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Screening of genotypes against cotton leafhopper, *Amarasca devastans* (Cicadellidae: Hemiptera)

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Abstract

Screening trials were executed at Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh during *kharif*, 2016-17 to identify tolerant / resistant genotypes against cotton leafhoppers. A total of eleven genotypes of cotton along with two resistance checks and one susceptible check were screened against leafhoppers and categorized them based on resistance injury index. The peak incidence of cotton leafhoppers was observed at 30 and 60 DAS with 6.0 number/ 3 leaves. While, the incidence was low and below ETL at 90 and 120 DAS in all the genotypes screened. The leaf hopper resistance injury index of various cotton genotypes screened had ranged from 1.26 to 3.65. Among all the entries, the lowest resistance injury index was exhibited by the genotype GISV-267 (1.26) and GSHV-173 (1.35). The other genotypes in the order of expressing resistance based on resistance injury index is categorized as GJHV-517 (1.56) > GJHV-497 (1.60) > LHDP-1 (1.68) > CNH-25 (1.72) > CPD-1501 (1.83) > TSH-0533-1 (2.21) > RAH-1069 (2.29) > BGDS-1055 (2.34) > DSC-1501 (2.38) > Bunny *Bt* (2.57) > Bunny non *Bt* (2.94) > DCH-32 (3.65).

Keywords: Screening, cotton leafhopper, injury index, genotypes, incidence

1. Introduction

Cotton (*Gossypium hirsutum* L.) is a friendly fiber being grown in 111 countries worldwide. Cotton is an important commercial cash crop cultivated in diverse agro ecosystems of the world for both domestic consumption and export purpose and hence, cotton crop is pronounced as “King of fibers” or “White gold”. In the world the cotton production is estimated as 125.7 M bales in 2015-16 ^[1]. India persistently maintaining the largest area under cotton cultivation and second largest producer next to China with 35.2 per cent of world area and 24 per cent of world production. In Andhra Pradesh cotton is cultivated in an area of 25.40 lakh ha with a production of 66.4 lakh bales per annum ^[2]. The cotton crop is severely affected with pests and about 1326 species of insects and mites attack cotton crop around the world ^[3]. The major destructive pests of cotton were sucking pests and bollworms at vegetative stage and reproductive stage of the crop growth, respectively. Among various sucking insects infesting cotton, the leafhopper, *Amarasca devastans* (Dist) is considered to be major and plays an important role in hindering crop growth and attributing an average yield loss of 25-35 per cent per annum ^[4,5].

Both the adults and nymphs of leafhopper suck the sap from veins on the underside of mature leaves concentrating mostly on the lower half of the cotton plant. As a result of this pest infestation, the margins of the leaves start curling downwards and in severe infestation levels leaves turn brick red in colour with a typical hopper burn symptoms. Besides stunted growth the pest also persuades the reduction in production of flowers, bolls and seed cotton yield, lint quality *etc.* Farmers rely of insecticides for managing the cotton leafhoppers but over rely on insecticides for managing this pest may lead to resurgence and other environmental risks. Host plant resistant plays a vital role in many crops and is a major component in integrated pest management. Hence, screening programme is inevitable for identification of resistance *Bt* hybrids against cotton leafhoppers and accordingly the present trial was undertaken.

2. Materials and Methods

The screening trial was carried out at Regional Agricultural Research Station, Lam, Guntur during *Kharif*, 2016-17 with 11 genotypes *viz.*, GSHV-173, RAH-1069, CPD-1501, BGDS-1055, GJHV-517, DSC-1501, LHDP-1, GJHV-497, CNH-25, TSH-0533-1, GISV-267 and

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three checks (Bunny-Bt, Bunny non -Bt and DCH-32) in randomized block design which were replicated twice. Each genotype including checks were sown in three lines with a plot size of 12.6 m² having 27 plants per genotype. As infester row one row of bhendi crop was grown for every six rows of cotton genotypes. All the agronomic practices were followed as per recommendations and no plant protection measures were adopted during study period. The incidence of leafhoppers on five randomly selected plants per plot per three leaves *i.e.*, from top, middle and bottom canopies of the

plant was recorded at 30, 60, 90 and 120 DAS. The kapas yield from each plot was recorded separately in kg per plot from two pickings and converted into q ha⁻¹. The injury grade for leafhoppers infesting cotton genotypes was recorded for each genotype as suggested by Indian Central Cotton Committee (Table 1) and accordingly resistance index *i.e.*, hopper burn index (Nageswara Rao, 1973) [7] was calculated and categorized the tolerance / resistance level of the genotypes (Table 2).

