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# Heterosis for Some Important Quantitative Traits in Cotton (*Gossypium hirsutum* L.)

D. Kumaresan, J. Ganesan[1], P. Azhaguvel[1] and P. Senthil Kumar[1]

Department of Agricultural Botany
Agricultural College and Research Institute
Madurai - 625 104, Tamilnadu, India

***ABSTRACT.*** *A study was carried out to assess the nature and extent of heterosis, heterobeltiosis and standard heterosis for six quantitative traits in a 6×6 diallel cross in cotton (Gossypium hirsutum L.). The hybrid SVPR 1 × LRA 5166 was judged as the best among all the hybrids evaluated, since it showed significant heterosis for important traits viz., number of bolls per plant and seed cotton yield, number of seeds per boll and boll weight. The cross MCU 7 × LRA 5166 exhibited highly significant negative heterosis for days to first flower which indicates earliness of flowering.*

## INTRODUCTION

Cotton is an important fibre crop, subjected to heterosis as well as recombination breeding. Heterosis was first recognised in cotton by Mell (1894). Later many workers reported this phenomenon for various yield attributing traits. Although India contains 40% of the total world cotton area, the productivity is low when compared to other developed countries while the demand for cotton is increasing due to rising population. The need therefore exists to enhance cotton production and productivity in the coming decades. The projected demand for 2020 AD is envisaged at 23-24 million bales. Hence an investigation was made to ascertain important hybrid combinations that could be directly recommended for cultivation. The present investigation therefore aims to establish the extent of heterosis for important quantitative traits in cotton through diallel analysis.

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1 Department of Agricultural Botany, Annamalai University, Chidambaram-608002, Tamilnadu, India.

## MATERIALS AND METHODS

Experimental material comprising of six genotypes of cotton and their thirty hybrids from a set of 6×6 diallel crosses was grown in a randomised block design with three replications at Faculty of Agriculture, Annamalai University, Chidambaram in Tamilnadu during 1997. The recommended cultural practices were followed. Observations were recorded for six quantitative characters on five randomly selected plants from each treatments of each replication and the mean values were used for the estimation of relative heterosis (di) (deviation of hybrid from mid parent), heterobeltiosis (dii) (deviation of hybrid from best parent) and standard heterosis (diii) (deviation of hybrid from standard parent) using best check LRA 5166. Significance for heterosis was tested by using t test given by Wynne *et al.* (1979).

## RESULTS AND DISCUSSION

Data on heterotic response for quantitative characters in 30 crosses are presented in Table 1. The minimum and maximum heterosis for days to first flower ranged from -6.43% (MCU 7 × LRA 5166) to 11.34% (MCU 7 × ADT 1) for relative heterosis, from -8.78% (ADT 1 × LRA 5166) to 8.33% (MCU 7 × ADT 1) for heterobeltiosis and from -8.78% (ADT 1 × LRA 5166) to 4.34% (LRA 5166 × MCU 9) for standard heterosis. Only one hybrid (MCU 7 × LRA 5166) exhibited negative heterosis for all three bases of heterosis, which indicates earliness. Similar results also have been reported by Sharma (1979). For plant height relative heterosis ranged from -11.07 (MCU 9 × LRA 5166) to 15.29% (ADT 1 × SVPR 1), heterobeltiosis ranged from -14.56 (ADT 1 × LRA 5166) to 13.22% (ADT 1 × SVPR 1) and standard heterosis from -14.69 (MCU 10 × MCU 9) to 7.21% (ADT 1 × SVPR 1). Positive and significant relative heterosis and heterobeltiosis was found in the cross (ADT 1 × SVPR 1) for this character.

The relative heterosis for number of bolls per plant, ranged from -27.66% (MCU 9 × LRA 5166) to 27.49% (LRA 5166 × SVPR 1), heterobeltiosis ranged from -32.25% (MCU 9 × LRA 5166) to 18.12% (SVPR 1 × LRA 5166 and LRA 5166 × SVPR 1) and standard heterosis from -32.25% (MCU 9 × LRA 5166) to 18.12% (SVPR 1 × LRA 5166 and LRA 5166 × SVPR 1). Relative heterosis for three hybrids, heterobeltiosis and standard heterosis for two hybrids respectively were positive and significant. The hybrids SVPR 1 × LRA 5166 and its reciprocal hybrid recorded

