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# Combining ability analysis for seed yield and component traits in Indian mustard [*Brassica juncea* (L.) Czern & Coss.]

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**The present investigation on combining ability analysis for seed yield and its component characters in Indian mustard was carried out under two different environments *i.e.* timely sown ($E_1$) and late sown ($E_2$) which revealed that both additive and non-additive variances were present for the expression of all the characters studied in both the environments and the former playing major role. The study of GCA indicated that the genotypes namely RH-9617, RH-9806 RH-9615 and were good combiners for earliness, siliqua length, 1000-seed weight, number of seeds/siliqua, primary branches/plant and oil content. Hence, these parents could be used in crossing programmes for achieving further improvement. The study of SCA indicated that the cross combinations namely RH-9710 x RH-9806 and RH-9707 x RH-9806 should be exploited through heterosis breeding or should be used in recombination breeding for obtaining higher seed yield.**

**Keywords:** Combining ability, GCA, SCA, seed yield, component characters, Indian mustard

Among the major oilseed producing countries India contributes about 7% at the global level. Oilseed crops hold an important position in Indian economy also. Indian mustard {*Brassica juncea* (L.) Czern & Coss.} is the second important oilseed crop at national level after groundnut and contributes nearly 27% to edible oil pool of the country. Major mustard growing states are UP., Rajasthan, M.P., Punjab, Haryana, West Bengal, Assam and Bihar. To boost up further the production and productivity of Indian mustard, exploitation of heterosis may play a significant role in the years to come. Further, for developing better genotypes through hybridization, the choice of suitable parents is a matter of great concern. Combining ability analysis is one of the powerful tools to test the value of parental lines to produce superior hybrids and for recombinants. Indian mustard being a self pollinated crop, the technique of line x tester of Kempthorne (1957) for combing ability analysis is very important for screening lines with rapidity. Keeping this background in view, the present investigation was undertaken.

## Materials and methods

The experimental material comprised of 10 lines and 3 testers which were crossed in line x tester mating fashion and 30 $F_1$ hybrids were developed. All the $F_{1s}$ along with parents were grown in a

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randomized block design replicated thrice under two different environments *i.e.* timely sown, in the last week of October ($E_1$) and late sown, in the last week of November ($E_2$). Each genotype was accommodated in a paired row of 4 meter length spaced 30cm apart. Three weeks after sowing, the plant-to-plant distances within rows were adjusted to 10-15 cm by thinning. The observations were recorded for different quantitative characters *viz*. days to 1st flowering, days to 50 % flowering, days to maturity, plant height (cm), number of primary branches/plant, number of secondary branches plant, main shoot length (cm), number of siliqua on main shoot, siliqua length (cm), number of seeds/siliqua, 1000-seed weight (g), seed yield/plant (g) and oil content (%).The average values for all the traits were then used for statistical analysis. The combining ability analysis was carried out as suggested by Kempthorne (1957).

**Results and discussion**

Analysis of variance for combining ability revealed that mean square due to lines and testers were highly significant for all the characters under study except for siliqua length in the testers under both the environments ($E_1$ and $E_2$) and oil content in $E_1$ meaning thereby that considerable amount of genetic variability was present in the experimental material. Mean squares due to testers were higher than those of lines for most of the characters under study which indicated that genetic variability among the testers was much more than in lines.

The data presented in Table 1 reveals that among females RH-9617 and RH-9615 were found good general combiners for the characters viz., days to 1st flowering, days to 50% flowering, primary branches/plant, siliqua length, seeds/siliqua and oil content. Among male parents, RH-9806 had highest GCA effects for seed yield and its attributes along with earliness. RH-9624 had highest GCA effects for main shoot length and bold seeds. For number of siliqua on main shoot RH-9624 had highest GCA effects whereas, RH-9615 had significant GCA effects for main shoot length, siliqua length and 1000- seed weight which are main contributors to the seed yield. These parents can be used in further breeding programmes in Indian mustard. Verma (2000) also reported similar results in Indian mustard. Spragme (1966) reported that when general combining ability effects are significant additive or additive x additive gene effects are responsible for the inheritance of that particular trait. In the present study most the yield attributing traits had significant GCA effects which revealed that they are of fixable nature and by adopting simple selection these traits can be improved in Indian mustard and the parents which are good general combiners for yield and its attributing traits could be used in further crossing programme.

