HETEROSIS AND INBREEDING DEPRESSION IN RACIAL DERIVATIVES OF *Gossypium hirsutum* L. FOR BOLLWORM (*Helicoverpa armigera* Hubner) RESISTANCE

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ABSTRACT

Heterosis over mid parent and better parent in \( F_1 \) and inbreeding depression in the \( F_2 \)s were studied for number of sympodia per plant, number of bolls per plant, seed cotton yield per plant, ginning outturn, boll damage and locule damage. The relative heterosis and heterobeltiosis were significant for seed cotton yield in all the six crosses. The relative heterosis was negatively significant for boll damage and locule damage confirming bollworm damage in the \( F_1 \), but compared to the better parent the bollworm damage was high in \( F_1 \). The inbreeding depression was positive for boll damage and locule damage in all the six crosses showing less bollworm damage in \( F_2 \) generation and it will be because of the segregation of resistant genes.

*Gossypium hirsutum* L. is the predominant species among the four cultivated cotton species in India. It is grown in all the cotton growing areas. Eventhough genetic variability of the cultivars is fairly wide; there is further scope for broadening the genetic base to obtain suitable hybrids/varieties with high yield. In recent years, cotton breeders made considerable effort to develop high yielding genetic cultivars with better fibre quality and a number of such cultivars have been released but very less effort has been made on the resistance breeding especially for bollworm resistance. In the present study, therefore, some interracial derivatives of cotton has been evaluated for its ability to manifest heterosis and inbreeding depression in six crosses for yield and yield components besides for bollworm resistance.

Three inter racial derivatives viz., *Gossypium hirsutum* race *palmeri* der. 9-18, *G. hirsutum* race *palmeri* der. 16-26 and *G. hirsutum* race *morrilli* der. IRH II were used as a female parents. The two established varieties MCU 5 and LRA 5166 were used as male parents to create six cotton hybrids. The experimental material consists of six \( F_1 \)s. A spacing of 75 x 30 cm was adopted with 20 plants per row with three replications. The data were recorded on five competitive plants in each row for number of sympodia per plant, number of bolls per plant, seed cotton yield per plant, ginning outturn, boll damage and locule damage.

List of crosses involving parents

Cross 1 - *Gossypium hirsutum* race *palmeri* der. 9-18 x MCU 5
Cross 2 - *Gossypium hirsutum* race *palmeri* der. 9-18 x LRA 5166
Cross 3 - *Gossypium hirsutum* race *palmeri* der. 16-26 x MCU 5
Cross 4 - *Gossypium hirsutum* race *palmeri* der. 16-26 x LRA 5166
Cross 5 - *Gossypium hirsutum* race *morrilli* der. IRH II x MCU 5
Cross 6 - *Gossypium hirsutum* race *morrilli* der. IRH II x LRA 5166

The heterosis was estimated as percent increase in the mean of the \( F_1 \) over the mid parent and better parent. The inbreeding

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Table 1. Expression of Heterosis and inbreeding depression for number of sympodia per plant, number of bolls per plant and seed cotton yield per plant

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Number of sympodia/plant</th>
<th>Number of bolls/plant</th>
<th>Seed cotton yield/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>** di**</td>
<td>** dii**</td>
<td>** ID**</td>
</tr>
<tr>
<td>Cross 1</td>
<td>-11.97**</td>
<td>-19.19*</td>
<td>8.44</td>
</tr>
<tr>
<td>Cross 2</td>
<td>-0.26</td>
<td>-3.03</td>
<td>5.47</td>
</tr>
<tr>
<td>Cross 3</td>
<td>32.70**</td>
<td>20.44**</td>
<td>22.09**</td>
</tr>
<tr>
<td>Cross 4</td>
<td>8.97**</td>
<td>4.68</td>
<td>20.00*</td>
</tr>
<tr>
<td>Cross 5</td>
<td>0.28</td>
<td>-5.12</td>
<td>7.67*</td>
</tr>
</tbody>
</table>

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

- ** di = Relative Heterosis**
- ** dii = Heterobeltiosis**
- ** ID = Inbreeding depression.**

Table 2. Expression of Heterosis and inbreeding depression for ginning outturn, boll damage and locule damage

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Ginning outturn</th>
<th>Boll damage</th>
<th>Locule damage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>** di**</td>
<td>** dii**</td>
<td>** ID**</td>
</tr>
<tr>
<td>Cross 1</td>
<td>7.19**</td>
<td>-2.44</td>
<td>3.54</td>
</tr>
<tr>
<td>Cross 2</td>
<td>-0.63</td>
<td>-9.74**</td>
<td>3.02</td>
</tr>
<tr>
<td>Cross 3</td>
<td>7.54**</td>
<td>-3.10</td>
<td>4.40*</td>
</tr>
<tr>
<td>Cross 4</td>
<td>13.03**</td>
<td>1.63</td>
<td>6.99*</td>
</tr>
<tr>
<td>Cross 5</td>
<td>2.94</td>
<td>-12.04**</td>
<td>6.20</td>
</tr>
<tr>
<td>Cross 6</td>
<td>-0.77</td>
<td>-15.37**</td>
<td>3.52*</td>
</tr>
</tbody>
</table>

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

- ** di = Relative Heterosis**
- ** dii = Heterobeltiosis**
- ** ID = Inbreeding depression.**

Depression in F₂ generation was worked out as per cent decrease in the performance of F₁ to the F₂.

