Heterosis for Some Quantitative Characters in *Brassica juncea* L.

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**Abstract:** Five crosses of *Brassica juncea* viz., SMP 13-78 x Zem-I, SML 31E x Zem-I, DL 8 x Zem-I, SM 83000 x Zem-I, Pr 171-71 x Zem-I were made. These crosses (F$_1$'s) along with their parents were sown and heterosis was studied for branches per plant, plant height (cm), number of silicas and yield per plant (g) in F$_1$ generation. It was found that a cross of SMP 13-78 x Zem-I showed maximum heterosis and heterobeltiosis for all the characters studied. Therefore, this cross combination can fruitfully be utilized for improving yield and its components in future breeding programmes.

**Key words:** *Brassica juncea*, heterosis, heterobeltiosis, yield components, Pakistan

**Introduction**
The rapeseed and mustard yield in Pakistan is generally low in comparison with other countries. A key factor in the poor performance is the scarcity of high yielding, locally adapted cultivars. The breeder, ultimately, looks for better ways and means which can guarantee to raise per unit production. Among other means of boosting productivity, the exploitation of heterosis holds a good promise and has increased the production of various crops enormously. It evidently acknowledged in the literature that hybrid vigour manifests itself both for developmental and economical characters in Rapeseed and Mustard. The effect of the phenomenon on yield and various components is obviously well documented by the breeders and reported to affect the seed yield, branches and pods per plant to an appreciable extent (Grant and Beversdorf, 1985; Katiyar et al., 2000; Khan et al., 1993). Heterosis for branches per plant, height of the main stem, silicas and yield per plant had variably been reported by different workers. A little heterotic effect was observed in yield per plant. Additional studies also showed different magnitude of heterosis in silicas per plant and 1000-seeds weight (Weirong et al., 1999). Heterosis was the highest for seed yield per plant followed by pods and branches per plant. (Ali et al., 2000). Different workers in their studies have reported a considerable degree of heterotic effect for height of the main stem, pods, branches and seed yield per plant (Serryk and Stefansson, 1983; Varshey, 1985; Parsad and Singh, 1985). Heterotic effect in seed yield per plant was observed up to the extent of 96.4% (Cunkoc et al., 2000). The studies revealed highly significant increase over the better parents for height, seed yield and number of branches per plant (Singh et al., 1985).

A varying degree of heterosis was estimated for seed yield, 1000-seeds weight, plant height and yield per pod over mid parent values. It was further confirmed that some of the crosses exhibited heterobeltiosis also (Verma et al., 2000; Khulbe et al., 1998). So, F$_1$ generation comparing mid and superior parents, heterosis occurred for all the characters to varying degree. However, in the proposed study good types with different genetic background are crossed for such information. The amount of heterosis for different characters was assessed and results of the present study were obtained.

**Materials and Methods**
The following 5 crosses were made to study the heterotic effect for number of branches, plant height, number of silicas per plant and yield during the year, 2000-2001.

- SMP 13-78 x Zem-I
- SML 31E x Zem-I
- DL 8 x Zem-I
- SM 83000 x Zem-I
- Pr 171-71 x Zem-I

The seeds obtained from these crosses were sown as F$_1$ in the following year, i.e. 2001-2002 at Oilseeds Research Institute, Faisalabad. F$_1$ crosses along with their parents were sown by dibbling in four replications. The following data for ten plants in each replication was recorded.

- Number of branches per plant.
- Plant height (cm)
- Number of silicas per plant.
- Yield per plant (g).

Heterosis in F$_1$ for all these characters were calculated in
percentage over the mid parent and heterobeltiosis over
the better parent values. The data was subjected to
analysis of variance to see whether the differences in the
performance of parents and their F₁'s were real or just
incidental.

Results and discussion

Number of branches per plant: It is clear from Table 1 that
only the cross of DL 8 x Zem-I could show highly
significant differences among F₁'s and their parents.
During the study number of branches per plant, heterosis
was observed in crosses over mid parent, ranging from
3.4% (SM 83000 x Zem-I) to 23.8% (DL 8 x Zem-I). The
crosses of SMP 13-78, SML 31E and DL 8 with Zem-I
showed heterosis over their better parents ranging from
12.1% (SMP 13-78 x Zem-I) to 18.2% (DL 8 x Zem-I)
meanings thereby over dominance type of gene action in
all these crosses, while heterosis in SM 83000 x Zem-I had
showed additive type of gene action with partial
dominance. Ali et al. (2000), Varshney (1985) and Singh et
al. (1985) have reported reasonable degree of heterosis on
number of branches per plant while studying the F₁
generation of *Brassica juncea*.

