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Research Note

# Study on the heterosis for yield and yield contributing traits in sesame (*Sesamum indicum* L.)

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**Abstract**
The present investigation was undertaken with an objective to study the magnitude of heterosis involved in 32 hybrids obtained by crossing four (female) x eight (male) genotypes in L x T fashion along with their 12 parents and two standard checks (JLT-408 and PRACHI) evaluated during summer, 2019-20 at Oilseeds Research Station, Latur. Data were recorded on yield and its different contributing traits. The analysis of variance for experimental design revealed significance differences among the parents, hybrids and parents *vs* hybrids for most of the characters indicated the presence of genetic variability among the experimental material. The crosses *viz*., SWETHA x V-25, V-34 x TBS-12, V-32 x TBS-7, SWETHA x R-26 and SWETHA x TBS-12 found with high heterobeltiosis and standard heterosis over check JLT-408 and PRACHI for seed yield along with other yield contributing traits. Significant heterobeltiosis and standard heterosis for seed yield were observed for the majority of yield and yield attributing traits. Selection of high heterotic hybrids with high *per se* performance would be reliable in the improvement of sesame.

**Keywords:** Sesame, heterosis, heterobeltosis, standard heterosis

Sesame (*Sesamum indicum* L.) is an ancient oil yielding crop and popularly known as the "Queen of oil seeds" due to its excellent quality of the seed, oil and meal (Virani *et al.,* 2017). It has been domesticated well over 3000 years. Worldwide, it is used for nutritional, medicinal, and industrial purposes. The genus Sesamum consists of many species and the most cultivated one is *Sesamum indicum* L. It has a 2n=26 chromosome number. India is the largest producer of sesame in the world and ranks first in terms of sesame-growing area with a cultivated area of 19.53 lakh hectares, annual production of 8.32 lakh tonnes and productivity of 478 kg/ha (Source: Ministry of Agriculture, Govt. of India).

In a self-pollinated crop like sesame there is a good scope for exploitation of heterosis. Heterosis is defined as the deviation of $F_1$ hybrid over its mid parent (Relative heterosis), better parent (Heterobeltiosis) and standard parent (Standard heterosis) as the consequence of hybridization. This evidently indicates the potentiality of the crop for improvement in yields. Commercial exploitation of heterosis is feasible only if the means of producing hybrid seeds economically could be made available. Commercial exploitation of heterosis confined to cross pollinated group of crops with the success in self pollinated crops *viz.*, rice, tomato etc. Efforts are under way to develop hybrids in sesame.

The experiment was laid out in a randomized block design with two replications at Oilseed Research Station, Latur during *Summer,* 2020 with a total of 46 treatments, comprising four females, eight males, 32 $F_1$`s and two checks. The crossing programme was carried out in L x T mating design. The experimental material was consisting

of four lines (V-34, R-22, V-32, SHWETHA) and eight testers (TBS-2, TBS-9, TBS-12, TBS-7, V-18, R-26, V-17 and V-25) along with two checks (JLT-408 and PRACHI). Five representative plants per treatment in each replication were selected randomly, tagged and observations were recorded on these plants for different characters *viz.* days to 50% flowering, days to maturity, plant height (cm), the number of branches per plant, the number of capsules per plant, the number of seeds per capsule, length of capsule (cm), width of capsule (cm) 1000 seed weight (g), seed yield per plant (g) and oil content (%). The mean values of all the treatments for the characters under study were worked out. Standard error and critical difference at 1 and 5 per cent levels of significance were calculated by using the formula given by Panse and Sukhatme, (1985). Per cent heterosis was estimated for all the characters under study over mid parent, superior parent and over the standard check (Rai, 1979).

The analysis of variance revealed that, all the eleven characters showed highly significant differences in all treatments and crosses (**Table 1**). Parents showed significant differences for all characters except for plant height (cm) and the number of branches per plant, indicating the presence of a considerable amount of variability in all characters of the experimental material.