Data on heterosis and inbreeding depression are presented in Table 1 and Table 2.

Number of sympodia per plant: Heterosis over mid parent was significant in the crosses 1, 3, 4 and 6 with the values ranging from -11.97 in cross 1 to 32.70 in the cross 3. A negative heterosis over mid parent was observed in the cross 1. The heterobeltiosis for number of sympodia per plant was significant in the crosses 1 and 3. The cross 1 possessed negative heterosis, while the heterobeltiosis ranged from -19.19 in cross 1 to 20.44 in cross 3. The inbreeding depression was significant in the crosses 3, 4, 5 and 6 and ranged from 7.67 in cross 5 to 22.09 in cross 3. Duhoon et al. (1983) reported positive heterosis for this trait.

Number of bolls per plant: Heterosis over mid parent (di) was significant in all the crosses with the values ranging from 14.19 in cross 6 to 29.14 in cross 1. The heterobeltiosis was significant in the crosses 1, 2, 3 and 5 and it was maximum in cross 1 (17.41). The inbreeding depression was significant in all the crosses except in cross 6 with the values ranging from 7.99 in cross 6 to 22.71 in cross 1.

The positive heterosis for number of bolls per plant was reported by Siddiqui (1993).
and Bhatade and Rajeswar (1994). This heterosis for number of bolls per plant reflected the expression of heterosis for yield in majority of the crosses and this character needs consideration while selecting the parents for heterosis breeding programme. Inbreeding depression in $F_2$ was with an agreement to the reports by Gunaseelan and Krishnaswami (1988).

**Seed cotton yield per plant:** The relative heterosis ($d_O$) was significant and positive in all the six crosses with the values ranged from 11.60 in cross 5 to 30.94 in cross 3. Heterosis estimates over better parent ($d_{ii}$) were also significant in all the six crosses, the values ranged from 8.20 in cross 1 to 20.96 in cross 3. Inbreeding depression was significant in all the crosses except in cross 5 and the values ranged from 15.67 in cross 1 to 30.41 in cross 3.

The heterosis for seed cotton yield had been reported earlier by Sundaramurthy and Gururajan (1993); Bhatade and Rajeswar (1994). High heterosis for seed cotton yield in most of the crosses resulted from high heterosis for any one or the combined effect of moderate heterosis for different yield components.

**Ginning outturn:** The heterosis over the mid parent was positive in the crosses 1, 3, and 4, but the heterosis over better parent was negative in all the crosses except in cross 4 and the values ranged from $-15.37$ to 1.63. The heterosis for ginning outturn was reported earlier by Gururajan and Basu (1992) and Saeed et al. (1994).

The inbreeding depression was significant in the crosses 3, 4 and 6. Only very slight inbreeding depression was observed. This was in agreement with the reports by Gunaseelan and Krishnaswami (1988).

**Boll damage:** Boll damage and locule damage are the important characters to assess the bollworm infestation in the cotton. The estimates on heterosis ($d_O$) for boll damage was significant in all the crosses except cross 6 and it was negative in all the crosses. It indicates lower bollworm damage in $F_1$ as compared to popular cultivars. The heterobeltiosis ($d_{ii}$) was significant and positive in the crosses 3, 4, 5 and 6 and negatively significant in the cross 2 (-2.14). It indicates that as compared to the wild derivatives the $F_1$s had the maximum bollworm damage. The inbreeding depression was positive in $F_2$ of all the six crosses.

**Locule damage:** Like boll damage, the heterosis over the mid parent was significantly negative for locule damage in all the crosses showing the effect of wild derivatives. The heterosis over the better parent was significant and positive in all the six crosses studied (3.94 to 45.58) and indicated more locule damage in the $F_1$ compared to their respective wild derivative parent. The inbreeding depression was significant in cross 1, 2, and 5, while it was positive in all the six crosses showing less locule damage in $F_2$.

To summarize, the boll damage and locule damage was less in the racial derivative G. hirsutum race mormilli der. IRH II and whenever this parent was used in the crossing in $F_1$ also the damage was minimum. But when the yield and yield components are also taken in to consideration, the crosses involving G. hirsutum race palmeri der. 16-26 which had minimum bollworm damage and had the higher seed cotton yield and high number of bolls and sympodia per plant. It was also found that increase in number of sympodia and boll number indirectly contributed to the increase in seed cotton yield per plant. To conclude, among the six crosses studied, crosses namely palmeri der. 16-26 x MCU 5 and palmeri der. 16-26 x LRA 5166 were selected and back crosses were made to increase yield and bollworm resistance.
REFERENCES