Estimates of SCA effects are presented in Table 2 which indicated that out of 30 crosses none of the cross showed consistently high SCA effect for all the characters under study under both $E_1$ and $E_2$. RH-9806 showed negative significant SCA for days to 1st first flowering with genotypes RH -9608, RH-9404, RH-9615, RH-9621. For days to 50% flowering negative significant SCA was shown by RH-9404, RH-9621, RH-9608 and RH-9615. For days to maturity RH-9609, RH-9615, RH-9608 exhibited negative significant SCA effects in cross combination with RH-9806. For primary branches/plant positive significant SCA effect was shown by RH-9806 with combination of RH-9404, RH-9608 and RH-9609. For main shoot length RH-9806 showed positive SCA with cross combination of RH-9617 and RH-9624.The cross combinations RH-9707x RH-9806 and RH-9615 x UDN-69 shown significant higher seed yield in $E_1$ and $E_2$. For number of seeds / siliqua RH-9624 x RH-9806 and RH-9404 x UDN-69 were promising in both the environments, RH-9624 x RH-9806 and RH-9707 x RC-781 for oil content in both the environments; RH-9608 x RH-9806 and RH-9615 x RH-9806 in $E_1$ and $E_2$ for days to 1st flowering, days to 50% flowering and days to maturity.

**Table 1: Estimation of combining ability effects of the parents under normal sown ($E_1$) and late sown environments ($E_2$)**

| Sr. No. | Parents | Days to $1^{st}$ flowering | | Days to 50% flowering | | Days to maturity | | Plant height (cm) | | No. of primary branches/plant | | No. of secondary branches/plant | | Main shoot length (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ |
| 1. | RH-9404 | 2.03 | 0.67 | 1.97 | 0.55 | 3.34 | 2.00 | 4.47 | 4.47 | 0.79* | 0.40* | 4.26* | 0.99* | 1.28* | 0.95* |
| 2. | RH-9513 | -0.80* | 1.19 | -0.67* | 1.27 | -1.83* | 0.68* | -5.85* | -5.02* | -0.38 | -0.42 | 1.05* | 1.02* | 1.88* | -2.44* |
| 3. | RH-9608 | 2.07 | 0.55 | 0.74 | -0.45* | 2.56 | 2.12 | 4.70 | 5.56 | -0.23 | 0.07* | 0.31 | -0.26* | -3.45 | -4.13 |
| 4. | RH-9609 | 0.15 | 0.04* | 0.05* | -0.17* | 2.21 | 0.76* | -1.30 | 2.48* | -0.21 | -0.09 | 0.01 | 0.92* | -0.79 | -0.17* |
| 5. | RH-9615 | -2.67* | -0.69* | -1.54* | -0.39* | 4.00 | 1.74 | 4.55 | 5.57 | -0.19 | 0.27* | -0.36 | 0.83* | 4.89* | 3.52* |
| 6. | RH-9617 | -1.96 | -1.51 | -1.93* | -1.45* | 0.88* | -0.98* | -6.01* | -8.44* | 0.31* | 0.29* | -0.80 | -0.92 | 0.59* | 3.13* |
| 7. | RH-9621 | 1.37* | -0.70* | -1.06* | -0.50* | -0.14* | 0.25* | 18.35 | 10.27 | 0.32* | 0.37* | -2.02 | -0.39* | 2.46* | 4.65* |
| 8. | RH-9624 | -1.10* | 0.33 | -0.08* | 0.42* | -3.67* | -1.60* | -4.60* | -2.65* | -0.13 | -0.28 | 0.30 | -0.39* | -4.07 | -2.74* |
| 9. | RH-9607 | 0.07* | 0.08* | 0.07* | -0.24* | -5.12* | -5.45* | -11.76* | -12.91* | -0.84 | -0.35 | -3.74 | -1.85 | 1.38* | -6.11 |
| 10. | RH-9610 | 2.57 | 0.06* | 2.51 | 0.09* | -2.27* | 0.50* | -5.56* | 0.37* | 0.18* | -0.25 | 0.33* | 0.10* | -4.58 | 3.35* |
| SE( Female) | | 0.96 | 0.23 | 1.26 | 0.29 | 0.96 | 0.31 | 5.20 | 3.62 | 0.49 | 0.21 | 2.10 | 0.46 | 3.01 | 1.38 |
| 11. | RH-9806 | -3.05* | 0.37 | -2.92* | 0.41 | -0.58* | 1.16 | -20.05* | -12.63* | 0.52* | -0.45 | -3.05 | -0.72 | 2.86* | 3.36* |
| 12. | RC-781 | -1.29* | -0.78 | -1.31* | -0.72* | 0.31 | -1.56* | 10.72 | 7.79 | 0.42* | 0.43* | 0.64* | 0.04* | -2.86 | -4.55 |
| 13. | UDN-69 | 4.33 | 0.41 | 4.04 | 0.31* | 0.27 | 0.40 | 9.33 | 4.84 | 0.11 | 0.01* | 2.41* | 0.76* | 0.03* | 1.19* |
| SE( Male) | | 0.53 | 0.13 | 0.69 | 0.16 | 0.53 | 0.17 | 2.85 | 1.98 | 0.27 | 0.12 | 1.20 | 0.25 | 1.98 | 0.75 |

