*Biological Forum – An International Journal* **15(5a): 661-664(2023)**

**ISSN No. (Print): 0975-1130**
**ISSN No. (Online): 2249-3239**

# A Study on Heterosis in Interspecific Cotton Hybrids (*Gossypium hirsutum* L.× *Gossypium barbadense* L.) for Sucking Pest Resistance

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*(Received: 05 March 2023; Revised: 29 April 2023; Accepted: 05 May 2023; Published: 15 May 2023)*
*(Published by Research Trend)*

**ABSTRACT: *Gossypium hirsutum* L. × *Gossypium barbadense* L. interspecific hybrids were assessed to determine the degree of heterosis for sucking pest resistance. Forty F1 hybrids were made by crossing ten lines of *G. hirsutum* and four testers of *G. barbadense* in a line-by-tester fashion. Significant variations were found in all variables examined for sucking insect resistance throughout the crosses, according to analysis of variance. Heterosis was examined using two standard checks, MRC 7918 and Varlaxmi, as well as the midparent and better parent. The best heterotic combinations for jassid resistance and seed cotton yield were crosses RAH -1065 × Sujata, GBHV-170 × SB289E, AKH081 × Suvin, GBHV-170 × Reba-B-50, and DHY286 × Suvin. In contrast, tolerance to white flies was demonstrated by SCS-793 × SB-425 YF, AKH8828 × Suvin, and NH615 × SB289E. Significant heterosis in yield and resistance to sucking pests were demonstrated by these hybrids. By evaluating the superiority in heterosis in a large-scale study, these genotypes may be verified.**

**Keywords:** Heterosis, Sucking pest, Yield, Jassids, Cotton.

## INTRODUCTION

Cotton (*Gossypium* Spp.) has an important status among all the cash crops in the India and elsewhere. Cotton is an important agriculture commodity providing remunerative income to millions of farmers both in developed and developing countries. About 60 million people in our country are engaged in textile industry. Cotton is one of the major cash crops under cultivation in Maharashtra. Damage due to sucking pest is among many production constraints leading to decreased yields and profits (Mekala, 2004). Among these jassids, white flies and aphid are very harmful pests. Several diverse characteristics i.e., hairiness of leaves or number of trichomes, absence of nectars, reddish color of the stem and leaf, okra leaves and gossypol are found in species of cotton, often collectively called "defense umbrella" that repel insects (Mursal, 1994). Different studies have reviled that hairs on the plant surface are insignificant to insects (Alexander *et al*., 2004).

Research on host plant resistance to various diseases and insect pests has accelerated in recent years. The inheritance of host plant resistance (HPR) mechanism is known for different traits conferring resistance against the insect pest complex and diseases. Wide germplasm resources are exploited by cotton breeders for the evaluation of cotton cultivars resistant to the insect pests and diseases. High trichome density increases resistance against jassidsin *G. hirsutum* genotypes (Knight & Sadd 1954; Mursal, 1994). High-yielding cultivated upland cotton genotypes have long been regarded as uniform genetically and thus relatively vulnerable to potential pathogen or insect epidemics (Bowman, 1999).

Genetic improvement in cotton for resistance to biotic and abiotic factors along with improvement in yield and yield contributing traits is possible either through the exploitation of hybrid vigour or population improvement. The success of breeding programme depends on the identification of genotypes with the ability to transmit high production potential into specific genotypic combinations. According to Naqib *et al.* (2010), heterosis is a function of F1 genotypic combinations and is helpful in identifying the best parents for particular features. It has been shown that intra- and inter-specific heterosis over the best commercial cultivar can boost yield and yield-attributing characteristics (useful heterosis) (Yuan *et al.*, 2002).

Consequently, the goal of this work was to use line × tester analysis to assess the impacts of heterosis in F1 interspecific (*G. hirsutum* × *G. barbadense*) cross combinations in order to gather information on heterotic potential with better yield and resistance for sucking pest complex.

## MATERIALS AND METHODS

In the current study, four inbred lines of *G. barbadense* L. such as Reba-B-50, Sujata, Sb-425 YF, and Suvin similarly ten inbreed lines of *G. hirsutum* L. such as RAH1065, PH1075, P2151, GBHV170, SCS793, DHY286, AKH8828, AKH081, LRA5166, and PH348with varying morphological and agronomic characters were selected based on per se performance. During the Kharif season, 40 hybrids were created by crossing ten lines of *G. hirsutum* and four testers of *G. barbadense* in a line-by-tester fashion. For the crossing program, a 90-centimeter row spacing and a 60-centimeter plant spacing were used. Each plot has two rows that are 6 meters long. The forty hybrids that were produced, 14 parents, and two standard checks (MRC 7918 and Varalaxmi) were assessed in a randomized block design (RBD) with three replications throughout the next Kharif season. To ensure a healthy crop stand, all need-based intercultural techniques were used during the crop growth phase.