**Table 1. Heterosis for quantitative traits in cotton.**

| Crosses | Days to first flower | | | Plant height | | | Number of bolls per plant | | |
|---|---|---|---|---|---|---|---|---|---|
| | $d_i$ | $d_{ii}$ | $d_{iii}$ | $d_i$ | $d_{ii}$ | $d_{iii}$ | $d_i$ | $d_{ii}$ | $d_{iii}$ |
| ADT1 × SVPR1 | 3.54 | 3.08 | -5.97 | 15.29** | 13.22** | 7.21 | 0.53 | -1.46 | -14.31 |
| ADT1 × LRA5166 | -4.18 | -8.78 | -8.78** | -10.67** | -14.56** | -14.56 | -18.80 | -24.09 | -24.09 |
| ADT1 × MCU7 | -0.34 | -3.03 | -7.33 | -4.73 | -8.16 | -9.66* | 5.13 | -0.19 | -3.44 |
| ADT1 × MCU9 | 7.65* | 4.22 | 0.63 | 1.54 | -3.03 | -8.71* | 3.95 | 3.73 | -9.42 |
| ADT1 × MCU10 | 5.64 | 1.86 | -0.81 | 0.34 | -1.16 | -9.76* | 13.73 | 9.58 | -4.71 |
| SVPR1 × ADT1 | 4.83 | 4.37 | -4.80 | -5.34 | -7.04 | -11.97** | 6.62 | 5.62 | -8.15 |
| SVPR1 × LRA5166 | 2.41 | -2.08 | -2.08 | 0.77 | -1.90 | -1.90 | 22.39 | 27.49 | 18.12 |
| SVPR1 × MCU7 | 5.62 | 3.22 | -1.36 | 1.41 | -0.49 | -2.11 | -10.65 | -15.92 | -18.66 |
| SVPR1 × MCU9 | 7.57* | 4.59 | 1.00 | 3.46 | 3.16 | -2.31 | -10.18 | -11.20 | -22.46 |
| SVPR1 × MCU10 | 4.22 | 0.93 | -1.72 | 4.53 | 1.15 | -4.22 | -1.09 | -3.82 | -17.93 |
| LRA5166 × ADT1 | -1.62 | -6.33 | -6.33 | 0.78 | -3.16 | -3.61 | -13.37 | -19.02 | -19.02 |
| LRA5166 × SVPR1 | -2.70 | -6.97 | -6.97 | -10.66** | -12.45** | -12.45* | 27.49** | 18.12* | 18.12* |
| LRA5166 × MCU7 | -3.93 | -6.06 | -6.06 | 3.02 | 2.18 | 2.18 | 7.00 | 5.25 | 5.25 |
| LRA5166 × MCU9 | 6.17* | 4.34 | 4.34 | -9.11* | -11.77 | -11.17** | -13.73* | -19.20** | -19.20* |
| LRA5166 × MCU10 | 4.08 | 2.71 | 2.71 | -7.87* | -13.13** | -13.13** | -16.35* | -24.46** | -19.02** |
| MCU7 × ADT1 | 11.34** | 8.33* | 5.35 | 1.08 | -2.56 | -4.15 | 0.30 | -4.78 | -7.88 |
| MCU7 × SVPR1 | 2.62 | 0.28 | -4.16 | -4.72 | -6.65 | -8.03 | -14.03* | -19.10* | -21.74** |
| MCU7 × LRA5166 | -6.43* | -8.51 | -8.51* | -8.61* | -9.35* | -9.35* | -13.81* | -15.22 | -15.22 |
| MCU7 × MCU9 | -2.31 | -2.81 | -6.15 | -8.48* | -10.44** | -11.90** | -14.76* | -18.91* | -21.56** |
| MCU7 × MCU10 | 1.59 | 0.65 | -1.99 | -0.88 | -5.81 | -7.35 | -9.30 | -16.85* | -19.57* |
| MCU9 × ADT1 | 1.26 | -1.97 | -5.34 | 4.40 | 2.82 | -3.20 | 1.25 | 1.04 | -11.88 |
| MCU9 × SVPR1 | -1.11 | -3.84 | -7.15 | 3.67 | 3.38 | -2.11 | -11.02 | 9.75 | -14.17 |
| MCU9 × LRA5166 | -4.79 | -6.43 | -6.43 | -11.07** | -13.67** | -13.67** | -27.66** | -32.25** | -32.25** |
| MCU9 × MCU7 | 1.46 | 0.94 | -2.93 | -6.29 | -8.30 | -9.80* | -8.46 | -12.92 | -15.76* |
| MCU9 × MCU10 | 0.42 | 0.00 | -2.62 | -0.52 | -3.47 | -9.12* | 1.83 | -2.07 | -14.40 |
| MCU10 × ADT1 | 5.83 | 2.04 | -6.03 | -4.99 | -6.41 | -14.56** | -12.43 | -15.63 | -26.63** |
| MCU10 × SVPR1 | 8.83** | 5.39 | 2.62 | 1.06 | -2.23 | -7.41 | -1.09 | -3.82 | -17.93* |
| MCU10 × LRA5166 | 3.26 | 1.90 | 1.90 | -0.58 | -6.26 | -6.26 | -10.33 | -19.02* | -19.02* |
| MCU10 × MCU7 | 7.32** | 6.32 | 3.53 | 0.22 | -4.77 | -6.33 | -10.93 | -18.35* | -21.01** |
| MCU10 × MCU9 | 0.98 | -1.39 | -3.98 | -6.63 | -9.39* | -14.69** | -3.99 | -7.68 | -19.38** |

