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Field screening of cotton genotypes against leafhopper, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae) under irrigated condition

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Abstract
The study was conducted for preliminary screening trial of 67 cotton genotypes with check entries NDLH 1938 (Leaf hopper resistant), DCH 32(Susceptible to leafhopper and bollworm) and *Bt* Jadoo BG II (Bollworm resistant) for relative susceptibility/resistance against leafhopper, *Amrasca biguttula biguttula* (Ishida) laid out in Cotton Research Station, Srivilliputtur under All India Co-ordinate Cotton Improvement project (AICCIP on Cotton) during 2019-2020. Among the 67 genotypes screened, 9 genotypes were found to be highly resistant (LHIG1), 29 genotypes were categorized as resistant (LHIG 2), 25 genotypes Susceptible (LHIG 3) and 4 genotypes highly susceptible against leafhopper with a population ranged from 0.57 to 3.57, 0.63 to 3.97, 1.43 to 4.90 and 3.93 to 5.83 leafhopper/3 leaves/plant respectively based on the standard deviation value.

Keywords: Cotton, leafhopper, genotypes, screening, susceptibility, resistance

Introduction
Cotton plays a key role in the national economy in terms of generation of direct and indirect employment in the Agricultural and Industrial sectors. Among the various causes of low productivity of cotton in India, insect pests are one of the major factors. During growth period, 148 insect pests have been recorded on cotton crop, of which only 17 species were recorded as major insect pests [1]. Cotton pests primarily are divided into sucking pests and bollworms. The pests of major significance in cotton are sucking pests like jassids (*Amrasca biguttula biguttula*, Ishida), aphids (*Aphis gossypii*, Glover), whiteflies (*Bemisia tabaci*, Gennadius) and thrips (*Thrips tabaci* Lindeman). Leafhopper undoubtedly is more severe among the many destructive pests of cotton. Cotton jassid is reported to cause 18.78 per cent decline in cotton yield [2]. Host plant resistance is an important tool of integrated pest management. Host plant resistance depends upon mechanisms as well as components of resistance. Plant resistance affects the behaviour of herbivorous insect pest due to the pest makes decision to accept or reject the food. Due to these provisions plants exhibit immunity, resistance, susceptibility or tolerance against insect pest. Screening trial is used to determine plant resistance against insect pest under field condition. Therefore, the present study was conducted to identify resistant sources against leafhopper under field condition.

Material and Methods
The experiment to screen cotton germplasm against leafhopper was laid out at Cotton Research Station, Srivilliputtur under All India Co-ordinate Cotton Improvement project (AICCIP on Cotton) during winter season (August 2019- January 2020). A total of 67 cotton genotypes were subjected for screening in replicated trial with randomized block design and the untreated seeds were sown at 100x30 cm spacing on 27.08.2019 with NDLH 1938 (Leaf hopper resistant), DCH 32 (Susceptible to leafhopper and bollworm) and *Bt* Jadoo BG II (Bollworm resistant) as check entry. The entries were sown in two rows with 10 plants per row. Cotton entries were left unprotected. Leafhopper population was recorded from three leaves (top, middle, bottom), and injury grade was assessed as follows: 1-no damage (highly resistant), 2-light injury (moderately resistant), 3-medium injury (susceptible), 4-severe injury (highly susceptible) (visual symptoms assessed in whole plot basis). The population of leafhopper and Leaf Hopper Injury Grade (LHIG) were recorded twice (45 and 60 DAS) and

the maximum grade and population was recorded. Green boll damage was also recorded. The population of other sucking pests *viz*., thrips (top, middle and bottom) and whiteflies (3rd, 7th and 5th leaf), were also recorded from three leaves.