Every entry's five randomly chosen plants were observed for yield, yield-attributing, and sucking pest traits, such as the number of jassids per three leaves at 30 DAS, 45 DAS, 60 DAS, and 120 DAS, as well as the number of trichomes per square cm on the leaf, stem, and length of trichomes on the leaf, boll weight, number of bolls per plant, seed cotton yield, for each replication. According to the conventional procedure, the mean values were utilized to estimate heterosis over the midparent, better parent, and standard checks. Analysis of variance was applied to the recorded data for every character that Panse and Sukhatme (1978) reported. According to the standard protocol provided by Briggle (1963); Fonseca and Patterson (1968); Meredith and Bridge (1972), and so on, heterosis over mid parent, better parent, and standard check was calculated.

## RESULTS AND DISCUSSION

For every attribute examined, the pooled analysis of variance revealed substantial variations between the parents. Crosses that showed similar changes for all the features in all three settings were revealed. There is tremendous genetic diversity for practically all of the traits, as seen by the major variances between parents and hybrids and the interaction between parents and crosses for each character. The hybrids' mean squares and the parents vs. hybrids analysis for each character were found to be significant, indicating a considerable level of heterosis in the genotypes under study. Analyzing heterosis over baseline checks (MRC7918 and Varlaxmi) is a sensible way to gauge how useful it will be in practice. Thus, heterosis is reported above conventional checks in the current investigation. Table 1 contains the range of heterosis over standard checks for eleven characters, and Table 2 displays the crosses with the highest advantageous heterosis over standard check for various characters.

Presence of minimum number of sucking pests per leaves revealed the resistance of particular genotype for sucking pests, hence negative values are considered as significant values for the trait number of jassids per three leaves and number of white flies per leaves. Standard heterosis for the trait number of Jassids per three leaves at 30 days after sowing over check-1 (MRC 7918) ranged from -41.94 % to 419.35 % and over check-2 (Varlaxmi) ranged from -59.09 % to 265.91%. Most of the $F_1$ hybrids showed significant heterosis over both standard checks for number of Jassids per three leaves at 30 DAS, among these crosses GBHV-170 × SB289E, PH348 × Reba-B-50 and NH615 × Sujata showed highly significant results.

Highest negatively significant heterosis for the trait number of Jassids per three leaves at 45 days after sowing recorded up to -11.18 % over check variety MRC 7918 and up to -21.83 %over standard check Varlaxmi. GBHV-170 × Reba-B-50, NH615 × Sujata and AKH081 × Reba-B-50 showed highest desirable heterosis percentage for the trait number of Jassids per three leaves at 45 DAS. The highest significant negative heterosis for the trait number of Jassids per three leaves at 60 days after sowing expressed in the range -19.84 % to 38.7 % over the standard check MRC7918 and -1.25 to 61.88 %. $F_1$ hybrids such as GBHV-170 × Reba-B-50, NH615 × Sujata and AKH081 × Reba-B-50 were best performing crosses for the trait number of Jassids per three leaves at 60 days after sowing over both standard checks.

White flies are also harmful sucking pest for cotton crop their infestation observed after 120 days of planting, here the number of White flies per three leaves was recorded negatively significant up to -41.18 % over standard check MRC 7918 and up to 0.17 % over standard check Varlaxmi. Best performing crosses SCS-793 × SB-425 YF, AKH 8828 × Suvin and NH 615 × SB289E showed highly significant results over both the standard checks for number of White flies per three leaves at 120 DAS.

Presence of trichomes on leaf, stem and bract is desirable character for Jassid resistance in cotton crop. The number of Jassids on cotton had affected by the density and length of trichomes. The heterosis was recorded for the trait trichome density over both checks in all the three plant parts. The crossesGBHV170 × Reba-B-50, DHY286 × Sujata, NH615 × Sujata and AKH081 × Reba-B-50were found promising over standard checks MRC 7918 and Varlaxmi for all three trichome density representing characters i.e., number of trichomes per square centimeter on stem, leaves and bracts. The parents GBHV170, DHY286, AKH081, Reba-B-50, and Sujata were found one of the parents of heterotic $F_1$ for the Jassid resistance characters. It has also been found that cotton trichomes are linked to a decrease in leaf hopper attacks (Jenkins and Wilson 1996; Bourland *et al.*, 2003).