The magnitude of heterobeltosis and standard heterosis was observed for all eleven characters as shown in **Tables 2.1 to 2.4**. The genotypes with early flowering and maturity have a special significance in multiple cropping systems. Negative heterosis was considered desirable for the characters, *viz.,* days to 50% flowering and days to maturity. For other characters positive heterosis is considered as desirable. The crosses exhibiting significant negative heterotic effects for this trait are considered superior. Among 32 crosses, the crosses SWETHA x R-26 (-11.76%) and SWETHA x V-18 (-11.23 %) exhibited the highest significant negative heterosis over a better parent. A similar result was earlier reported by Patel *et al.* (2016). Among the crosses V-32 x V-17 showed the highest significant positive heterosis over better parent for plant height and a similar result was reported by Chaudhari *et al.* (2015). Cross combinations *viz*,.V-34 x TBS-9, R-22 x TBS-9, SWETHA x TBS-9, V-32 x V-17 and V-34 x TBS-7 showed the highest significant positive heterosis over checks G-1 and JLT-408, respectively for plant height. Virani *et al.* (2017) reported similar results for plant height. For the number of branches per plant, the cross SWETHA x TBS-7 exhibited the highest significant positive heterosis over a better parent followed by V-34 x TBS-2. For the number of capsules per plant positive heterosis is desirable. The crosses SWETHA x V-25, V-32 x TBS-7, V-32 x V-25, V-34 x TBS-9 and R-22 x V-25 showed the highest significant positive heterosis over a better parent. The cross combinations SWETHA x V-25, V-34 x TBS-9, V-32 x TBS-9, SWETHA x R-26 and V-34 x TBS-12 showed the highest significant positive heterosis over standard checks. These results were in agreement with the result obtained by Jadhav *et al.*(2013).

For the number of seeds per capsule, positive heterosis is desirable. Among the 32 crosses evaluated eight, three and three crosses showed significant positive heterosis over a better parent, checks JLT-408 and PRACHI, respectively. For the length of capsule, the range of heterosis was from -40.84 to 17.54 per cent over a better parent, whereas -15.24 to 19.05 and -13.87 to 20.97 per cent over checks JLT-408 and PRACHI. Similar results were earlier reported by Chaudhari *et al.* (2015).

Among the 32 crosses, six, ten and twelve crosses showed significant positive heterosis over a better parent, checks JLT-408 and PRACHI, respectively for 1000 seed weight. The cross V-34 x V-25 exhibited the highest significant positive heterosis over a better parent for 1000 seed weight. Similar results were earlier reported by Sundari and Kamala (2012). For seed yield per plant cross R-22 x V-18 exhibited the highest significant positive heterosis over a better parent. The crosses SWETHA x V-25, V-34 x TBS-12, V-32 x TBS-7, SWETHA x R-26 and SWETHA x TBS-12 exhibited

**Table 1. Analysis of variance of parents and hybrids for 11 characters in Sesame**

| Source of Variation | d f | Days to 50% flowering | Days to maturity | Plant height | Number of branches / plant | Number of capsule / plant | Number of seed / capsule | Length of capsule | Width of capsule | 1000 Seed weight | Seed yield / plant | Oil Content |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Replications | 1 | 0.284 | 0.920 | 0.402 | 0.041 | 0.961 | 1.375 | 0.004 | 0.0004 | 0.001 | 0.0192 | 0.013 |
| Treatments | 43 | 10.161** | 27.770** | 128.074** | 0.441** | 185.774** | 42.087** | 0.176** | 0.009** | 0.333** | 8.981** | 27.079** |
| Parents | 11 | 8.803** | 35.803** | 40.820 | 0.245 | 111.382** | 48.241** | 0.140** | 0.002** | 0.183** | 4.133** | 8.773** |
| Crosses | 31 | 10.366** | 25.769** | 140.337** | 0.430** | 215.879** | 34.282** | 0.195** | 0.011** | 0.394** | 9.778** | 34.041** |
| Parent v/s Crosses | 1 | 18.750** | 1.432 | 707.741** | 2.932** | 70.840** | 216.371** | 0.018 | 0.025** | 0.072 | 37.626** | 12.657** |
| Error | 43 | 1.563 | 1.920 | 21.109 | 0.127 | 3.721 | 3.126 | 0.018 | 0.0003 | 0.019 | 0.727 | 1.125 |

** indicated significance at 1 per cent level

**Table 2.1. Estimates of heterosis over better parent (BP) and standard check (SC) for yield and yield contributing characters in sesame (in per cent)**

