of seeds per capsule | 1000 seed weight | Oil content | Seed yield per plant |
|-------------------|-------------------------------|--------------|------------------------------|------------------------------|----------------|-----------------------------|------------------|-------------|----------------------|
| <b>Lines</b>      |                               |              |                              |                              |                |                             |                  |             |                      |
| <b>EVC 122</b>    | -1.135**                      | -15.520**    | -0.885**                     | -8.139**                     | -0.089**       | -2.049**                    | -0.264**         | -1.742**    | -1.251**             |
| <b>CT-50</b>      | 0.365*                        | -6.261**     | -0.377**                     | -5.839**                     | 0.167**        | 2.959**                     | 0.044            | 0.230**     | -0.827**             |
| <b>IC 500393</b>  | 0.948**                       | 13.380**     | 0.673**                      | 3.495**                      | -0.146**       | -3.216**                    | 0.140**          | 1.174**     | -1.262**             |
| <b>IC 129908</b>  | 0.885**                       | 3.047**      | 0.398**                      | 3.611**                      | 0.070**        | -1.391**                    | -0.001           | 0.039       | 1.432**              |
| <b>DORG 37-11</b> | 0.781**                       | 9.214**      | 0.706**                      | 17.428**                     | 0.250**        | 3.109*                      | 0.090*           | 0.182*      | 2.455**              |
| <b>EC 346829</b>  | -2.135**                      | -10.728**    | 0.198**                      | -5.255**                     | -0.305**       | -3.699**                    | -0.035           | -0.991**    | -0.008               |
| <b>EC 301961</b>  | 0.198                         | -7.270**     | -0.360**                     | -6.114**                     | -0.234**       | -0.891                      | -0.072*          | 0.454**     | -0.833**             |
| <b>CT-51</b>      | 1.865**                       | 14.139**     | -0.352**                     | 0.811                        | 0.286**        | 5.176**                     | 0.098**          | 0.654**     | 0.294**              |
| <b>SE</b>         | 0.143                         | 0.625        | 0.051                        | 1.198                        | 0.021          | 0.453                       | 0.035            | 0.079       | 0.085                |

| Testers     |          |          |          |          |          |          |          |          |          |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| JLT-408     | -0.469** | -2.211** | -0.306** | -4.426** | 0.024    | -0.182   | -0.019   | 0.253**  | -0.877** |
| Phule Til-1 | 0.031    | -2.074** | -0.510** | -9.455** | 0.186**  | 2.672**  | 0.207**  | 0.219**  | 0.752**  |
| Swetha      | 1.156**  | 1.289**  | -0.190** | 0.641    | -0.200** | -1.720** | -0.208** | -0.944** | 0.169**  |
| RT-125      | 0.719**  | 2.997**  | 1.006**  | 13.241** | -0.011   | -0.770** | 0.020    | 0.472**  | -0.044** |
| SE          | 0.101    | 0.442    | 0.036    | 0.847    | 0.015    | 0.320    | 0.0247   | 0.056    | 0.060    |

\*significant at 5 per cent level

\*\*significant at 1 per cent level

**Table 5: Scoring of parents based on *per se* performance and *gca* effects**

|        | EVC-122 |     | CT-50 |     | IC500393 |     | IC129908 |     | DORG-37-11 |     | EC346829 |     | EC301961 |     | CT-51 |     | JLT-408 |     | Phule Til-1 |     | Swetha |     | RT-125 |     | Score |     |
|--------|---------|-----|-------|-----|----------|-----|----------|-----|------------|-----|----------|-----|----------|-----|-------|-----|---------|-----|-------------|-----|--------|-----|--------|-----|-------|-----|
|        | Mean    | gca | Mean  | gca | Mean     | gca | Mean     | gca | Mean       | gca | Mean     | gca | Mean     | gca | Mean  | gca | Mean    | gca | Mean        | gca | Mean   | gca | Mean   | gca | Mean  | gca |
| DTF    | *       | √   | *     | -   | -        | -   | *        | -   | -          | -   | -        | √   | -        | -   | -     | -   | *       | √   | -           | -   | -      | -   | *      | -   | 5     | 3   |
| PH     | -       | -   | *     | -   | *        | √   | *        | √   | -          | √   | -        | -   | -        | -   | √     | -   | -       | -   | -           | *   | √      | -   | √      | 4   | 6     |     |
| NB     | -       | -   | -     | -   | -        | √   | -        | √   | *          | √   | -        | √   | -        | -   | *     | -   | -       | -   | -           | -   | -      | *   | √      | 3   | 5     |     |
| C/P    | -       | -   | -     | -   | -        | √   | *        | √   | -          | √   | -        | -   | -        | -   | *     | -   | -       | -   | -           | *   | -      | *   | √      | 4   | 4     |     |
| CL     | *       | -   | *     | √   | *        | -   | *        | √   | -          | √   | -        | -   | -        | -   | -     | √   | -       | -   | *           | √   | -      | -   | *      | -   | 6     | 5   |
| S/C    | *       | -   | *     | √   | *        | -   | *        | -   | -          | √   | -        | -   | -        | -   | -     | √   | -       | -   | -           | √   | -      | -   | *      | -   | 5     | 4   |
| 100S W | -       | -   | *     | -   | -        | √   | -        | -   | -          | √   | *        | -   | -        | -   | -     | √   | -       | -   | *           | √   | -      | -   | *      | -   | 4     | 4   |
| OC     | *       | -   | -     | √   | -        | √   | -        | -   | -          | √   | -        | -   | -        | √   | -     | √   | *       | √   | -           | √   | -      | -   | -      | √   | 2     | 8   |
| SY/P   | *       | -   | *     | -   | *        | -   | *        | √   | -          | √   | -        | -   | *        | -   | -     | √   | -       | -   | -           | √   | -      | √   | *      | -   | 6     | 5   |
| Score  | 5       | 1   | 6     | 3   | 4        | 5   | 6        | 5   | 1          | 8   | 1        | 2   | 1        | 1   | 2     | 6   | 2       | 2   | 2           | 5   | 2      | 2   | 7      | 4   |       |     |

