Analysis of variances and mean performance in Indian mustard (*Brassica juncea* L. Czern and Coss)

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**ABSTRACT**
The analysis of variance was carried out for nine characters for testing the significance of differences amongst the genotypes. Highly significant differences were recorded among the treatments for all the characters namely, days to flowering, days to maturity, plant height, length of main raceme, number of siliquae per plant, number of secondary branches per plant, oil content, test weight and seed yield per plant. Analysis of variance further indicated highly significant differences among the parents except. Highly significant differences were also found among F₁s for all the nine characters, parent vs. F₁s revealed highly significant differences for the characters, plant height, length of main raceme per plant, number of siliquae per plant. Phenotypic coefficients of variance are found higher than genotypic coefficient of variance for both parents and F₁.

**KEYWORDS**
Coefficient of Variances, GCV, Indian Mustard, PCV

**HOW TO CITE THIS ARTICLE**

Rapeseed mustard oil is used primarily for edible purposes and is the principal cooking oil in the mustard growing areas of the country. Besides, seeds are used as condiments and in preparations of salad, juices, curries and pickles. The meal cake left after oil extracting forms on important cattle feed and may also be used as organic manure. Inspite of fact that Indian mustard plays such as prominent role in agricultural economy, it has very low yields. There are several factors responsible for low yield at farmer's field. The important ones are delayed sowing, inadequate fertilizer application and various biotic and abiotic stresses. These situations are further aggravated by the fact that mustard is cultivated on marginal and sub marginal lands and also predominantly grown as mixed crop under rainfed conditions. The limited improvement in this crop has been mainly due to narrow genetic base and arbitrary choice of parents without understanding their genetic architecture and combining ability. During the past research efforts were made to evolve high yielding varieties to meet the growing demands of edible oil, especially mustard oil which is preferred by consumers. As a result of these efforts few varieties have been developed and oilseeds production has also increased but due to growing demand of edible oil, there is a necessity of intensive research efforts for further increasing the productivity of this crop specially in rainfed areas. The success of plant breeding programme depends...
on the nature and magnitude of genetic variance contributing the yield and its contributing traits. The basic procedure in understanding the nature and magnitude of variation is partitioning. Several sophisticated biometrical approaches have been developed and used by several workers for genetic evaluation of the genotypes. Line x tester, partial diallel, diallel and triple test cross techniques are the affective tool with proven merits for ascertaining the genetic behaviour of economic traits in genotypes within a considerable short period in early segregating generations, parental lines and their hybrid combination in both the segregating and non-segregating filial generation.

Indian mustard (Brassica juncea (L.) Czern and Coss) is the dominant species covering around 85 per cent of area under rapeseed mustard in India. The rest of the area is covered by three ecotypes of Brassica rapa variety brown sarson, yellow sarson and toria (Prakashshepra 1996). Among the toria Brassica rapa (L.) spp. Toria nearly 1.4% area. Eruca sativa, Brassica rapa L. spp. brown sarson and other occupy nearly 6 percent of the total area. Regarding the origin of Indian mustard (Brassica juncea) there are two opinions put forwarded for its origin. According to (Prakash and Hinata, 1980), the species has originated in middle east where the putative parental species Brassica campestris and Brassica nigra might have first came into contact (Hemingway, 1976) argued that Brassica juncea has probably arisen by hybridization between different Brassica campestris and Brassica nigra genotypes at different times and localities resulting in secondary centres of origin in China, North- Western India and the Caucasus.

Materials and Methods

The present experiment was carried out during rabi, 2017-18 using seven genetic diverse genotypes namely; DRMJ-31, LAHAR, PusaBihar, NRH-101, NRC-DR-2, PM-2, RH-749, NRCHB-101 and Pusa Krishna, of Indian mustard made available collected from the Section of Oilseed, Department of Genetics and Plant Breeding of Chandra Shekhar Azad University of Agriculture and Technology Nawabganj, Kanpur. Twenty one crosses were made in 7 x 7 diallel fashion design excluding their reciprocals. The experiment was laid out in randomized block design (RBD) with three replications at Agriculture Research Farm, Kalyanpur, Kanpur, U.P., India. These lines were grown in single row plot of 5 meter length. The spacing between row to row and plant to plant was 45 cm and 15 cm, respectively maintained by thinning. Recommended agronomic practices were adopted to raise a good crop. Five competitive plants from each plot were randomly selected for recording observations for all the quantitative characters except days to flowering and days to maturity which were recorded on the plot basis. The data were recorded for nine characters namely; days to flowering, days to maturity, plant height (cm), length of main raceme (cm), number of siliquae per plant, number of secondary branches per plant, oil content (%), test weight (g) oil content (%) and seed yield per plant (g) was estimated using NMR method. The components of variance in diallel cross were computed by the use of equation given by (Hayman, 1954a).

Results and Discussion

The analysis of variance was carried out for nine characters for testing the significance of differences amongst the genotypes (table 1). Highly significant differences were recorded among the treatments for all the characters namely, days to flowering, days to maturity, plant height, length of main raceme, number of siliquae per plant, number of secondary branches per plant, oil content, test weight and seed yield per plant. Analysis of variance further indicated highly significant differences among the parents except.