| S. No. | Name of crosses | Days to 50% flowering | | | Days to maturity | | | Plant height | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | BP | JLT-408 (SC-I) | PRACHI (SC-II) | BP | JLT-408 (SC-I) | PRACHI (SC-II) | BP | JLT-408 (SC-I) | PRACHI (SC-II) |
| 1 | V-34 x TBS-2 | -10.39** | 2.78 | 5.71 | -8.29 ** | -1.78 | -2.92 | -1.76 | 0.52 | -2.23 |
| 2 | V-34 x TBS-9 | -6.49 | -1.35 | 4.29 | -4.44 ** | 1.78 | 0.58 | 16.65** | 19.55** | 16.28** |
| 3 | V-34 x TBS-12 | -7.79* | -6.25 | 7.14 | -2.22 | 4.14* | 2.92 | 4.14 | 8.39 | 5.43 |
| 4 | V-34 x TBS-7 | -15.58** | -6.02 | 11.43* | -8.89 ** | -2.96 | -4.09* | 12.53** | 15.14** | 11.99** |
| 5 | V-34 x V-18 | -18.18** | -10.81* | -5.71 | -1.11 | 5.33** | 4.09* | -1.77 | 3.98 | 1.14 |
| 6 | V-34 x R-26 | -5.19 | -9.46* | -4.29 | -2.78 | 3.55* | 2.34 | -3.64 | -1.41 | -4.10 |
| 7 | V-34 x V-17 | -9.09** | -5.26 | 2.86 | -7.78** | -1.78 | -2.92 | 1.40 | 3.75 | 0.91 |
| 8 | V-34 x V-25 | -11.69** | 8.00 | 15.71** | -2.78 | 3.55* | 2.34 | -4.47 | -2.25 | -4.92 |
| 9 | R-22 x TBS-2 | -1.30 | -14.46** | 1.43 | 2.76 | 10.06** | 8.77** | 10.74* | 12.89** | 9.80* |
| 10 | R-22 x TBS-9 | 1.30 | 10.67* | 18.57** | 3.37* | 8.88** | 7.60** | 15.67** | 18.54** | 15.30** |
| 11 | R-22 x TBS-12 | 0.70 | 4.23 | 5.71 | -7.78** | -1.78 | -2.92 | 3.96 | 8.20 | 5.24 |
| 12 | R-22 x TBS-7 | -2.70 | -2.70 | 2.86 | -3.41* | 0.59 | -0.58 | 1.81 | 0.09 | -2.64 |
| 13 | R-22 x V-18 | -5.41 | -1.25 | 12.86** | 0.07 | 4.14* | 2.92 | -5.89 | -0.38 | -3.10 |
| 14 | R-22 x R-26 | -13.51** | -18.07** | -2.86 | 0.07 | 4.14* | 2.92 | -4.04 | -6.47 | -9.03* |
| 15 | R-22 x V-17 | 1.35 | -10.81* | -5.71 | 3.41* | 7.69** | 6.43** | -7.71 | -9.14* | -11.63** |
| 16 | R-22 x V-25 | -2.70 | -1.35 | 4.29 | 3.41* | 7.69** | 6.43** | 12.00** | 6.07 | 3.17 |
| 17 | V-32 x TBS-2 | -2.60 | -15.79** | -8.57 | -10.50** | -4.14* | -5.26** | 6.35 | 8.42 | 5.45 |
| 18 | V-32 x TBS-9 | -9.09** | -12.00** | -5.71 | -1.11 | 5.33** | 4.09* | 4.07 | 6.66 | 3.74 |
| 19 | V-32 x TBS-12 | 6.85 | -13.25** | 2.86 | -0.56 | 5.92** | 4.68** | 5.97 | 10.29* | 7.27 |
| 20 | V-32 x TBS-7 | -9.46** | 1.33 | 8.57 | -2.22 | 4.14* | 2.92 | -5.91 | -7.50 | -10.3* |
| 21 | V-32 x V-18 | -12.33** | 9.09 | 2.86 | 0.56 | 7.10** | 5.85** | -7.00 | -1.55 | -4.24 |
| 22 | V-32 x R-26 | -13.70** | -1.35 | 4.29 | -8.89** | -2.96 | -4.09* | -1.03 | -3.54 | -6.18 |
| 23 | V-32 x V-17 | -5.48 | 0.00 | 14.29** | -3.89* | 2.37 | 1.17 | 18.00** | 16.17** | 13.00** |
| 24 | V-32 x V-25 | 4.11 | 10.14** | 2.70 | 2.78 | 9.47** | 8.19** | 3.38 | 0.45 | -2.30 |
| 25 | SWETHA x TBS-2 | -1.25 | 14.49** | 6.67 | -2.14 | 8.28** | 7.02** | 9.91* | 12.05** | 8.98* |
| 26 | SWETHA x TBS-9 | -5.00 | 10.14** | 2.70 | -1.07 | 9.47** | 8.19** | 14.27** | 17.11** | 13.91** |
| 27 | SWETHA x TBS-12 | -6.25 | 8.70* | 1.35 | -8.02** | 1.78 | 0.58 | 3.04 | 7.24 | 4.31 |
| 28 | SWETHA x TBS-7 | -10.00** | 4.35 | -2.70 | -4.28** | 5.92** | 4.68** | 8.44 | 6.61 | 3.69 |
| 29 | SWETHA x V-18 | -11.25** | 2.90 | -4.05 | -11.23** | -1.78 | -2.92 | -11.54** | -6.35 | -8.91* |
| 30 | SWETHA x R-26 | -15.00** | -1.45 | -8.11* | -11.76** | -2.37 | -3.51* | 7.02 | 4.31 | 1.46 |
| 31 | SWETHA x V-17 | -17.50** | -4.35 | -10.81** | -10.70** | -1.18 | -2.34 | 5.14 | 3.52 | 0.68 |
| 32 | SWETHA x V-25 | -7.50* | 7.25 | 0.70 | -8.02** | 1.78 | 0.58 | 16.93** | 10.74* | 7.71 |

*and ** indicated significance at 5 and 1 per cent level, respectively.

