Heterosis for seed cotton yield and other agromorphological traits in GMS based hybrids of upland cotton (Gossypium hirsutum L.)

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Abstract
A study was made in upland cotton to assess the extent of heterosis over standard check for seed cotton yield and its related attributes traits at three locations viz., Surat, Bharuch and Hansot. The standard heterosis varied from -36.83 to 15.95 per cent. The three hybrids viz., G (B) 20 x G.Cot.10, G (B) 20 x DHY-286-1 and LRK-516 x DHY-286-1 showed significant and positive standard heterosis, in which the cross G(B) 20 x G.Cot.10 showed maximum value of standard heterosis for seed cotton yield per plant and manifested heterotic effects for its contributing characters like number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight, and number of seeds per boll and seed index.

Keywords: Cotton, GMS, seed cotton yield, standard check, standard heterosis

Introduction
Cotton, the king of the fibre, is also called white gold. The increased productivity can be achieved by developing superior varieties/hybrids through genetic improvement and by proper management practices. Thus, the situation offers immense scope for geneticists in general and cotton breeders in particular both at national and state level. To meet the challenges of increasing productivity, Gossypium hirsutum L. offers better scope for genetic improvement among the four-cultivated species of cotton. Majority of cotton produced by G. hirsutum species is medium and long staple. This species has very high adaptability with rich diversity for yield and yield related characters. However, at present the hybrid cotton seed is being produced by cumbersome and laborious process of hand emasculation and pollination. Probably this single largest factor has affected its further expansion and its production is not within the means of average farmer. To overcome the high cost of hybrid cotton seed, use of male sterility (as in sorghum, pearl millet etc.) Could be the only answer in eliminating labour intensive manual emasculation. Use of male sterile lines appears to be advantageous since the maintenance of male sterile population for seed production is easier and more over sterility source under reference is stable. Cytoplasmic nuclear interaction affects the petal size and anther number which can be used as markers in identifying the parental lines and for ascertaining genetic purity.

At present the only stable and dependable CGMS source under various environment is of G. harknessii which in interaction with genome of G hirsutum produces male sterility. A single dominant gene ‘Rf’ from G. harknessii is essential for fertility restoration and fertility enhancement factor from barbadense. Information on the presence of commercially exploitable heterosis within the available conventional, GMS and CGMS lines, their general combining ability and stability of resultant cross combinations is highly useful in evolving early maturing and high yielding stable hybrids. Accordingly, the present study was planned and executed with producing GMS based hybrids.

Materials and methods
The present investigation was conducted with three complete sets of 24 Gossypium hirsutum entries comprising of 14 F₁₈ produced by GMS method, 7 females and 2 males and 1 check were evaluated during kharif 2002 at three locations viz., Surat, Bharuch and Hansot. The experiment was laid out in a Randomized Complete Block design (RBD) with three replications. The parents and F₁₈ with standard checks were represented by a single row plot of 14 plants, placed at 120 cm x 45 cm. All the agronomical practices and plant protection measures were followed as and when required to raise a good crop of cotton. The seeds of these parents were obtained from Main Cotton Research Station, Surat. For obtaining the cross
seeds, parents were grown at Main Cotton Research Station, Surat. The 7 females and 2 males were crossed in L x T mating design to obtain 14 crosses of conventional hybrids making it totally 14 crosses. All the F₃s and selfed seeds of parents were stored properly in thick paper bags for sowing in the next season at three locations.

### Table 1a: Estimates of standard heterosis for different agro morphological characters in cotton

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Days to 50% flowering</th>
<th>Plant height (cm)</th>
<th>Monopodia per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 IH 20 x G.Cot.10</td>
<td>-18.72**</td>
<td>-12.63**</td>
<td>-19.25**</td>
</tr>
<tr>
<td>PH 93 x DHY 286-1</td>
<td>-26.11**</td>
<td>-21.36**</td>
<td>-22.46**</td>
</tr>
</tbody>
</table>

### Table 1b: Estimates of standard heterosis for different agro morphological characters in cotton

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Sympodia per plant</th>
<th>Number of bolls per plant</th>
<th>Boll weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>76 IH 20 x G.Cot.10</td>
<td>-34.18**</td>
<td>-38.29</td>
<td>-11.53</td>
</tr>
<tr>
<td>LH 900 x G.Cot.10</td>
<td>-25.34**</td>
<td>-21.55</td>
<td>-16.05</td>
</tr>
<tr>
<td>G(B) 20 x DHY 286-1</td>
<td>-14.96**</td>
<td>-15.54**</td>
<td>-18.59**</td>
</tr>
<tr>
<td>G(Cot.100 x G.Cot.10</td>
<td>-11.27**</td>
<td>-3.00</td>
<td>-14.68</td>
</tr>
<tr>
<td>G(Cot.100 x G.Cot.10</td>
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<td>-3.00</td>
<td>-14.68</td>
</tr>
</tbody>
</table>

### Table 1c: Estimates of standard heterosis for different agro morphological characters in cotton

<table>
<thead>
<tr>
<th>Crosses</th>
<th>Number of seeds per boll</th>
<th>Seed index (g)</th>
<th>Ginning percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH 900 x G.Cot.10</td>
<td>-29.12**</td>
<td>-42.86**</td>
<td>-33.82**</td>
</tr>
<tr>
<td>PH 93 x G.Cot.10</td>
<td>-10.65</td>
<td>-36.50**</td>
<td>-14.97</td>
</tr>
<tr>
<td>PH 93 x DHY 286-1</td>
<td>-2.40</td>
<td>-3.54</td>
<td>19.51</td>
</tr>
<tr>
<td>G(B) 20 x G.Cot.10</td>
<td>-12.75**</td>
<td>-23.55**</td>
<td>39.21**</td>
</tr>
<tr>
<td>G(Cot.100 x G.Cot.10</td>
<td>2.40</td>
<td>-10.43</td>
<td>-17.95</td>
</tr>
<tr>
<td>G(Cot.100 x G.Cot.10</td>
<td>-32.09</td>
<td>-23.55**</td>
<td>39.21**</td>
</tr>
<tr>
<td>G(Cot.100 x G.Cot.10</td>
<td>2.40</td>
<td>-10.43</td>
<td>-17.95</td>
</tr>
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</table>