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

**Table 1 - Continued.**

| Crosses | Boll weight | | | No. of seeds per boll | | | Seed cotton yield | | |
|---|---|---|---|---|---|---|---|---|---|
| | $d_i$ | $d_{ii}$ | $d_{iii}$ | $d_i$ | $d_{ii}$ | $d_{iii}$ | $d_i$ | $d_{ii}$ | $d_{iii}$ |
| ADT1 × SVPR1 | 1.25 | 0.94 | 21.18** | -0.09 | -3.84 | 10.42 | 25.17** | 17.64** | 16.20* |
| ADT1 × LRA5166 | 8.18 | -0.86 | 19.03 | 0.82 | -5.69 | 8.29 | -1.97 | -8.40 | -8.40 |
| ADT1 × MCU7 | -10.60 | -13.50 | 11.06 | -8.12* | -8.55 | 5.98 | 34.10** | 31.68** | 18.70* |
| ADT1 × MCU9 | 5.59 | 0.94 | 21.28* | 1.22 | -5.90 | 8.05 | 19.71** | 13.96** | 9.55 |
| ADT1 × MCU10 | -1.42 | -7.96 | 10.50 | 0.67 | -8.57 | 4.98 | 25.88** | 25.14** | 10.04 |
| SVPR1 × ADT1 | -2.51 | -2.81 | 16.68 | -0.86 | -4.58 | 9.57 | 6.64 | 0.23 | -1.00 |
| SVPR1 × LRA5166 | 10.00 | -1.10 | 20.62* | 11.45* | 8.19 | 14.91** | 30.36** | 29.56** | 29.56** |
| SVPR1 × MCU7 | -9.50 | -12.70 | 12.09 | -1.72 | -5.82 | 9.14 | 1.90 | -2.56 | -3.75 |
| SVPR1 × MCU9 | 17.82** | 12.96 | 34.77** | 14.11** | 10.05 | 16.89** | -5.39 | -6.66 | -7.80 |
| SVPR1 × MCU10 | 9.48 | 2.51 | 22.31* | 7.28 | 0.99 | 7.26 | 3.93 | -1.78 | -2.98 |
| LRA5166 × ADT1 | 3.58 | -5.07 | 13.96 | 0.68 | -5.82 | 8.14 | -6.81 | -12.91 | -12.91 |
| LRA5166 × SVPR1 | -1.54 | -9.51 | 7.97 | 3.47 | -0.44 | 6.68 | 25.66** | 24.89** | 24.89** |
| LRA5166 × MCU7 | 0.53 | -10.58 | 14.81 | -3.53 | -10.14 | 4.13 | 8.20 | 2.86 | 2.86 |
| LRA5166 × MCU9 | 5.77 | 1.20 | 10.78 | 7.13 | 6.41 | 6.41 | -17.63** | -19.22* | -19.22* |
| LRA5166 × MCU10 | -0.09 | -20.07 | 1.97 | -3.95 | -6.96 | -6.96 | 9.09 | 2.51 | 2.51 |
| MCU7 × ADT1 | 8.26 | 4.74 | 34.49** | 1.46 | 1.00 | 17.04* | 27.36** | 25.07** | 12.74 |
| MCU7 × SVPR1 | -1.85 | -5.33 | 21.56** | -0.84 | -4.98 | 10.12 | 1.56 | -2.88 | -4.07 |
| MCU7 × LRA5166 | -8.08 | -18.25 | 4.97* | -4.94 | -11.45* | 2.61 | 1.67 | -3.34 | -3.34 |
| MCU7 × MCU9 | 6.70 | -1.17 | 26.90** | 8.48 | 0.42 | 16.37** | -6.39 | -9.31 | -12.82 |
| MCU7 × MCU10 | -11.73 | -20.08** | 2.62 | -11.95** | -20.37** | -7.72 | 7.36 | 6.05 | -4.41 |
| MCU9 × ADT1 | -9.68 | -13.66 | 3.66 | -5.95 | -12.57 | 0.39 | 18.35 | 12.67 | 8.31 |
| MCU9 × SVPR1 | -2.99 | -6.99 | 10.97 | -4.252 | -7.62 | -1.88 | 11.19 | 9.70 | 8.35 |
| MCU9 × LRA5166 | 2.64 | -1.80 | 7.50 | -1.56 | -2.22 | -2.22 | -15.82** | -17.4* | -17.45* |
| MCU9 × MCU7 | -4.96 | -11.97 | 13.03 | 4.35 | -3.41 | 12.36* | -0.70 | -3.79 | -7.52 |
| MCU9 × MCU10 | 10.93 | 8.22 | 18.46 | 6.36 | 3.71 | 2.32 | -9.54 | -13.40 | -16.75* |
| MCU10 × ADT1 | -2.09 | -8.59 | 9.75 | -0.15 | -9.31 | 4.13 | -2.00 | -2.58 | 14.34 |
| MCU10 × SVPR1 | 9.96 | 2.99 | 22.87* | 6.49 | 0.24 | 6.47 | 17.73** | 11.26 | 9.90 |
| MCU10 × LRA5166 | 15.34* | 13.05 | 17.71 | 8.44 | 5.04 | 5.04 | -3.92 | -9.72 | -9.72 |
| MCU10 × MCU7 | 11.97 | 1.39 | 30.18** | 7.20 | -3.04 | -5.77 | -16.67* | 15.25 | 3.88 |
| MCU10 × MCU9 | -1.45 | -3.85 | 5.25 | -2.05 | -4.50 | -5.77 | -5.71 | -9.73 | -13.22 |