**Table 2.2.Estimates of heterosis over better parent (BP) and standard check (SC) for yield and yield contributing characters in sesame (in per cent)**

| S. No. | Name of crosses | Number of branches per plant | | | Number of capsules per plant | | | Number of seeds per capsule | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | BP | JLT-408 (SC-I) | PRACHI (SC-II) | BP | JLT-408 (SC-I) | PRACHI (SC-II) | BP | JLT-408 (SC-I) | PRACHI (SC-II) |
| 1 | V-34 x TBS-2 | 22.86* | 16.22 | 13.16 | -31.34** | -16.92** | -24.85** | 3.22 | -0.41 | 0.60 |
| 2 | V-34 x TBS-9 | -12.12 | -21.62* | -23.68* | 23.12** | 36.92** | 23.86** | 3.61 | 0.81 | 1.22 |
| 3 | V-34 x TBS-12 | 18.18 | 5.41 | 2.63 | 13.88** | 31.65** | 19.09** | 14.18** | 5.54* | 5.97* |
| 4 | V-34 x TBS-7 | 3.03 | -8.11 | -10.53 | -14.22** | -12.53** | -20.87** | -6.04* | -3.24 | -2.85 |
| 5 | V-34 x V-18 | 6.06 | -5.41 | -7.89 | -25.10** | -14.73** | -22.86** | 1.90 | -5.81* | -5.43* |
| 6 | V-34 x R-26 | 12.12 | 0.70 | -2.63 | 3.10 | 16.92** | 5.77 | 2.57 | -2.84 | -2.44 |
| 7 | V-34 x V-17 | 18.92 | 18.92 | 15.79 | -14.66** | -14.29** | -22.47** | -4.67 | -9.05** | -8.68** |
| 8 | V-34 x V-25 | 3.03 | -8.11 | -10.53 | -34.35** | -34.07** | -40.47** | 3.04 | -3.92 | -3.53 |
| 9 | R-22 x TBS-2 | -13.89 | -16.22 | -18.42 | -24.80** | -9.01* | -17.69** | -1.40 | -4.86 | -4.48 |
| 10 | R-22 x TBS-9 | 2.78 | 0.70 | -2.63 | -3.36 | 7.47 | -2.78 | 8.47** | 5.54* | 5.97* |
| 11 | R-22 x TBS-12 | 13.89 | 10.81 | 7.89 | -18.25** | -5.49 | -14.51** | 5.89* | -0.41 | 0.60 |
| 12 | R-22 x TBS-7 | 0.07 | -2.70 | -5.26 | -8.19 | -6.37 | -15.31** | -3.15 | -0.27 | 0.14 |
| 13 | R-22 x V-18 | 8.33 | 5.41 | 2.63 | 10.42** | 25.71** | 12.72** | 2.73 | -3.38 | -2.99 |
| 14 | R-22 x R-26 | 13.89 | 10.81 | 7.89 | -20.93** | -10.33* | -18.89** | 3.57 | -1.89 | -1.49 |
| 15 | R-22 x V-17 | -5.41 | -5.41 | -7.89 | -34.15** | -46.81** | -51.89** | -14.59** | -18.51** | -18.18** |
| 16 | R-22 x V-25 | 11.11 | 8.11 | 5.26 | 20.90** | -5.93 | -14.91** | -3.88 | -9.59** | -9.23** |
| 17 | V-32 x TBS-2 | **2.70** | 2.70 | 0.70 | -16.80** | 0.66 | -8.95* | -6.44* | -9.73** | -9.36** |
| 18 | V-32 x TBS-9 | 5.41 | 5.41 | 2.63 | -2.77 | 8.13 | -2.19 | -1.39 | -4.05 | -3.66 |
| 19 | V-32 x TBS-12 | 10.81 | 10.81 | 7.89 | -19.96** | -7.47 | -16.30** | 4.26 | -4.19 | -3.80 |
| 20 | V-32 x TBS-7 | -2.70 | -2.70 | -5.26 | 33.19** | 35.82** | 22.86** | -9.71** | -7.03** | -6.65** |
| 21 | V-32 x V-18 | 0.07 | 0.70 | -2.63 | -40.73** | -32.53** | -38.97** | 6.50* | -4.73 | -4.34 |
| 22 | V-32 x R-26 | 5.41 | 5.41 | 2.63 | 1.16 | 14.73** | 3.78 | 9.56** | 3.78 | 4.21 |
| 23 | V-32 x V-17 | -17.57 | -17.57 | -19.74* | 7.48 | -13.19** | -21.47** | -8.78** | -12.97** | -12.62** |
| 24 | V-32 x V-25 | 18.92 | 18.92 | 15.79 | 29.78** | 4.40 | -5.57 | 4.06 | -2.97 | -2.58 |
| 25 | SWETHA x TBS-2 | 2.78 | 0.70 | -2.63 | -8.08* | 11.21* | 0.60 | 1.12 | -2.43 | -2.04 |
| 26 | SWETHA x TBS-9 | -5.56 | -8.11 | -10.53 | 1.78 | 13.19** | 2.39 | 4.72 | 1.89 | 2.31 |
| 27 | SWETHA x TBS-12 | -19.44 | -21.62* | -23.68* | 4.75 | 21.10** | 9.54* | 19.26** | 9.59** | 10.04** |
| 28 | SWETHA x TBS-7 | 30.56** | 27.03** | 23.68* | 20.69** | 23.08** | 11.33** | -7.48** | -4.73 | -4.34 |
| 29 | SWETHA x V-18 | -13.89 | -16.22 | -18.42 | 5.60 | 20.22** | 8.75* | 10.12** | -1.49 | -1.09 |
| 30 | SWETHA x R-26 | 2.78 | 0.70 | -2.63 | 16.80** | 31.87** | 19.28** | 0.29 | -5.00* | -4.61 |
| 31 | SWETHA x V-17 | -21.62* | -21.62* | -23.68 | -6.28 | -7.47 | -16.30** | 6.09* | 1.22 | 1.63 |
| 32 | SWETHA x V-25 | 13.89 | 10.81 | 7.89 | 57.21** | 55.82** | 40.95** | 10.14** | 2.70 | 3.12 |