Results and Discussion

Field Screening

Incidence of leafhopper in cotton genotypes were observed during winter season 2019-2020 as shown on Table 1 & 2. Based on the standard deviation values, the germplasm lines were categorized as Highly resistant (Grade 1), Resistant (Grade 2), susceptible (Grade 3) and highly susceptible (Grade 4) are shown in (Table 3). Results of the experiment revealed that, no genotype was found to be resistant. 67 genotypes, *viz.*, RB 615, RHC 1409, GJHV 566, ZC (BGDS 1063), GJHV-554, BGDS 1063, SVPR 6, RAHH 1951, RAHC 1028 were categorized as highly resistant to leaf hopper with leafhopper injury grade 1 by recording a population range from 0.57 to 3.57 leafhopper per 3 leaves per plant respectively. 29 genotypes *viz.*, GISV319, BS 8-19, GJHV 557, TSH 363, GTHV 15/34, GISV 323, Suraj, BGDS 1047, L 1527,GSHV 208, GISV 322, SVPR 6, RAH 1076, RHC 1217, GSHV 185, CPD 1702, TSH 325, HS 298, RAHH 1951, LAHH 36, DHH 1901, RAHH 1952, LHDP 5, DS C 1801, SVPR 6, RHC HD, 1420, LHDP 2, 9558, RHC-HD 1438 were resistant with leafhopper injury grade 2 by recording as population range from 0.63 to 3.97/3leaves per plant respectively. 25 genotypes *viz.*,CPD 1902, CCH 19-2, ZC (Phule Yamuna/BGDS 1063), RB 614, RHC 1419, GISV 323, RAH 1046 , BS 7-19, SHS 234, CCH 19-1, SVPR 5, TSH 383, BS 4-18, CPD 1701, TSH 357, TCH 1837, Suraj, SVPR 6, SIMA-5, Suraj , BS 1, DHH 1902, ARBHH 1901 RAHH 455, RHC HD 1433 were susceptible to leafhopper with leafhopper injury grade 3 by recorded as population range from 1.43 to 4.90/3leaves/plant respectively. 4 genotypes *viz.*, RAH 1047, CPD 1901, RAH 1075, ARBHH 1902 were highly susceptible to leafhopper with leafhopper injury grade 4 by recorded as population range from 3.93 to 5.83/ 3leaves per plant respectively. [3]95 genotypes screened in similar manner and reported that none of the genotypes was found resistant, tolerant and moderately tolerant and most of the genotypes were highly susceptible. The remaining 51 genotypes *viz*., Pelimond Cleveland, RS 4001, SA335, 137-CO-3M, 9(11), D16, I 41, 30-1, 418/49-45F X LSS6/63, LH33, SVPR 2, SA201, G 4836, Dunn-56, Big Boll Trump, DPL 14, 418/49-45F X LSS4/63, H509, SH469(1-1), TCH 1806, TCH 1808, 134XCO2 Mead, 10(1), 531, 418/49-45F X LSS7/63, SH169, 467 MD, RS277, H386, SH469, RS 267, RS 235, Tzang PO, RS271, Coker, H392, H329, H492, Acala-1577-D, MU2, SA21, SAS15, SICIDS, PRS12, H487, PK 863, Alogodelgs Breans, Hybrid Surat Type, HB61, PR 22 and RS212 were categorized as highly susceptible. [4]Reported that Parbhani Kranthi, line 199 and GOH 1 were most preferred by leafhopper. [5]Reported that the pooled nymphal population of the leafhopper was lower in Punjab Padmini (1.87) followed by DOV-91-4 (1.96) and Arka Anamika (1.98) and highest in Pusa Sawani (3.77). [6]16 genotypes screened and they identified that 4085 were resistance and LK-861 was susceptible to cotton leafhopper.