Table 1 cont…

| Sr. No. | Parents | No. of siliqua on main shoot | | Siliqua length (cm) | | No. of seeds/ siliqua | | 1000- seed weight (g) | | Seed yield/plant (g) | | Oil content (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ |
| 1 | RH-9404 | 3.55* | 3.61* | -0.09* | -0.07* | 1.09* | 1.18* | -0.23 | -0.03* | 1.78* | 1.15* | -0.29 | 0.13* |
| 2 | RH-9513 | 1.34* | 1.38* | -0.41* | -0.33* | -0.56 | -0.12* | 1.29* | 0.65* | 0.13* | -0.05* | -0.18 | -0.12 |
| 3 | RH-9608 | -0.54 | -2.21 | -0.27 | -0.20* | -0.06* | -0.38* | -0.05* | -0.09* | 0.99* | 0.43* | 0.64 | -0.52 |
| 4 | RH-9609 | 2.81* | -1.07 | -0.11* | 0.04* | -0.64 | -0.48* | -0.30* | -0.01* | 0.53* | -0.20* | 0.35* | 0.46* |
| 5 | RH-9615 | -3.77 | 0.89* | 0.55* | 0.57* | 0.65* | 0.40* | 0.27* | 0.17* | 0.14* | -0.36* | 0.04* | 0.23* |
| 6 | RH-9617 | -4.33 | -2.19 | 0.68* | 0.48* | 0.75* | 0.78* | 0.70* | 0.46* | -0.04* | 0.33* | 0.77* | 0.50* |
| 7 | RH-9621 | 7.50* | 7.56* | 0.14* | 0.31* | -0.18* | -0.37* | -0.33 | -0.24* | -1.74 | 1.36* | -0.02* | -0.26 |
| 8 | RH-9624 | -3.24 | -3.89 | -0.15* | -0.40 | -1.35 | -1.30 | -0.92 | -0.58 | -2.50 | -0.59 | -0.18 | -0.26 |
| 9 | RH-9607 | -3.63 | -3.22 | 0.14* | 0.20* | -0.12* | 0.25* | -0.10* | -0.17* | -0.97 | -1.73 | 0.01* | 0.13* |
| 10 | RH-9610 | 0.31 | -0.94 | 0.46 | -0.57 | 0.31* | 0.03* | 0.34* | -0.15* | 1.74* | 1.61* | 0.17* | -0.27 |
| SE(Females) | | 2.77 | 1.73 | 0.10 | 0.09 | 0.41 | 0.29 | 0.10 | 0.10 | 0.77 | 0.47 | 0.23 | 0.24 |
| 11 | RH-9806 | -4.60 | 0.59* | 0.15* | 0.19* | 0.08* | 0.29* | 0.52* | 0.22* | 2.74* | -2.38 | 0.07* | 0.42** |
| 12 | RC-781 | 3.78* | 0.21* | -0.01* | -0.02* | 0.29* | 0.31* | 0.09* | 0.03* | 1.17* | 1.54* | -0.09 | 0.20* |
| 13 | UDN-69 | 0.82* | -0.81 | -0.13 | -0.17 | -0.37 | -0.60 | -0.43 | -0.25 | -3.91 | 0.83 | 0.01* | -0.62 |
| SE( Male) | | 1.52 | 0.95 | 0.05 | 0.05 | 0.22 | 0.16 | 0.06 | 0.06 | 0.42 | 0.26 | 0.13 | 0.13 |

*Significant at p=0.05.