*and ** indicated significance at 5 and 1 per cent level, respectively.

**Table 2.3. Estimates of heterosis over better parent (BP) and standard checks (SC) for yield and yield contributing characters in sesame (in per cent)**

| S. No. | Name of crosses | Length of capsule | | | | | | Width of capsule | | | | | | 1000 Seed weight | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | BP | | JLT-408 (SC-I) | | PRACHI (SC-II) | | BP | | JLT-408 (SC-I) | | PRACHI (SC-II) | | BP | | JLT-408 (SC-I) | | PRACHI (SC-II) | |
| 1 | V-34 x TBS-2 | -4.69 | | -3.17 | | -1.61 | | 0.60 | | 5.19 | * | 3.18 | | 11.43 | ** | 8.33 | * | 11.43 | ** |
| 2 | V-34 x TBS-9 | 10.94 | * | 12.70 | ** | 14.52 | ** | -18.07 | ** | -11.69 | ** | -13.38 | ** | -20.99 | ** | -11.11 | ** | -8.57 | * |
| 3 | V-34 x TBS-12 | -5.31 | | -3.81 | | -2.26 | | 1.74 | | 13.64 | ** | 11.46 | ** | -2.50 | | 8.33 | * | 11.43 | ** |
| 4 | V-34 x TBS-7 | 8.82 | * | 17.46 | ** | 19.35 | ** | 5.45 | * | 12.99 | ** | 10.83 | ** | 1.37 | | 2.78 | | 5.71 | |
| 5 | V-34 x V-18 | -11.56 | * | -10.16 | * | -8.71 | | -1.69 | | 13.64 | ** | 11.46 | ** | -21.62 | ** | -19.44 | ** | -17.14 | ** |
| 6 | V-34 x R-26 | -16.06 | ** | -5.40 | | -3.87 | | 8.64 | ** | 14.29 | ** | 12.10 | ** | 8.57 | * | 5.56 | | 8.57 | * |
| 7 | V-34 x V-17 | -14.49 | ** | -6.35 | | -4.84 | | 10.37 | ** | 17.53 | ** | 15.29 | ** | -8.06 | | -20.83 | ** | -18.57 | ** |
| 8 | V-34 x V-25 | 7.66 | | 9.37 | * | 11.13 | * | -2.42 | | 4.55 | | 2.55 | | 25.76 | ** | 15.28 | ** | 18.57 | ** |
| 9 | R-22 x TBS-2 | -15.24 | ** | -15.24 | ** | -13.87 | ** | -7.93 | ** | -1.95 | | -3.82 | | -5.33 | | -1.39 | | 1.43 | |
| 10 | R-22 x TBS-9 | 6.45 | | 4.76 | | 6.45 | | -7.83 | ** | -0.65 | | -2.85 | | 1.23 | | 13.89 | ** | 17.14 | ** |
| 11 | R-22 x TBS-12 | 11.29 | * | 9.52 | * | 11.29 | * | -5.81 | ** | 5.19 | * | 3.18 | | 1.25 | | 9.72 | * | 12.86 | ** |
| 12 | R-22 x TBS-7 | -10.29 | * | -3.17 | | -1.61 | | -9.70 | ** | -3.25 | | -5.10 | * | -10.67 | ** | -6.94 | | -4.29 | |
| 13 | R-22 x V-18 | -40.84 | ** | -6.35 | | -4.84 | | -17.42 | ** | -4.55 | | -6.37 | ** | 12.00 | ** | 16.67 | ** | 20.00 | ** |
| 14 | R-22 x R-26 | -19.72 | ** | -9.52 | * | -8.06 | | 1.83 | | 8.44 | ** | 6.37 | ** | -22.67 | ** | -19.44 | ** | -17.14 | ** |
| 15 | R-22 x V-17 | 8.70 | | 19.05 | ** | 20.97 | ** | 10.37 | ** | 17.53 | ** | 15.29 | ** | 17.33 | ** | 22.22 | ** | 25.71 | ** |
| 16 | R-22 x V-25 | -12.50 | ** | -11.11 | * | -9.68 | * | -4.25 | | 2.60 | | 0.64 | | 1.33 | | 2.78 | | 5.71 | |