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**Table 1: Mean performance of parents for various traits**

| Parents            | Days to 50 per cent flowering | Plant height (cm) | Number of branches per plant | Number of capsules per plant | Capsule length (cm) | Number of seeds per capsule | 1000 seed weight (g) | Oil content (per cent) | Seed yield per plant (g) |
|--------------------|-------------------------------|-------------------|------------------------------|------------------------------|---------------------|-----------------------------|----------------------|------------------------|--------------------------|
| <b>Lines</b>       |                               |                   |                              |                              |                     |                             |                      |                        |                          |
| <b>EVC-122</b>     | 37.67**                       | 93.13             | 4.03                         | 93.83                        | 3.10**              | 76.53**                     | 3.36                 | 51.99**                | 13.30**                  |
| <b>CT-50</b>       | 38.67**                       | 96.30**           | 3.53                         | 91.03                        | 3.15**              | 77.20**                     | 3.64**               | 46.05                  | 14.26**                  |
| <b>IC 500393</b>   | 40.33                         | 119.63**          | 3.67                         | 95.90                        | 3.14**              | 78.97**                     | 3.24                 | 46.31                  | 13.30**                  |
| <b>IC 129908</b>   | 38.67**                       | 111.87**          | 4.00                         | 101.23**                     | 3.13**              | 78.47**                     | 3.33                 | 46.33                  | 13.81**                  |
| <b>DORG-37-11</b>  | 40.00                         | 78.93             | 4.60**                       | 94.47                        | 2.33                | 65.93                       | 3.23                 | 45.10                  | 12.55                    |
| <b>EC 346829</b>   | 40.67                         | 77.00             | 4.47                         | 90.23                        | 2.64                | 67.17                       | 3.46**               | 46.60                  | 10.30                    |
| <b>EC 301961</b>   | 42.00                         | 76.60             | 4.33                         | 97.10                        | 2.44                | 63.53                       | 3.17                 | 45.82                  | 13.52**                  |
| <b>CT-51</b>       | 40.00                         | 88.77             | 6.93**                       | 107.10**                     | 2.14                | 63.17                       | 3.28                 | 46.85                  | 12.29                    |
| <b>Mean</b>        | 39.75                         | 92.78             | 4.45                         | 96.36                        | 2.76                | 71.37                       | 3.34                 | 46.88                  | 12.92                    |
| <b>SED</b>         | 0.143                         | 0.624             | 0.051                        | 1.198                        | 0.021               | 0.453                       | 0.035                | 0.079                  | 0.085                    |
| <b>CD(0.05)</b>    | 0.287                         | 1.250             | 0.103                        | 2.395                        | 0.042               | 0.906                       | 0.070                | 0.159                  | 0.170                    |
| <b>CD(0.01)</b>    | 0.381                         | 1.660             | 0.137                        | 3.183                        | 0.056               | 1.204                       | 0.093                | 0.211                  | 0.225                    |
| <b>Testers</b>     |                               |                   |                              |                              |                     |                             |                      |                        |                          |
| <b>JLT-408</b>     | 37.33**                       | 100.77            | 3.33                         | 91.4                         | 2.54                | 67.53                       | 3.19                 | 49.32**                | 13.08                    |
| <b>Phule Til-1</b> | 39.33                         | 104.70            | 3.20                         | 93.3                         | 2.72**              | 66.10                       | 3.47**               | 46.47                  | 12.45                    |
| <b>Swetha</b>      | 40.33                         | 117.37**          | 3.33                         | 104.07**                     | 2.48                | 65.83                       | 2.91                 | 46.33                  | 12.38                    |
| <b>RT-125</b>      | 38.67*                        | 107.33            | 5.60**                       | 115.37**                     | 2.74**              | 70.30**                     | 3.32**               | 45.78                  | 14.52**                  |