**Table 2: Estimation of specific combing effects of crosses under normal sown ($E_1$) and late sown environments ($E_2$)**

| Sr. No. | Hybrid | Days to 1st flowering | | Days to 50% flowering | | Days to maturity | | Plant height(cm) | | No. of primary branches/plant | | No. of secondary branches/plant | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ |
| 1 | RH-9404-X RH-9806 | 0.39 | -1.45* | -0.12 | -1.75 | 2.42* | 0.63* | 1.48 | 0.29* | 1.13* | 1.01* | 8.69 | 0.71 |
| 2 | RH-9513-x RH-9806 | -2.12 | 7.69 | -2.51 | -0.70 | 4.07 | 4.59* | -0.25* | -.15* | 1.85 | 0.41* | 1.02 | -0.46 |
| 3 | RG-9608 X RH- 9806 | -1.95 | -1.73* | -0.42 | -1.58 | -2.88* | -5.69* | -0.66* | -0.54 | -3.04* | -2.32* | -2.23 | -2.22 |
| 4 | RH-9609 X RH-9806 | 0.80 | 1.24 | 0.77 | 1.25 | -4.44 | -3.28* | 0.38* | 0.65* | 0.42* | -0.29* | -2.98 | 0.57 |
| 5 | RH-9615 X RH-9806 | -2.28 | -1.24* | -3.04 | -1.11 | -5.53 | -5.23* | -0.22 | -0.24* | -0.58* | -0.67* | -6.27 | -3.14 |
| 6 | RH-9617 X RH-9806 | -0.22 | 0.73 | 0.32 | 1.42 | 4.34 | 12.38 | -1.01* | -0.39* | -1.83* | -0.85* | -0.99 | 2.68 |
| 7 | RH-9621 X RH-9806 | -1.50 | -1.08* | -1.75 | -0.93 | 6.17 | 2.97* | 1.05 | 0.02* | 1.75* | 0.32* | -1.10 | 0.11 |
| 8 | RH-9624 X RH-9806 | 1.38 | 0.96 | 1.51 | 0.81 | -1.24 | -2.28* | 0.17* | 0.30* | 1.30* | 1.32* | 0.7 | 0.99 |
| 9 | RH-9707 X RH-9806 | 2.45 | 2.31 | 2.55 | 1.94 | 0.31* | -3.82* | 0.01* | 0.04* | -0.40* | -0.38* | 1.85 | 0.11 |
| 10 | RH- 9710 X RH-9806 | 3.04 | 0.89 | 2.65 | 0.64 | -3.22* | 1.00* | -0.94* | 0.07* | -0.60* | 1.46 | 1.23 | 0.66 |
| 11 | RH-9404 X RC-781 | 2.96 | 2.67 | 2.36 | 2.59 | -8.24* | -8.29* | -1.72* | -0.92* | -5.38* | -1.30 | -4.60 | -0.78 |
| 12 | RH9513 X RC-781 | 1.89 | 1.41 | 2.04 | 1.47 | -13.16* | -10.54* | -0.26* | 0.30* | -3.13* | -1.64* | 0.43 | 0.96 |
| 13 | RH-9608 X RC-781 | -2.25 | 0.29 | -0.91 | 0.32 | -0.24* | -4.65 | -0.27* | 0.29* | -2.46* | -0.13* | 0.48 | 1.36 |
| 14 | RH-9609 X RC-781 | 0.58 | -0.51* | 0.28 | -0.21 | 7.83 | 8.83 | -0.23* | -0.27* | 0.18* | -0.14 | 2.87 | -1.09 |