### Results

The estimates of heterosis measured as per cent increase or decrease over standard check (standard heterosis) in individual environment and on pooled basis are presented in Table 1a to 1d and results obtained are given below:

- **Loc-I**: Local 1
- **Loc-II**: Local 2
- **Loc-III**: Local 3
- **Pooled**: Pooled

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### Discussion

The heterotic response of an F₁ is indicative of genetic diversity among the parents involved (Moll et al., 1962). In the present investigation, the standard heterosis varied from -36.83 to 15.95 per cent, where two hybrids showed significant and positive standard heterosis, whereas the cross G(B) 20 x

### Days to 50 per cent flowering

In GMS based hybrids, the heterosis over standard check ranged from -26.51 to 15.10 per cent. Number of crosses which showed significant negative standard heterosis were eleven. The crosses viz, LRK 516 x G. Cot.10, PH 93 x G. Cot.10 and 76 IH 20 x G. Cot.10 recorded maximum values of standard heterosis in desired direction.

### Plant height (cm)

In GMS based hybrids, standard heterosis ranged from -49.25 to 2.82 per cent. Eight hybrids exhibited significant and negative heterosis over standard check. Three crosses viz., LRK 516 x D HY 286-1, LRK 516 x G.Cot.10 and LR 5166 x G.Cot.10 recorded maximum values of standard heterosis in desired direction.

### Number of monopodia per plant

In GMS based hybrids, the heterosis over standard check ranged from -8.03 to 57.03 per cent. Nine crosses recorded significant and positive heterosis over standard check. The best cross combinations G(B) 20 x G. Cot.10, LRK 516 x D HY 286-1, PH 93 x G. Cot.10 and 76 IH 20 x G. Cot.10 registered maximum values of standard heterosis.

### Number of sympodia per plant

In GMS based hybrids, the standard heterosis ranged from -30.32 to 23.11 per cent. In standard heterosis, only one hybrid LRK 516 x D HY 286-1 showed significant and positive heterosis.

### Number of bolls per plant

In hybrids developed by GMS method, the standard heterosis ranged between -31.64 and 15.67 per cent. Four crosses viz., G(B) 20 x G. Cot.10, G(B) 20 x D HY 286-1, G. Cot.100 x D HY 286-1 and 76 IH 20 x D HY 286-1 reported significant and positive standard heterosis.

### Boll weight (g)

In GMS based hybrids, the standard heterosis fluctuated between 2.37 to 33.30 per cent and 11 hybrids reported significant and positive standard heterosis, in which crosses viz., G.Cot.100 x G.Cot.10, LRK 516 x D HY 286-1, G(B) 20 x D HY 286-1, G(B) 20 x G.Cot.10 and LH 900 x D HY 286-1 showed maximum values of standard heterosis.

### Seed cotton yield per plant (g)

In GMS based hybrids, standard heterosis varied from -36.83 to 15.95 per cent. Two hybrids showed significant and positive standard heterosis. Two crosses viz., G(B) 20 x G.Cot.10 and LRK 516 x D HY 286-1 showed maximum values of standard heterosis.

### 2.5 per cent span length (mm)

In crosses developed by GMS method, standard heterosis ranged from -17.23 to -6.58 per cent. None of the hybrids recorded significant and positive standard heterosis.

### Fibre strength (g/text)

In GMS based hybrids, heterosis over standard check varied from -7.27 to 6.51 per cent. None exhibited positive and significant standard heterosis.

### Number of seeds per boll

In GMS based crosses, standard heterosis ranged from -15.83 to 29.53 per cent. Six hybrids showed positive and significant standard heterosis. The crosses viz., G (B) 20 x D HY 286-1, LRK 516 x D HY 286-1, G. Cot.100 x G. Cot.10, G (B) 20 x G. Cot.10 and 76 IH 20 x D HY 286-1 exhibited maximum values of standard heterosis.

### Seed index (g)

In crosses developed by GMS method, heterosis over standard check varied from -10.11 to 23.77 per cent. Nine crosses exhibited significant and positive heterosis over standard check. Five crosses viz., LRA 5166 x D HY 286-1, G. Cot.100 x G. Cot.10, LRA 5166 x G. Cot.10 and 76 IH 20 x D HY 286-1 recorded maximum values of heterosis over standard check.

### Ginning percentage (%)

In GMS based crosses, standard heterosis ranged from -4.44 to 20.74 per cent. Six hybrids viz., PH 93 x G. Cot.10, PH 93 x D HY 286-1, G. Cot.100 x D HY 286-1, 76 IH 20 x G. Cot.10 and G (B) 20 x G. Cot.10 exhibited significant and positive standard heterosis.

### Seed cotton yield per plant (g)

In GMS based hybrids, standard heterosis varied from -36.83 to 15.95 per cent. Two hybrids showed significant and positive standard heterosis.
Prospects for successful production of pure and low cost first generation hybrid seed using GMS system appears to be bright in near future. This system not only circumvent emasculation but may even set aside the necessity of hand pollination by developing effective cross pollination system, possibly developing insect pollinators or at least by some mechanical device.

References
21. Patil FB, Shinde YM, Thombre MV. Heterosis in multiple environments for yield components and its