Table 1: Cotton Leafhopper Injury Grade

| Grade | Symptoms on the attacked plant |
|---------|---|
| Grade 1 | Leaves free from crinkling and yellowing at the leaf margins. |
| Grade 2 | Few leaves on lower portions of plant curling, crinkling and slight yellowing at the leaf margins |
| Grade 3 | Crinkling and curling over all. Yellowing, bronzing and browning of leaves in the middle and lower portions, plant growth hampered. |
| Grade 4 | Extreme curling, yellowing, bronzing, browning, drying of leaves, defoliation and stunted growth. |

$$\text{Resistance Index} = \frac{G_1 \times P_1 + G_2 \times P_2 + G_3 \times P_3 + G_4 \times P_4}{P_1 + P_2 + P_3 + P_4}$$

P₁, P₂, P₃ and P₄ are the no. of plants with G₁, G₂, G₃ and G₄ grades, respectively.

Table 2: Cotton Leafhopper Resistance Index (Hopper burn index)

| Resistance/Injury Index | Category |
|-------------------------|------------------|
| 1.0 - 1.5 | Highly resistant |
| 1.5 - 2.0 | Resistant |
| 2.0 - 2.5 | Intermediate |
| >2.5 | Susceptible |

Table 3: Incidence of leafhoppers on different cotton genotypes during *kharif* 2016-17

| Treatments | Genotypes | No. of Leafhoppers /3 leaves/plant | | | | | Overall mean | Injury Index |
|-----------------|---------------|------------------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------|--------------|
| | | 30 DAS | 60 DAS | 90 DAS | 120 DAS | | | |
| T ₁ | GSHV-173 | 9.2 (3.2) ^a | 8.0 (3.0) ^a | 2.8 (1.9) ^a | 2.6 (1.9) ^a | 5.65 (2.6) ^a | 1.35 | |
| T ₂ | RAH-1069 | 10.8 (3.4) ^a | 14.6 (3.9) ^a | 3.5 (2.1) ^a | 3.5 (2.1) ^a | 8.1 (3.0) ^a | 2.29 | |
| T ₃ | CPD-1501 | 10.0 (3.3) ^a | 12.6 (3.7) ^a | 2.5 (1.9) ^a | 2.5 (1.9) ^a | 6.9 (2.8) ^a | 1.83 | |
| T ₄ | BGDS-1055 | 10.0 (3.3) ^a | 19.1 (4.5) ^b | 2.8 (1.9) ^a | 3.1 (2.0) ^a | 8.7 (3.1) ^{ab} | 2.34 | |
| T ₅ | GJHV-517 | 10.0 (3.3) ^a | 6.7 (2.8) ^a | 4.4 (2.3) ^a | 1.9 (1.7) ^a | 5.7 (2.6) ^a | 1.56 | |
| T ₆ | DSC-1501 | 9.6 (3.3) ^a | 22 (4.8) ^b | 4.5 (2.3) ^a | 2.6 (1.9) ^a | 9.7 (3.3) ^a | 2.38 | |
| T ₇ | LHDP-1 | 11.3 (3.5) ^a | 10.9 (3.4) ^a | 2.7 (1.9) ^a | 2.1 (1.8) ^a | 6.7 (2.8) ^a | 1.68 | |
| T ₈ | GJHV-497 | 9.4 (3.2) ^a | 9.0 (3.2) ^a | 3.1 (2.0) ^a | 2.5 (1.9) ^a | 6.0 (2.6) ^a | 1.60 | |
| T ₉ | CNH-25 | 8.4 (3.1) ^a | 9.7 (3.3) ^a | 6.8 (2.8) ^a | 2.4 (1.8) ^a | 6.8(2.8) ^a | 1.72 | |
| T ₁₀ | TSH-0533-1 | 10.8 (3.4) ^a | 14.9 (4.0) ^a | 3.3 (2.1) ^a | 2.0 (1.7) ^a | 7.7 (3.0) ^a | 2.21 | |
| T ₁₁ | GISV-267 | 8.6 (3.1) ^a | 6.6 (2.8) ^a | 3.8 (2.2) ^a | 2.4 (1.8) ^a | 5.3 (2.5) ^a | 1.26 | |
| T ₁₂ | Bunny-Bt | 16.9 (4.2) ^b | 25.7 (5.2) ^b | 14.2 (3.9) ^b | 11.0 (3.5) ^b | 16.9 (4.2) ^{bc} | 2.57 | |
| T ₁₃ | Bunny non -Bt | 18.0 (4.4) ^b | 29.9 (5.6) ^b | 17.0 (4.2) ^b | 12.4 (3.7) ^b | 19.3 (4.5) ^{bc} | 2.94 | |
| T ₁₄ | DCH-32 | 21.8 (4.8) ^b | 38.5 (6.3) ^c | 19.8 (4.6) ^b | 15.7 (4.1) ^b | 24.0 (5.0) ^c | 3.65 | |
| F-test | | Sig | Sig | Sig | Sig | Sig | | |
| SEm± | | 0.2 | 0.4 | 0.2 | 0.1 | 0.2 | | |
| CD (P=0.05) | | 0.8 | 1.3 | 0.7 | 0.4 | 0.5 | | |
| CV (%) | | 10.0 | 15.0 | 12.6 | 7.6 | 12.1 | | |