| 17 | V-32 x TBS-2 | -15.87 | ** | -15.87 | ** | -14.52 | ** | 2.31 | | 14.94 | ** | 12.74 | ** | 22.54 | ** | 20.83 | ** | 24.29 | ** |
| 18 | V-32 x TBS-9 | 0.60 | | -3.17 | | -1.61 | | -20.83 | ** | -11.04 | ** | -12.74 | ** | -20.99 | ** | -11.11 | ** | -8.57 | * |
| 19 | V-32 x TBS-12 | 12.28 | * | 1.59 | | 3.23 | | -17.92 | ** | -7.79 | ** | -9.55 | ** | 3.75 | | 15.28 | ** | 18.57 | ** |
| 20 | V-32 x TBS-7 | -2.94 | | 4.76 | | 6.45 | | 4.05 | | 16.88 | ** | 14.65 | ** | 9.59 | * | 11.11 | ** | 14.29 | ** |
| 21 | V-32 x V-18 | 15.00 | ** | 9.52 | * | 11.29 | * | 0.60 | | 15.58 | ** | 13.38 | ** | 6.76 | | 9.72 | * | 12.86 | ** |
| 22 | V-32 x R-26 | -2.82 | | 9.52 | * | 11.29 | * | -9.25 | ** | 1.95 | | 0.60 | | 1.41 | | 0.60 | | 2.86 | |
| 23 | V-32 x V-17 | -26.09 | ** | -19.0 | ** | -17.74 | ** | -16.76 | ** | -6.49 | ** | -8.28 | ** | -2.82 | | -4.17 | | -1.43 | |
| 24 | V-32 x V-25 | -10.94 | * | -9.52 | * | -8.06 | | -1.16 | | 11.04 | ** | 8.92 | ** | -5.63 | | -6.94 | | -4.29 | |
| 25 | SWETHA x TBS-2 | 7.94 | | 7.94 | | 9.68 | * | -5.62 | ** | 9.09 | ** | 7.01 | ** | 2.86 | | 0.60 | | 2.86 | |
| 17 | V-32 x TBS-2 | -15.87 | ** | -15.87 | ** | -14.52 | ** | 2.31 | | 14.94 | ** | 12.74 | ** | 22.54 | ** | 20.83 | ** | 24.29 | ** |
| 18 | V-32 x TBS-9 | 0.60 | | -3.17 | | -1.61 | | -20.83 | ** | -11.04 | ** | -12.74 | ** | -20.99 | ** | -11.11 | ** | -8.57 | * |
| 19 | V-32 x TBS-12 | 12.28 | * | 1.59 | | 3.23 | | -17.92 | ** | -7.79 | ** | -9.55 | ** | 3.75 | | 15.28 | ** | 18.57 | ** |
| 20 | V-32 x TBS-7 | -2.94 | | 4.76 | | 6.45 | | 4.05 | | 16.88 | ** | 14.65 | ** | 9.59 | * | 11.11 | ** | 14.29 | ** |
| 26 | SWETHA x TBS-9 | 16.39 | ** | 12.70 | ** | 14.52 | ** | -6.74 | ** | 7.79 | ** | 5.73 | * | -9.88 | ** | 1.39 | | 4.29 | |
| 27 | SWETHA x TBS-12 | 17.54 | ** | 6.35 | | 8.06 | | -24.16 | ** | -12.34 | ** | -14.01 | ** | -21.25 | ** | -12.5 | ** | -10.0 | ** |
| 28 | SWETHA x TBS-7 | 1.47 | | 9.52 | * | 11.29 | * | -13.48 | ** | 0.60 | | -1.91 | | 0.60 | | 1.39 | | 4.29 | |
| 29 | SWETHA x V-18 | 3.33 | | -1.59 | | 0.60 | | -19.10 | ** | -6.49 | ** | -8.28 | ** | -25.68 | ** | -23.6 | ** | -21.4 | ** |
| 30 | SWETHA x R-26 | -16.90 | ** | -6.35 | | -4.84 | | -12.92 | ** | 0.65 | | -1.27 | | 1.43 | | -1.39 | | 1.43 | |
| 31 | SWETHA x V-17 | -8.70 | * | 0.60 | | 1.61 | | -26.40 | ** | -14.64 | ** | -16.56 | ** | -5.80 | | -9.72 | | -7.14 | |
| 32 | SWETHA x V-25 | -3.12 | | -1.59 | | 0.60 | | -16.85 | ** | -3.90 | | -5.73 | * | 4.35 | | 0.60 | | 2.86 | |