Plant height (cm): The data of plant height given in Table
1 out of five crosses showed significant differences
among F₁'s and their parents. In this case heterosis was
observed in all the crosses over their mid parent values
while crosses of SMP 13-78, SML 31E, DL 8 and SM 83000
with Zem-I showed heterotic effect even over better
parents which reveals the fact that over dominance type of
gene action was present in these crosses while heterosis in Pr 171-71 x Zem-I had showed additive type of
gene action with partial dominance. The magnitude of
heterosis over mid parent values ranged from 6.5% (Pr 171-71
x Zem-I) to 15.8% (SML 31E x Zem-I) but the degree of
increase over better parents range from 4.2% (SM 83000 x
Zem-I) to 8.8% (DL 8 x Zem-I). The above findings confirm
those of Weirong et al. (1999), Ali et al. (2000), Verma et
al. (2000) and Khulbe et al. (1998) who already reported
heterosis for this character.

Number of siliquas per plant: As regards number of
siliquas per plant only two crosses, i.e., SMP 13-78 x Zem-
I and SML 31E x Zem-I showed significant differences
among F₁'s and their parents (Table 1). The magnitude of
hybrid vigour when compared with mid parent values
ranged from 5.3% (SM 83000 x Zem-I) to 10.3% (SMP 13-78
x Zem-I) and 3.6% (DL 8 x Zem-I) to 12.5% (SMP 13-78
x Zem-I) when compared with better parental values. The
crosses of SMP 13-78, SML 31E and DL 8 with Zem-I
showed heterosis over their better parents which indicated
the fact that over dominance type of gene action was
present in these crosses while heterosis in SM 83000
x Zem-I has additive type of gene action with partial
dominance. Hybrid vigour have also been observed for
this character by Weirong et al. (1999), Ali et al. (2000),
Parsad and Singh (1985) and Katiyar et al. (2000).

Yield per plant (g): In case of yield per plant SMP 13-78 x
Zem-I and SML 31E x Zem-I showed highly significant
differences among F₁'s and parents (Table 1). All the
crosses showed heterosis when compared with mid
parental values with a range of 5.5% (SM 83000 x Zem-I)
to 87.2% (SMP 13-78 x Zem-I). Heterobeltiosis values of
the crosses depict that over dominance type of gene
action was present in these crosses. The range of
heterobeltiosis in this case was 1.2% (SM-83000 x Zem-I)
to 55.9% (SMP 13-78 x Zem-I). These results are in
accordance with Sernyk and Stefansson (1983), Ali et al.

Table 1: Heterosis in intra specific crosses of *Brassica juncea* L.

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Heterosis of F₁ over MPs</th>
<th>Heterosis of F₁ over BPs</th>
<th>Heterosis of F₁ over MPs</th>
<th>Heterosis of F₁ over BPs</th>
<th>Heterosis of F₁ over MPs</th>
<th>Heterosis of F₁ over BPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pr 171-71 x Zem-I</td>
<td>-6.9</td>
<td>-18.2</td>
<td>6.5</td>
<td>-1.3</td>
<td>-1.4</td>
<td>-18.7</td>
</tr>
<tr>
<td>DL 8 x Zem-I</td>
<td>23.8**</td>
<td>18.2*</td>
<td>12.8**</td>
<td>4.2</td>
<td>5.3</td>
<td>5.5</td>
</tr>
<tr>
<td>SM 83000 x Zem-I</td>
<td>3.4</td>
<td>-9.1</td>
<td>12.8**</td>
<td>4.2</td>
<td>5.3</td>
<td>5.5</td>
</tr>
<tr>
<td>SML 31E x Zem-I</td>
<td>22.6*</td>
<td>15.2</td>
<td>15.8**</td>
<td>7.4</td>
<td>33.7**</td>
<td>31.9**</td>
</tr>
<tr>
<td>SMP 13-78 x Zem-I</td>
<td>14.4*</td>
<td>12.1</td>
<td>12.0**</td>
<td>6.9</td>
<td>81.5**</td>
<td>32.5**</td>
</tr>
</tbody>
</table>

* Significant ** Highly significant
(2000), Cunkou et al. (2000), Singh et al. (1985), Verma et al. (2000) and Khulbe et al. (2000). Who obtained similar results for heterosis in F₁ hybrids in *B. juncea* and *B. napus*.

**References**