Table 4: Grouping of different genotypes based on leafhopper Injury Index

| Resistance/Injury Index | Category | Name of the genotype |
|-------------------------|-----------------------|---|
| 1.0 - 1.5 | Highly resistant | GISV-267, GSHV-173 |
| 1.5 - 2.0 | Resistant | GJHV-517, GJHV-497, LHDP-1, CNH-25, CPD-1501 |
| 2.0 - 2.5 | Moderately resistance | BGDS-1055, RAH-1069, DSC-1501, TSH-0533-1 |
| >2.5 | Susceptible | Bunny <i>Bt</i> , Bunny non- <i>Bt</i> , DCH-32 |

3. Results and Discussion

A total of 14 cotton genotypes along with checks were screened during *kharif* 2016-17 to assess the tolerant/ resistant genotypes against cotton leafhoppers. The population of

leafhoppers was observed high at 30 DAS and 60 DAS above ETL (6.0 no/ 3 leaves /plant) in all the genotypes. While, it was low and below ETL at 90 DAS and 120 DAS in all the genotypes. At 30 DAS, the leafhoppers population was

ranging from 8.4 (CNH-25) to 21.8 (DCH-32) no./ 3 leaves in different cotton genotypes. Among the genotypes CNH-25 (8.4 no./3 leaves/plant), GISV-267 (8.6 no./3 leaves/plant), GSHV-173 (9.2 no./3 leaves/plant), GJHV-497 (9.2 no./3 leaves/plant) and CPD-1501(9.6 no./3 leaves/plant) recorded leafhopper population less than 10.0/3 leaves. All the genotypes were found on par with each other and superior than check hybrids in screening trail with respected to leafhopper infestation. The maximum leafhopper population (no. / 3 leaves/ plant) was recorded on DCH-32 (21.8) and found on par with the genotypes Bunny-Bt (16.9) and Bunny non -Bt (18.0) (Table 3).

The average leafhopper population (no. / 3 leaves/ plant) was recorded to be the highest at 60 DAS. At square forming stage the leafhopper population among the screened genotypes ranged from 6.6 to 38.5. Among the genotypes, GISV-267 (6.6 no. /3 leaves/plant), GJHV-517 (6.7 no./3 leaves/plant), GSHV-173 (8 no. / 3 leaves/plant) and GJHV-497 (9.0 no. / 3 leaves/plant) had recorded the minimum leafhopper population which were on par with each other. However, all the genotypes had resulted in harbouring significantly lesser leafhopper population compared to checks hybrids DCH-32 (38.5 no./3 leaves/plant) and was on par with Bunny non-Bt (29.9 no./3 leaves/plant) and Bunny-Bt 25.7 no./ 3 leaves/plant) (Table 3 & Fig 1).

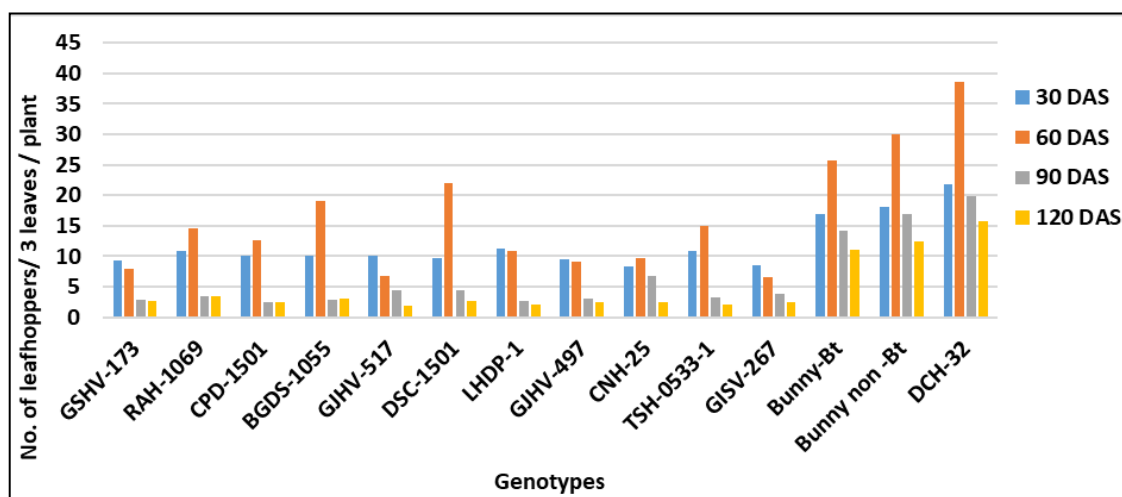


Fig 1: Incidence of leafhoppers on different cotton genotypes during Kharif, 2016-2017 at RARS, Lam, Guntur