*and ** indicated significance at 5 and 1 per cent level, respectively.

**Table 2.4. Estimates of heterosis over better parent (BP) and standard check (SC) for yield and yield contributing characters in sesame (in per cent)**

| S. No. | Name of crosses | Seed yield per plant | | | Oil content | | |
|---|---|---|---|---|---|---|---|
| | | BP | JLT-408 (SC-I) | PRACHI (SC-II) | BP | JLT-408 (SC-I) | PRACHI (SC-II) |
| 1 | V-34 x TBS-2 | 6.00 | -0.93 | -7.42 | 2.69 | 2.80 | 5.95* |
| 2 | V-34 x TBS-9 | 27.18** | 22.43** | 14.41 | -5.43* | -3.30 | -0.57 |
| 3 | V-34 x TBS-12 | 40.10** | 28.97** | 20.52** | 3.36 | 4.40* | 7.50** |
| 4 | V-34 x TBS-7 | -7.96 | -2.80 | -9.17 | 1.10 | 1.25 | 3.36 |
| 5 | V-34 x V-18 | -9.89 | -23.36** | -28.38** | -14.84** | -14.27** | -12.16** |
| 6 | V-34 x R-26 | 18.95* | 5.61 | -1.31 | 4.48* | 2.70 | 4.50 |
| 7 | V-34 x V-17 | -23.60* | -36.45** | -40.61** | 1.21 | -5.07 | -2.22 |
| 8 | V-34 x V-25 | -22.47* | -35.51** | -39.74** | -19.57** | -23.22** | -21.88** |
| 9 | R-22 x TBS-2 | -4 | -10.28 | -16.16* | 1.80 | 2.45 | 5.02 |
| 10 | R-22 x TBS-9 | 18.93 | 14.49 | 6.99 | 0.85 | 2.99 | 4.29 |
| 11 | R-22 x TBS-12 | 9.64 | 0.93 | -5.68 | -3.25 | -2.41 | 0.57 |
| 12 | R-22 x TBS-7 | -4.42 | 0.93 | -5.68 | -6.24** | -7.11 | -4.40 |
| 13 | R-22 x V-18 | 42.86** | 21.50* | 13.54 | 3.87 | 4.25 | 7.40** |
| 14 | R-22 x R-26 | 4.71 | -7.48 | -13.54 | 2.23 | 1.01 | 2.22 |
| 15 | R-22 x V-17 | -7.06 | -26.17** | -31.00** | 11.30** | 5.25* | 8.02** |
| 16 | R-22 x V-25 | 10.59 | -12.15 | -17.90* | -13.35** | -21.51 | -19.50** |
| 17 | V-32 x TBS-2 | 14.00 | 6.54 | -0.44 | 5.36* | 5.90** | 9.05** |
| 18 | V-32 x TBS-9 | 0.97 | -2.80 | -9.17 | 0.58 | 3.85 | 5.64* |
| 19 | V-32 x TBS-12 | 3.55 | -4.67 | -10.92 | -17.70** | -16.22** | -14.64** |
| 20 | V-32 x TBS-7 | 20.35 | 27.10** | 18.78* | -6.43** | -6.44** | -3.26 |
| 21 | V-32 x V-18 | -12.09 | -25.23** | -30.13** | -9.79** | -9.11** | -6.78** |
| 22 | V-32 x R-26 | 35.79** | 20.56* | 12.66 | 1.90 | 4.78 | 5.43* |
| 23 | V-32 x V-17 | -2.86 | -36.45** | -40.61** | 2.50 | 3.91 | 6.05** |
| 24 | V-32 x V-25 | 27.40* | -13.08 | -18.78* | -20.22** | -19.68** | -17.95** |
| 25 | SWETHA x TBS-2 | 4.72 | 3.74 | -3.06 | -4.66* | -4.44 | -1.71 |
| 26 | SWETHA x TBS-9 | -15.09 | -15.89 | -21.40** | 1.49 | -2.57* | 6.78** |
| 27 | SWETHA x TBS-12 | 24.53** | 23.36** | 15.28* | -3.63 | 2.88 | 0.16 |
| 28 | SWETHA x TBS-7 | 4.42 | 10.28 | 3.06 | 1.70 | 4.12* | 4.40 |
| 29 | SWETHA x V-18 | -20.75* | -21.50* | -26.64** | 5.78* | 5.21* | 7.29** |
| 30 | SWETHA x R-26 | 26.42** | 25.23** | 17.03* | -8.28** | -8.99** | -6.36** |
| 31 | SWETHA x V-17 | -12.26 | -13.08 | -18.78* | -2.19 | -2.35 | 0.36 |
| 32 | SWETHA x V-25 | 40.57** | 39.25** | 30.13** | 1.80 | -0.21 | 2.85 |