Highly significant differences were also found among F1S for all the nine characters, parent vs. F1S revealed highly significant differences for the characters, plant height, length of main raceme per plant, number of siliquae per plant. The mean values of parents and their F1S crosses along with their respective range (maximum, minimum) for nine characters are presented in table 2. These findings were also similar to (Khalbe et al., 2000, Kumar and Srivastava, 2000, Rao and Gulati, 2001, Oshastidar and Patra, 2002, Parmar et al., 2004, Satyendra et al., 2004, Dixit et al., 2007, Kerkhi et al., 2007, Kumar et al., 2007, Prajapati et al., 2009, Gupta et al., 2010). The mean days to flowering among parents ranged from 73.67 days (Urvashi, Pusa Bold) to 82.33 days (Jawahar Mustard-1) with mean value of 76.85 days. In hybrid, it varied from 67.67 days (PusaAgrani x Durgamani) to 79.67
(Jawahar Mustard-1) having mean value of 74.92 days. Maturity duration for parents ranged from 117.67 (Pusa Agrani) to 135.00 (R.L.M-198) with mean value of 131.28 days, while in F₁ crosses it varied from 121.33 (Pusa Agrani x Urvashi) to 134.67 days (Pusa Bold x R.L.M-198) days with a mean value of 129.31 days. Among parents, the range was observed from 158.00 cm (Pusa Agrani) to 191.00 cm (Jawahar Mustard-1) with mean value of 181.19 cm. For F₁, it varied from 164.00 cm (Pusa Agrani x Urvashi) to 184.33 (Pusa Bold x R.L.M-198) with an average of 176.41 cm.

The length of main raceme in parents varied from 37.00 cm (Jawahar Mustard-1) to 57.00 cm (Maya) with mean value of 46.81 cm. In F₁ hybrid, it ranged from 45.33 cm (Pusa Agrani x Urvashi) to 57.00 cm (Maya x R.L.M-198, Jawahar Mustard-1 x R.L.M-198) having a mean value of 52.00 cm. The number of siliques per plant among parents varied from 287.00 (Pusa Agrani) to 359.67 (Urvashi) with a mean value 329.47. In F₁ hybrids, it ranged from 290.33 (Pusa Agrani x Pusa Bold) to 350.33 (Maya x Durgamani) with a mean value of 330.00.

The number of secondary branches per plant among parents varied from 18.00 (Pusa Agrani) to 26.33 (Maya) with a mean value of 22.76 and in F₁ it ranged from 20.33 (Durgamani x Jawahar Mustard-1) to 26.67 (Durgamani x Urvashi) with a mean value of 23.41. The percentage of oil content in parents varied from 36.45 (Pusa Bold) to 38.97 (Maya) for F₁ hybrid, its range was from 37.61 (Jawahar Mustard-1 x R.L.M-198) to 41.20 (Maya x Urvashi). Mean values of percent oil content were 37.52 and 39.31 for parents and F₁ hybrids, respectively. The average test weight i.e. 1000 seed weight in parents and F₁s varied from 4.34 gms (RLM-198) to 5.92 gms (Pusa Bold) and 4.60 gms (Pusa Agrani x Jawahar Mustard-1) to 6.14 gms (Maya x Pusa Bold) having a mean values 4.95 gms and 5.51 gms, respectively.

In parents, it was observed from 26.33 gms (PusaAgrani) to 40.33 gms (Urvashi) and in F₁s it ranged from 28.67gms (Pusa Agrani x Durgamani) to 41.67 gms (Maya x Durgamani) with mean values of 33.18 gms (parent) and 36.03 gms (F₁ hybrid). These findings were also similar to (Sheikh and Singh, 2001, Sharma et al., 2003, Singh and Lallu, 2004, Singh and Dixit, 2006). The results of GCV and PCV for parents and F₁ are presented in the table-2. The results of GCV for parents are found higher for length of main raceme (16.20) followed by seed yield per plant (12.37), test weight (12.09), number of secondary branches per plant (10.65), number of silique per plant (8.32), days to 50% flowering (7.55), plant height (5.83), days to maturity (4.63) and oil content (2.80).

Highest value of PCV for parents are found for length of main raceme (16.61) followed by seed yield per plant (15.48), test weight (12.36), number of secondary branches per plant (10.65), number of siliques per plant (8.47), days to 50% flowering (7.77), plant height (5.90), days to maturity (4.71) and oil content (2.92). Highest value of GCV for F₁ are found for length of main raceme (9.08) followed by test weight (8.89), seed yield per plant (8.52), number of siliques per plant (5.20), days to 50% flowering (4.33), number of secondary branches per plant (4.30), days to maturity (3.64), plant height 5 (3.30) and oil content (2.87). Highest value of PCV for F₁ are found for seed yield per plant (10.47) followed by length of main raceme (9.78), test weight (9.75), number of secondary branches per plant (8.69), number of siliques per plant (5.31), days to 50% flowering (4.72), days to maturity (3.82), plant height 5 (3.50) and oil content (3.03). These findings were also similar to (Singh et al., 2003, Singh et al., 2006, Singh et al., 2007, Singh et al., 2007, Tahir et al., 2007, Singh et al., 2008, Singh et al., 2008b, Singh et al., 2009c, Singh et al., 2010, Singh and Ranjeet, 2010).