At 90 DAS the crop was at peak flowering and boll formation stage and the leafhopper population ranged from 2.50 to 19.8 no. / 3 leaves/plant in different cotton genotypes. The population of leafhoppers was very low and below ETL in all the genotypes except check hybrids at 90 DAS and 120 DAS without significant differences among themselves. However, all the genotypes were found superior by recording lesser population of leafhoppers over check hybrids (Table 3).

Leafhopper population and natural enemies was observed early in the cropping season, gradually increased and reached to maximum between 30 to 90 days after sowing (Table 3). The overall mean population showed that the population varied between 5.35-24.0 no. / 3 leaves / plant. The mean population of leafhoppers was low in the genotypes such as GISV-267 (5.3/3 leaves/plant), GSHV-173 (5.6/3 leaves/plant), GJHV-517(5.7/3 leaves/plant) and GJHV-497 (6.0/3 leaves/plant). But statistically there were no significant differences among the genotypes. However, all the genotypes recorded significantly lesser population of leafhoppers when compared to standard checks *i.e.* Bunny Bt (16.9/3 leaves/plant), Bunny non-Bt (19.3/3 leaves/plant) and susceptible check DCH-32 (24.0/3 leaves/plant).

The resistance injury index of different cotton genotypes ranged from 1.26 to 3.65. Among all the entries, the lowest resistance injury index was showed by the genotype GISV-267 (1.26) and GSHV-173 (1.35). The other genotypes in the order of expressing resistance based on resistance injury index is categorized as GJHV-517 (1.56) > GJHV-497 (1.60) > LHDP-1 (1.68) > CNH-25 (1.72) > CPD-1501 (1.83) > TSH-0533-1 (2.21) > RAH-1069 (2.29) > BGDS-1055 (2.34) > DSC-1501 (2.38) > Bunny Bt (2.57) > Bunny non Bt (2.94) > DCH-32 (3.65). The genotypes GISV-267 and GSHV-173

which had exhibited less leafhopper population during screening were proven to be highly resistant genotypes based on leafhopper injury index *i.e.* 1.26 and 1.35, respectively (Table 4).

Similar studies were carried out many researchers and based on the resistance index as per ICCI (Indian Central Cotton Committee) Murugesan and Kavitha (2010) [8] evaluated the cotton entries and grouped under five categories as, Highly resistant- KC 2, SVPR 2; Resistant-TKH 1128: Intermediate-MCU 5, MCU 10, NISD 2, TKH 1143,TKH 1175: Susceptible- TKH 1789, TKH 1173, TKH 1174, TKH 1178, TKH 1179, TKH 1185, TKH 1186, TKH 1209, TKH 1225, TKH 1233 and Highly susceptible- ICMF 20, LRA 5166, TKH 1133, TKH 1172, TKH 1176, TKH 1182, TKH 1197, TKH 1198.

Dhawan *et al.* (2011) [9] also studied the performance of commercially released Bt cotton hybrids for their reaction to pest complex and stated that all the Bt hybrids recorded 0.43 to 1.36 leafhopper nymphs/3 leaves and among the hybrids, MRC 6304 Bt and RCH 308 Bt recorded the highest and the lowest population of leafhoppers, respectively. Analogous studies by Neelima *et al.* (2010) [10] stated that among 55 genotypes of cotton genotypes screened CCHO52, RAH 100, J. TAPLI and VIKRAM were resistant with lowest injury index value (1.00) and least damage to leaves.

Amjad *et al.* (2009) [11] tested five cotton cultivars and reported that FH-682 and FH-634 were found to be resistant against leafhoppers. Vikas *et al.* (2007) [12] reported that H-1246 and Ratna were found to be resistant to leafhoppers with leafhopper injury grade I. Pushpam and Raveendran (2005) [13] screened 13 genotypes and reported that KC-2 was resistant with the lowest injury index value of 1.00. Radhika

et al. (2006)^[14] reported that NHH-44 and NDLH-1588 were found resistant to leafhoppers with the lowest injury index value (0.1-1.0).

4. Conclusion

Among the various genotypes screened against cotton leafhoppers the genotypes GISV-267, GSHV-173, GJHV-517, GJHV-497, LHDP-1 and CNH-25 were found resistant against leafhoppers which can be used for further breeding programme to develop resistant varieties against leafhoppers.

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