*and ** indicated significance at 5 and 1 per cent level, respectively.

**Table 3. Heterosis of the best five crosses on the basis of their *per se* performance for seed yield per plant and related traits in sesame**

| S. No. | Crosses | *Per se* performance for seed yield / plant (g) | Heterosis (%) | | | Significant better parent heterosis for other traits in desirable direction | Better parent heterosis for other traits in desirable direction |
|---|---|---|---|---|---|---|---|
| | | | Over better parent | Over standard check-1 (JLT-408) | Over standard check-2 (Prachi) | | |
| 1 | SWETHA x V-25 | 14.90 | 40.57** | 39.25** | 30.11** | DF, DM, PH, NC, NS | NB, SW, OC |
| 2 | V-34 x TBS-12 | 13.80 | 40.10** | 28.97** | 20.52** | DF, NC, NS | DM, PH, NB, WC, OC |
| 3 | V-32 x TBS-7 | 13.60 | 20.35 | 27.10** | 18.78* | DF, NC, SW | DM, WC |
| 4 | SWETHA x R-26 | 13.40 | 26.42** | 25.23** | 17.03* | DF, DM, NC | PH, NB, NS, SW |
| 5 | SWETHA x TBS-12 | 13.20 | 23.53** | 23.36** | 15.28* | DM, NS, LC | DFF, PH, NC |

* Significant at 5 % level, ** Significant at 1 % level

DF = Days to 50 % flowering
DM = Days to maturity
PH = Plant height (cm)
NB = Number of branches
NC = Number of capitulum per plant
NS = Number of seeds per capitulum
SW = 1000 seed weight (g)
OC = Oil content (%)
LC = Length of capsule (cm)
WC = Width of capsule

the highest significant heterosis over check JLT-408 and PRACHI. These results were in agreement with the results of Beniwal *et al.* (2018). For oil content, cross R-22 x V-17 exhibited the highest significant positive heterosis over better parent followed by SWETHA x V-18 and V-32 x TBS-2. The crosses V-32 x TBS-2, R-22 x V-17 and SWETHA x V-18 exhibited positive significant heterosis for oil content over the checks. These results were similar with Virani *et al.* (2017) for oil content in sesame.

High heterotic hybrids for seed yield having high *per se* performance as well as significant desirable heterosis for other yield attributing traits were found in the present study (**Table 3**). Therefore, the selection of these hybrids either on the basis of *per se* performance or on the basis of magnitude of heterotic effects for sesame improvement would be reliable in future.

## REFERENCES


Beniwal, B. R., Sastry, E. V. D. and Solanki, Z. S. 2018. Combining ability and heterosis studies in sesame. *(Sesamum indicum* L.). *International Journal of Genetics*, **10**(5): 415-419. [Cross Ref]

Chaudhari, G. B., Naik, M. R., Anarase, S. A. and Ban, Y. G. 2015. Heterosis studies for quantitative traits in sesame. *Electronic Journal of Plant Breeding*, **6**(1): 218-224.

Jadhav, R. S. and Mohrir, M. N. 2013. Heterosis studies for quantitative traits in sesame. *Electronic Journal of Plant Breeding*, **4**(1): 1056– 1060.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers, 4th ed., ICAR, New Delhi, 347 p.

Patel, R. M., Chauhan, R. M. and Patel, J. A. 2016. Heterosis for yield and yield components in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*, **7**(4): 1151-1154. [Cross Ref]

Rai, B. 1979. Heterosis breeding. Agro. Biological Publication, Delhi-I, 1005 –1.

Sundari Padma, M. and Kamala, T. 2012. Heterosis in *Sesamum indicum* L. *Asian Journal of Agricultural Science*, **4**(4): 287–290.

Virani, M. B., Vachhani, J.H., Kachhadia, V.H., Chavadhari, R.M. and Mungala, R.A. 2017. Heterosis studies in sesame (*Sesamum indicum* L.). *Electronic Journal of Plant Breeding*, **8**(3): 1006-1012. [Cross Ref]