| 15 | RH-9615 X RC-781 | 1.60 | 0.32* | 3.20 | 0.15 | 1.11* | -5.09* | -0.03* | 0.34* | 0.58* | -0.48* | 6.84 | 3.17 |
| 16 | RH- 9617 X RC-781 | -0.41 | -0.49* | -1.11 | -0.58 | 16.88 | 10.22 | 1.72 | 0.66 | 4.99 | 2.31 | -4.68 | -3.78 |
| 17 | RG-9621 X RC-781 | 0.24 | -0.03* | 0.19 | -0.13 | -1.99* | 1.34* | -0.26* | 1.01 | -0.23* | 1.07* | -2.86 | -0.18 |
| 18 | RH-9624 X RC-781 | -0.28 | 0.41* | -0.95 | 0.04 | 4.10 | 2.33* | 0.33* | -0.58* | 2.02 | -0.46* | -0.12 | -0.76 |
| 19 | RH-9707 X RC-781 | -2.65 | -2.68* | -3.11 | -2.52 | -3.78* | 8.18 | 0.27* | -0.11* | 2.12 | 0.77* | 0.89 | 0.46 |
| 20 | RH- 9710 X RC-781 | -1.68 | -1.39* | -2.01 | -0.12 | -2.51* | -2.33* | 0.45* | -0.14* | 1.32 | -0.01 | 0.74 | 0.64 |
| 21 | RH-9404 X UDN-69 | -3.36 | -1.22* | -2.24 | -0.84 | 5.81 | 8.93 | 0.25* | 0.63* | 4.24 | 0.30* | -4.09 | 0.64 |
| 22 | RH-9513 X UDN-69 | 0.23 | -0.62* | 0.47 | -0.76 | 9.09 | 5.95* | 0.51 | -0.16* | 1.29 | 1.23* | -1.46 | -0.50 |
| 23 | RH- 9608 X UDN-69 | 4.20 | 1.44 | 1.32 | 1.27 | 3.11 | 10.34 | 0.94* | 0.83 | 5.50 | 2.44 | 1.75 | 0.86 |
| 24 | RH-9609 X UDN-69 | -1.38 | -0.73* | -1.05 | -1.04 | -2.39* | -5.55* | -0.15* | -0.38* | -0.60* | 0.43* | 0.11 | 0.52 |
| 25 | RH-9615 X UDN-69 | 0.68 | 0.81 | -0.20 | 0.96 | 4.42* | 10.33 | 0.25* | -0.10* | 0.01* | 1.15* | -0.58 | -0.02 |
| 26 | RH 9617 X UDN-69 | 0.63 | -0.24* | 0.79 | -0.84 | -21.21* | -22.60 | -0.71 | -0.26* | -3.15* | -1.46* | 5.67 | 1.10 |
| 27 | RH- 9621 X UDN-69 | 1.26 | 1.12 | 1.56 | 1.07 | -4.18* | -4.31* | 0.79* | -1.04* | -1.15* | -1.39* | 3.95 | 0.06 |
| 28 | RH 9624 X UDN-69 | -1.10 | -1.37 | -0.55 | -0.85 | -2.86* | -0.05* | 0.50* | 0.28* | -3.32* | -0.86* | -0.65 | -0.22 |
| 29 | RH-9707 X UDN-69 | 0.20 | 0.37* | 0.56 | 0.58 | 3.47 | -4.36* | 0.29* | 0.11* | -1.72* | -0.39* | -2.73 | -0.57 |
| 30 | RH-9710 X UDN-69 | 1.37 | 0.49* | -0.64 | 0.48 | 5.73 | 1.33* | 0.49* | 0.08* | -0.72* | -1.45* | -1.98 | -1.29 |
| | SE | 1.66 | 0.40 | 2.19 | 0.50 | 9.01 | 6.27 | 0.85 | 0.37 | 3.80 | 0.78 | 1.67 | 0.54 |