** - Significant at 1% level     * - Significant at 5% level significant and positive heterosis for all the three bases of heterosis. Similar results were reported by Siddiqui and Patil (1994).

In case of boll weight heterosis ranged from -11.73% to 17.28% (relative heterosis), from -20.80% to 13.05% (heterobeltiosis) and 1.97% to 34.77% (standard heterosis). Relative heterosis for two hybrids and standard heterosis for ten hybrids were positive and significant.

Heterosis for number of seeds per boll ranged from -11.95% (ADT 1 × SVPR 1) to 14.11% (SVPR 1 × MCU 9) for relative heterosis, from -20.37% (MCU 9 × LRA 5166) to 10.09% (SVPR 1 × MCU 9) for heterobeltiosis and from -7.72% (MCU 7 × MCU 9) to 17.04% (MCU 7 × ADT 1) for standard heterosis. Relative heterosis for two hybrids and standard heterosis for five hybrids were positive and significant.

With seed cotton yield the relative heterosis ranged from 17.63% (LRA 5166 × MCU 9) to 34.10% (ADT 1 × MCU 7), heterobeltiosis and standard heterosis from -19.22% (LRA 5166 × MCU 9) to 29.56% (SVPR 1 × LRA 5166). The crosses ADT 1 × SVPR 1 and SVPR 1 × LRA 5166 and LRA 5166 × SVPR 1 exhibited significant and positive heterosis for all the three bases of heterosis for seed cotton yield.

## CONCLUSIONS

In the present investigation, it was concluded that the cross SVPR 1 × LRA 5166 exhibited significant standard heterosis for important yield attributing traits. It is therefore apparent that the cross SVPR 1 × LRA 5166 would be promising for developing hybrid varieties in cotton.

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