In the current study, crosses AKH081 × Sujata, PH348 × Sujata, and GBHV-170 × SB-425 YF showed significant positive heterosis for Seed cotton yield, Average boll weight, and Number of bolls per plant over the checks hybrids. These crosses are thought to be the most important yield and yield attributing characters. The lint index, seed index, and yield all showed strong and positive heterosis, as did Khadi *et al.* (2004); Tuteja and Agrawal (2013).

Therefore, the current study concludes that, in addition to percentage of heterosis, emphasis must be given to the selection of prospective crosses for continued use in

breeding programs based on the performance of parents and hybrids for various traits. To verify the superiority for heterosis, a large-scale trial will evaluate for confirmation of superior crosses for the several traits found in the current experiment.

**Table 1: Range of standard heterosis (%) for different characters.**

| Sr. No. | Character | Range of heterosis over standard checks | | | |
|---|---|---|---|---|---|
| | | MRC7918 | | Varlaxmi | |
| 1. | Jassids per three leaves at 30 DAS | -41.94 | 419.35 | -59.09 | 265.91 |
| 2. | Jassids per three leaves at 45 DAS | -11.18 | 164.60 | -21.83 | 86.03 |
| 3. | Jassids per three leaves at 60 DAS | -19.84 | 38.7 | -1.25 | 61.88 |
| 4. | White flies per three leaves at 120 DAS | -41.18 | 119.75 | 0.17 | 71.60 |
| 5. | Number of trichomes per square cm on leaf | -29.05 | 64.32 | -45.32 | 89.11 |
| 6. | Number of trichomes per square cm on stem | -28.56 | 70.81 | -53.58 | 65.57 |
| 7. | Length of trichomes on leaf | -31.07 | 46.84 | -16.46 | 39.56 |
| 8. | Average boll weight | -40.93 | 7.83 | -36.64 | 15.65 |
| 9. | Number of bolls per plant | -40.99 | 30.40 | -32.09 | 17.37 |
| 10. | Seed cotton yield | -38.40 | 12.24 | -17.63 | 50.07 |

**Table 2: Best performing crosses with maximum heterosis for various traits.**

| Sr. No. | Traits | Best performing $F_1$ Hybrids |
|---|---|---|
| 1. | Jassids per three leaves at 30 DAS | GBHV-170× SB289E (-41.94 % and -59.09 %), PH348 × Reba-B-50 (24.19 % and -46.59 %), NH615 × Sujata (-10.22 % and -36.74 %) |
| 2. | Jassids per three leaves at 45 DAS | GBHV-170 × Reba-B-50 (11.18 % and -21.83 %), NH615 × Sujata (0.12 % and -14.1 %), AKH081 × Reba-B-50 (0.12 % and 1.6 %) |
| 3. | Jassids per three leaves at 60 DAS | GBHV-170 × Reba-B-50 (22.1 % and 0.3 %), NH615 × Sujata (4.11 % and -1.1 %), AKH081 × Reba-B-50 (-3.5 % and 0.3 %) |
| 4. | White flies per three leaves at 120 DAS | SCS-793 × SB-425 YF (-41.18 % and 0.11 %), AKH 8828 x Suvin (-23.4 % and 0.17 %), NH 615 x SB289E (-6.5 % and 1.3 %) |
| 5. | Number of trichomes per square cm on leaf | GBHV-170 × Reba-B-50 (64.32 % and -75.6 %), NH615 × Sujata (61.3 % and -89.11%), AKH081 × Reba-B-50 (16.8 % and 50.6 %) |
| 6. | Number of trichomes per square cm on stem | GBHV170 × Reba-B-50 (70.81% and 65.57%), DHY286 × Sujata (49.50% and 33.03%) and AKH081 × Reba-B-50 (38.11 % and 45.9 %) |
| 7. | Length of trichomes on leaf | SCS 793 × Reba-B-50 (46.84% and 33.03 %), NH615 × Sujata (49.50% and 39.56%) and GBHV-170 × Reba-B-50 (23.45 % and 27.1 %) |
| 8. | Average boll weight | AKH081 × Sujata (4.31 % and 7.83 %) and PH348 × Sujata (3.1 % and 6.05 %), |
| 9. | Number of bolls per plant | GBHV-170 × SB-425 YF (30.40 % and 18.9%), GBHV-170 × Sujata (21.2% and 14.6 %) and GBHV-170 × Suvin (23.99 % and 19.20 %) |
| 10. | Seed cotton yield | PH348 × Sujata (12.24 % and 50.07 %), RAH -1065 × Sujata (10.18 % and 47.32 %), PH-1075 × Sujata (9.13 % and 45.91 %) |

## CONCLUSION

Therefore, the current study concludes that, in addition to percentage of heterosis, emphasis must be given to the selection of prospective crosses for continued use in breeding programs based on the performance of parents and hybrids for various traits. To verify the superiority for heterosis, a large-scale trial will evaluate for confirmation of superior crosses for the several traits found in the current experiment.