Table 2. cont…

| Hybrid | | Main shoot length(cm) | | No of siliqua on main shoot | | Siliqua length (cm) | | No. of seeds / siliquae | | 1000- seed weight (g) | | Seed yield / plant (g) | | Oil content (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ | $E_1$ | $E_2$ |
| 1 | RH-9404-X RH-9806 | 2.66* | -6.05 | 2.59* | 0.04* | -0.82 | 0.06* | -0.04* | -0.78* | 0.74* | 0.27* | -0.29 | 2.76* | -0.06* | -0.13* |
| 2 | RH-9513-x RH-9806 | 0.49* | -0.86* | 0.47* | 0.55* | 0.18* | -0.16* | -0.18* | -2.01 | 0.93* | 0.36* | -0.08* | 3.93* | -0.27 | -0.23* |
| 3 | RG-9608 X RH- 9806 | 1.33 | 1.93* | -3.04 | -0.47 | -0.26* | 0.35* | 0.18* | -1.26* | 2.00* | 0.43* | 0.09* | -0.01 | 0.08* | 0.11* |
| 4 | RH-9609 X RH-9806 | -2.14 | -3.23 | -3.00 | -0.50* | -0.29* | -0.07* | 0.14* | -2.68 | -0.40* | -0.43* | -0.16* | -1.91 | -0.14* | -0.19* |
| 5 | RH-9615 X RH-9806 | -3.98 | -0.95* | -0.32 | -0.09* | -0.04* | 0.56* | 0.26* | 1.18* | 1.99* | 0.42* | 0.41* | -5.32 | -0.07* | -0.01* |
| 6 | RH-9617 X RH-9806 | 3.82* | -2.56 | 0.93* | -0.02* | 0.29* | -0.34 | -0.36 | -0.89* | 0.07* | -0.68 | -0.13* | 1.23* | 0.28* | 0.13* |
| 7 | RH-9621 X RH-9806 | -4.43 | 0.25 | 2.48* | -0.70* | -1.07 | -0.04* | -0.01* | -1.40 | 0.33* | 1.21* | 1.63* | -1.67 | -0.11* | -0.14* |
| 8 | RH-9624 X RH-9806 | 3.64* | 0.97* | 5.21* | 1.01* | 0.93* | -0.22* | -0.05* | 0.89* | -1.54 | -0.44* | -0.10* | 4.49* | -0.31 | 0.37* |
| 9 | RH-9707 X RH-9806 | -3.94 | 8.04* | -2.00 | 0.08* | 0.18* | 0.66* | 0.07* | 4.49* | -2.01 | -1.23 | -1.12 | 0.16* | -0.25 | -0.19* |
| 10 | RH- 9710 X RH-9806 | 2.55* | 2.45* | -3.33 | 0.14* | 0.16* | -0.09* | -0.02* | 2.45* | -2.11 | 0.08* | -0.26 | -3.65 | 0.25* | 0.27* |
| 11 | RH-9404 X RC-781 | -0.39 | 7.89* | -0.89 | -2.04 | 1.33 | 0.30* | 0.21* | 0.79* | -0.21* | -0.30* | 0.67* | -0.19 | -0.06* | -0.11* |
| 12 | RH9513 X RC-781 | -4.55 | -2.02 | -3.01 | -0.58* | 0.72 | -0.65 | -0.53 | 3.76* | 0.44* | -0.85 | -0.22* | -4.92 | -0.01* | 0.02* |
| 13 | RH-9608 X RC-781 | -4.59 | -6.33 | -0.67 | 0.58* | 0.43* | 0.59* | 0.44* | -1.46 | -0.55* | 0.79* | -0.09* | -1.92 | 0.02* | 0.02* |
| 14 | RH-9609 X RC-781 | -0.88 | -4.28* | 1.05* | 0.16* | -0.01* | 0.14* | -0.04* | -0.17* | -1.36 | 0.36* | -0.07* | 0.06* | 0.22* | 0.19* |
| 15 | RH-9615 X RC-781 | 1.07 | -1.61 | 0.96* | 0.13* | -0.18* | -0.16* | -0.09* | -1.61 | -2.94 | -0.86 | -0.73 | -0.17 | -0.30 | -0.38 |
| 16 | RH- 9617 X RC-781 | 1.67 | 1.55 | 7.96* | 0.07* | -0.13* | 0.43* | 0.41* | -0.65* | -2.49 | -0.33* | -0.81 | -0.92 | -0.73 | -0.52 |
| 17 | RG-9621 X RC-781 | -2.47 | -2.04 | -5.80 | 0.39 | 1.28* | 0.27* | 0.36* | -1.76 | -0.04* | -1.50 | -0.71 | -3.17 | 0.18* | 0.21* |
| 18 | RH-9624 X RC-781 | -2.24 | -2.38 | -2.60 | 1.37 | 0.25* | 0.39* | 0.24* | 0.63* | 3.20* | 1.02* | 0.92* | 1.88* | -0.06* | -0.01* |
| 19 | RH-9608 X RC-781 | 2.55* | 5.38* | 0.89* | 0.30* | 0.24* | -0.46* | -0.14* | -1.07* | 1.83* | 1.46* | 1.03* | 5.08* | 0.41* | 0.19* |