Table 1. ANOVA of parents F₁’s for 9 characters in a 7 x 7 parental diallel cross of Indian mustard mean sum of squares.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f.</th>
<th>Days to flowering</th>
<th>Days to maturity</th>
<th>Plant height (cm)</th>
<th>Length of main raceme (cm)</th>
<th>No. of Siliqua/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replications</td>
<td>02</td>
<td>04.08</td>
<td>06.25</td>
<td>10.36</td>
<td>0.01</td>
<td>06.58</td>
</tr>
<tr>
<td>Treatments</td>
<td>27</td>
<td>49.93**</td>
<td>78.01**</td>
<td>167.16**</td>
<td>106.92**</td>
<td>1169.86**</td>
</tr>
<tr>
<td>Parents</td>
<td>06</td>
<td>102.98**</td>
<td>112.15**</td>
<td>340.76**</td>
<td>175.53**</td>
<td>2280.65**</td>
</tr>
<tr>
<td>F₁s</td>
<td>20</td>
<td>33.56**</td>
<td>68.66**</td>
<td>105.71**</td>
<td>70.46**</td>
<td>894.90**</td>
</tr>
<tr>
<td>Parents Vs. F₁s</td>
<td>01</td>
<td>59.06**</td>
<td>60.04**</td>
<td>354.75**</td>
<td>424.32**</td>
<td>04.34</td>
</tr>
<tr>
<td>Error</td>
<td>54</td>
<td>2.03</td>
<td>2.02</td>
<td>05.13</td>
<td>3.56</td>
<td>16.44</td>
</tr>
</tbody>
</table>
Table 1. Contd......

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f.</th>
<th>No. of secondary branches/plant</th>
<th>Oil content (%)</th>
<th>Test weight (g)</th>
<th>Seed yield/plant (g)</th>
</tr>
</thead>
<tbody>
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<td>Replications</td>
<td>02</td>
<td>3.32</td>
<td>0.17</td>
<td>0.09</td>
<td>4.00</td>
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<tr>
<td>Treatments</td>
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<td>09.81**</td>
<td>5.57**</td>
<td>0.85**</td>
<td>42.57**</td>
</tr>
<tr>
<td>Parents</td>
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<td>22.52**</td>
<td>3.40**</td>
<td>1.09**</td>
<td>60.09**</td>
</tr>
<tr>
<td>F1s</td>
<td>20</td>
<td>06.16</td>
<td>3.97**</td>
<td>0.07*</td>
<td>33.09**</td>
</tr>
<tr>
<td>Parents Vs. F1s</td>
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<td>06.67</td>
<td>50.97**</td>
<td>2.10**</td>
<td>127.14**</td>
</tr>
<tr>
<td>Error</td>
<td>54</td>
<td>3.51</td>
<td>0.13</td>
<td>0.03</td>
<td>05.71</td>
</tr>
</tbody>
</table>

*Significant at P = 0.05; **Significant at P = 0.01

Table 2. Mean, range and coefficient of variation for 9 characters in parents and F1s of 7 parent diallel cross in Indian mustard

<table>
<thead>
<tr>
<th>Characters</th>
<th>Mean</th>
<th>Range</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X_p</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Days to flowering</td>
<td>76.85</td>
<td>74.92</td>
<td>73.67</td>
</tr>
<tr>
<td>Days to maturity</td>
<td>131.28</td>
<td>129.31</td>
<td>117.67</td>
</tr>
<tr>
<td>Plant height</td>
<td>181.19</td>
<td>176.41</td>
<td>158.00</td>
</tr>
<tr>
<td>Length of main raceme</td>
<td>46.81</td>
<td>52.00</td>
<td>37.00</td>
</tr>
<tr>
<td>No. siliquae/plant</td>
<td>329.47</td>
<td>330.00</td>
<td>287.00</td>
</tr>
<tr>
<td>No. of secondary branches/plant</td>
<td>22.76</td>
<td>23.41</td>
<td>18.00</td>
</tr>
<tr>
<td>Oil content</td>
<td>37.52</td>
<td>39.31</td>
<td>36.45</td>
</tr>
<tr>
<td>Test weight</td>
<td>4.95</td>
<td>5.31</td>
<td>4.34</td>
</tr>
<tr>
<td>Seed yield/plant</td>
<td>33.18</td>
<td>36.03</td>
<td>26.33</td>
</tr>
</tbody>
</table>

X_p = Mean of parent, X_F1 = Mean of F1s; GCV = Genotypic coefficient of variation; PCV = Phenotypic coefficient of variation.

References