**Acknowledgement.** Authors are grateful to Cotton research Centre, VNMKV and PDKV Akola for providing germplasm and thankful to Principal ACSC for providing research and field facility.

**Conflict of Interest.** None.

## REFERENCES

Alexander, P. J., Forlow Jech, L., & Henneberry, T. J. (2004). *Preliminary screening of different cottons for resistance to sweet-potato whitefly infestations* (pp. 209–212). Cotton, UK: A College of Agriculture and Life Sciences [Report]. Tucson, AZ: College of Agriculture, University of Arizona.

Bourland, F. M., Hornbeck, J. M., McFall, A. B., & Calhoun, S. D. (2003). A rating system for leaf pubescence of cotton. *Journal of Cotton Science*, *7*, 8–15.

Bowman, D. T. (1999). Public cotton breeders-do we need them? *J. Cot. Sci.*, *3*, 139–152.

Briggle, L. W. (1963). Heterosis in wheat: A review. *Crop Science*, *3*(5), 407–412.

Fonseca, S., & Patterson, F. L. (1968). Hybrid vigor in a seven parent diallel crosses in common winter wheat (*Triticum aestivum* L.). *Crop Science*, *8*(1), 85–88.

Jenkins, J. N., & Wilson, F. D. (1996). Host plant resistance. In King, E. G., & Phillips, J. R. *Coleman RJ editors. Cotton insects and mites: Characterization and management* Reference Book Series (pp. 563–597). Memphis, (TN): Cotton Foundation. Cotton Foundation.

Khadi, B. M., Patil, B. R., & S. K. (2004). Heterosis studies in long staple intra *hirsutum* hybrids of cotton. Pattansahetti; I.S. *Katager and S. L. Mogali*. *Crop Improvement*. International Symposium on strategies for sustainable cotton production-A Global Vision, *23–25*(v) (pp. 233–235). Dharwad, Karnataka, India: UAS.

Knight, R. L., & Sadd, J. (1954). The genetics of jassid resistance in cotton - III. The kapaspurao, kawanda*punctatum* and Philippines Ferguson group. *Journal of Genetics*, *52*(1), 186–198.

Mekala, D. K. (2004). *Screening upland cotton for resistance to cotton Flea hopper (Heteroptera:Miridae)* [Thesis] Department of Plant Breeding. Texas A&M University.

Meredith, W. R., & Bridge, R. R. (1972). Heterosis and gene action in cotton (*Gossypium hirsutum* L.). *Crop Science*, *12*(3), 304–310.

Mursal, I. E. J. (1994). New cotton varieties for cotton pest management. In G. A. Constable & N. W. Forrester (Eds.), *Challenging the future*. *Proceedings of the World Cotton Res. Conference-1* (pp. 373–375). Melbourne: CSIRO.

Naqib, U. K., Huseyin, B., & Gul, H. (2010). Cottonseed oil and yield assessment via economic heterosis and heritability in intra-specific cotton populations. *African Journal of Biotechnology*, *9*(44), 7418–7428.

Panse, V. G., and Sukhatme, P. V. (1978). *Statistical methods for agricultural workers* (pp. 103–108). New Delhi: Indian Council of Agricultural Research.

Tuteja, O. P., & Agrawal, M. (2013). Heterosis for Seed Cotton Yield and other Traits in GMS based Hybrids of American Cotton (*Gossypium hirsutum*). *Cotton Res. J.*, *5*(2), 131–141.

Yuan, Y., Zhang, T., Guo, W., Pan, J., & Kohel, R. J. (2002). Heterosis and gene action of boll weight and lint percentage in high quality fiber property varieties in upland cotton. *Acta AgronomicaSinica*, *28*, 196–202.

**How to cite this article:** Adsare A.D. and Atram S.G. (2023). A Study on Heterosis in Interspecific Cotton Hybrids (*Gossypium hirsutum* L. × *Gossypium barbadense* L.) for Sucking Pest Resistance. *Biological Forum – An International Journal*, *15*(5a): 661-664.