| 20 | RH- 9710 X RC-781 | 3.84* | 2.16* | 2.27* | -0.25* | 0.18* | 0.17* | 0.07* | 1.55* | 2.03* | 0.21* | 0.60* | 4.27* | 0.35* | 0.39* |
| 21 | RH-9404 X UDN-69 | -2.28 | -1.85 | -1.70 | 1.05* | 1.41* | -0.36 | -0.17* | 0.03* | -0.53* | 0.03* | 0.22* | -2.57 | 0.12* | 0.24* |
| 22 | RH-9513 X UDN-69 | 1.06 | 2.88* | 2.55* | 0.05* | 0.54* | 0.77* | 0.72* | -1.76 | -1.38 | 0.49* | 0.30* | 0.99* | 0.28* | 0.21* |
| 23 | RH- 9608 X UDN-69 | 0.26* | 4.40 | 3.69* | 1.05* | -0.17* | -0.24* | -0.62 | 2.72* | -1.44 | -1.21 | -0.40* | 1.93* | -0.08* | -0.13* |
| 24 | RH-9609 X UDN-69 | 3.03* | 7.51* | 1.35* | 0.35* | 0.30* | -0.06* | -0.06* | 2.84* | 1.76* | 0.06* | 0.22* | 1.84* | -0.09* | 0.01* |
| 25 | RH-9615 X UDN-69 | 2.91* | 2.55* | -0.64 | -0.04* | 0.22* | -0.40* | -0.17* | 0.43* | 6.95* | 0.44* | 0.32* | 5.48* | 0.39* | 0.37* |
| 26 | RH 9617 X UDN-69 | -5.49 | 4.11* | -8.79 | -0.04* | -0.16* | 0.81* | 0.77* | 1.55* | 2.42* | 1.01* | 0.94* | -0.30 | 0.46* | 0.39* |
| 27 | RH- 9621 X UDN-69 | 6.90* | 1.79* | 3.32* | 0.31* | -0.21* | -0.23 | -0.36 | 3.15* | -0.38 | 0.30* | -0.92 | 4.85* | -0.07* | -0.07* |
| 28 | RH 9624 X UDN-69 | -1.40 | -3.36 | -2.61 | -2.38 | -1.18 | -0.17* | -0.18* | -1.52 | -1.65 | -0.58* | -0.82 | -6.37 | -0.24* | -0.36 |
| 29 | RH-9707 X UDN-69 | 1.39 | -13.4 | 1.11* | -0.38* | -0.42* | -0.20* | 0.71* | -3.42 | 0.18* | -0.24* | 0.09* | -5.24 | -0.17* | -0.01* |
| 30 | RH-9710 X UDN-69 | -6.39 | -4.61 | 1.11* | 0.09* | -0.34 | 0.08* | -0.05* | -4.00 | 0.10* | -0.29* | -0.35 | -0.62 | -0.60 | -0.66 |
| | SE | 4.27 | 2.39 | 4.10 | 0.71* | 0.49 | 0.18 | 0.18 | 1.33 | 0.81 | 0.39* | 0.43 | 2.99 | 0.17 | 0.16 |

*Significant at 5% level.

However, the crosses viz. RH-9608 x RH-9806 and RH-9615 x RH-9806 which were good combiners for earliness were also poor general combiners for seed yield. From these results it may be concluded that high SCA alone could not be a sole criterion for getting a heterotic hybrid. Similar results have earlier been reported by Swarankal *et al.* (2002) in Indian mustard. Any sort of combination among the parents could give hybrid vigour which might be due to favourable dominant genes or epistatic action. Above findings were supported by Sood *et al.* (2000) and Singh *et al.* (2003) in Indian mustard.

Based upon the results obtained in the present study, it is summed up that the parents namely RH-9617, RH-9615 and RH-9806 are identified as good general combiners and the specific crosses combinations namely RH-9710 x RH-9806 and RH-9707 x RH-9806 should be exploited through heterosis breeding or should be used in recombination programme for tapping desirable transgressive segregants in segregating generations. The intermating between selected segregants in advance generations of segregation would help to accumulate favourable, desirable alleles for further improvement in seed yield and its component characters in Indian mustard.

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