|                 |       |        |       |        |       |       |       |       |       |
|-----------------|-------|--------|-------|--------|-------|-------|-------|-------|-------|
| <b>Mean</b>     | 38.92 | 107.54 | 3.87  | 101.03 | 2.62  | 67.44 | 3.22  | 46.98 | 13.11 |
| <b>SED</b>      | 0.101 | 0.441  | 0.036 | 0.847  | 0.015 | 0.320 | 0.025 | 0.056 | 0.060 |
| <b>CD(0.05)</b> | 0.203 | 0.883  | 0.073 | 1.693  | 0.030 | 0.641 | 0.049 | 0.112 | 0.120 |
| <b>CD(0.01)</b> | 0.270 | 1.174  | 0.097 | 2.251  | 0.040 | 0.852 | 0.066 | 0.149 | 0.159 |

\*\*significant at 1 per cent level

**Table 2: General combining ability effects of various traits in parents**

| Parents            | Days to<br>50 per<br>cent<br>flowerin<br>g | Plant<br>height | Number<br>of<br>branches<br>per plant | Number<br>of<br>capsules<br>per plant | Capsule<br>length | Number<br>of seeds<br>per<br>capsule | 1000<br>seed<br>weight | Oil<br>content | Seed<br>yield<br>per<br>plant |
|--------------------|--------------------------------------------|-----------------|---------------------------------------|---------------------------------------|-------------------|--------------------------------------|------------------------|----------------|-------------------------------|
| <b>Lines</b>       |                                            |                 |                                       |                                       |                   |                                      |                        |                |                               |
| <b>EVC 122</b>     | -1.135**                                   | -15.520*<br>*   | -0.885**                              | -8.139**                              | -0.089**          | -2.049**                             | -0.264**               | -1.742**       | -1.251**                      |
| <b>CT-50</b>       | 0.365*                                     | -6.261**        | -0.377**                              | -5.839**                              | 0.167**           | 2.959**                              | 0.044                  | 0.230**        | -0.827**                      |
| <b>IC 500393</b>   | 0.948**                                    | 13.380*<br>*    | 0.673**                               | 3.495**                               | -0.146**          | -3.216**                             | 0.140**                | 1.174**        | -1.262**                      |
| <b>IC 129908</b>   | 0.885**                                    | 3.047**         | 0.398**                               | 3.611**                               | 0.070**           | -1.391**                             | -0.001                 | 0.039          | 1.432**                       |
| <b>DORG 37-11</b>  | 0.781**                                    | 9.214**         | 0.706**                               | 17.428**                              | 0.250**           | 3.109*                               | 0.090*                 | 0.182*         | 2.455**                       |
| <b>EC 346829</b>   | -2.135**                                   | -10.728*<br>*   | 0.198**                               | -5.255**                              | -0.305**          | -3.699**                             | -0.035                 | -0.991**       | -0.008                        |
| <b>EC 301961</b>   | 0.198                                      | -7.270**        | -0.360**                              | -6.114**                              | -0.234**          | -0.891                               | -0.072*                | 0.454**        | -0.833**                      |
| <b>CT-51</b>       | 1.865**                                    | 14.139*<br>*    | -0.352**                              | 0.811                                 | 0.286**           | 5.176**                              | 0.098**                | 0.654**        | 0.294**                       |
| <b>SE</b>          | 0.143                                      | 0.625           | 0.051                                 | 1.198                                 | 0.021             | 0.453                                | 0.035                  | 0.079          | 0.085                         |
| <b>Testers</b>     |                                            |                 |                                       |                                       |                   |                                      |                        |                |                               |
| <b>JLT-408</b>     | -0.469**                                   | -2.211**        | -0.306**                              | -4.426**                              | 0.024             | -0.182                               | -0.019                 | 0.253**        | -0.877**                      |
| <b>Phule Til-1</b> | 0.031                                      | -2.074**        | -0.510**                              | -9.455**                              | 0.186**           | 2.672**                              | 0.207**                | 0.219**        | 0.752**                       |
| <b>Swetha</b>      | 1.156**                                    | 1.289**         | -0.190**                              | 0.641                                 | -0.200**          | -1.720**                             | -0.208**               | -0.944**       | 0.169**                       |
| <b>RT-125</b>      | 0.719**                                    | 2.997**         | 1.006**                               | 13.241**                              | -0.011            | -0.770**                             | 0.020                  | 0.472**        | -0.044**                      |
| <b>SE</b>          | 0.101                                      | 0.442           | 0.036                                 | 0.847                                 | 0.015             | 0.320                                | 0.0247                 | 0.056          | 0.060                         |

\*significant at 5 per cent level

\*\*significant at 1 per cent level