Table 1: Leaf hopper incidence in cotton genotypes under irrigated condition during 2019-2020 (North zone cotton genotypes)

Genotypes	Leafhopper Injury Grade	No. of leafhopper / 3 leaves	Genotypes	Leafhopper Injury Grade	No. of leafhopper / 3 leaves
CPD 1902	3	2.90	ARBH 1901	3	3.93
GISV319	2	2.53	Quality Check (Suraj)	2	2.47
RAH 1047	4	4.07	RAH 1046	3	1.97
CCH 19-2	3	2.73	BGDS 1047	*2*	*2.13*
BS 8-19	2	3.43	RB 615	1	2.40
CPD 1901	4	5.83	L 1527	2	2.70
GJHV 557	2	3.40	BS 7-19	3	2.47
ZC (Phule Yamuna/BGDS 1063)	3	3.07	SHS 234	3	3.83
TSH 363	2	3.97	CCH 19-1	3	3.40
RB 614	3	3.27	SVPR 5	3	2.53
GTHV 15/34	2	1.80	TSH 383	3	4.90
RHC 1419	3	3.50	RHC 1409	1	3.27
GISV 323	2	2.30	GJHV 566	1	2.23
DCH 32	4	7.87			
NDLH 1938	2	2.60			
Bt JADOO BG II	2	2.37			

Table 2: Leaf hopper incidence leaf hopper during 2019-2020 (South zone cotton genotypes)

Genotypes	Leafhopper Injury Grade	No. of leafhopper / 3 leaves	Genotypes	Leafhopper Injury Grade	No. of leafhopper / 3 leaves
RAH 1075	4	3.93	HS 298	2	1.47
BS 4-18	3	3.43	DHH 1902	3	1.73
GSHV 208	2	3.03	BGDHH 697	2	1.50
CPD 1701	3	3.33	ARBHH 1901	3	2.00
ZC (BGDS 1063)	1	2.37	ZC (RAHH 455)	3	1.43
GISV 322	2	1.63	LAHH 36	2	1.47
GJHV-554	1	2.30	ARBHH 1902	4	3.97
SVPR 6	2	1.63	SVPR 6	1	1.07
RAH 1076	2	2.57	DHH 1901	2	1.00
TSH 357	3	2.23	RAHH 1952	2	1.57

TCH 1837	3	3.57	RAHH 1951	1	0.57
QC (Suraj)	3	3.67	RHC HD 1433	3	1.67
RHC 1217	2	2.73	LHDP 5	2	1.17
GSHV 185	2	2.87	RAHC 1028	1	1.37
SVPR 6	3	2.27	DS C 1801	2	1.77
SIMA-5	3	3.50	SVPR 6	2	0.93
QC (Suraj)	3	3.63	RHC HD 1420	2	1.33
CPD 1702	2	4.23	LHDP 2	2	1.40
TSH 325	2	2.23	Zonal Check (Suraj)	2	0.63
ZC (BGDS 1063)	1	1.80	RHC-HD 1438	2	1.20
BS 1	3	2.13			
DCH 32	4	7.87			
NDLH 1938	2	2.60			
Bt JADOO BG II	2	2.37			

Table 3: Reaction of cotton germplasm against leafhopper, *Amrasca biguttula biguttula*

LHIG	Range of leafhopper/3leaves/Plant		Cotton genotypes
Grade 1	Highly resistant	0.57 to 3.57	RB 615, RHC 1409, GJHV 566, ZC (BGDS 1063), GJHV-554, BGDS 1063, SVPR 6, RAHH 1951 RAHC 1028
Grade 2	Moderately resistant	0.63 to 3.97	GISV319, BS 8-19, GJHV 557, TSH 363, GTHV 15/34, GISV 323, Suraj, BGDS 1047, L 1527, GSHV 208, GISV 322, SVPR 6, RAH 1076, RHC 1217, GSHV 185, CPD 1702, TSH 325, HS 298,RAHH 1951, LAHH 36, DHH 1901, RAHH 1952, LHDP 5, DS C 1801, SVPR 6, RHC HD, 1420, LHDP 2,9558, RHC-HD 1438
Grade 3	Susceptible	1.43 to 4.90	CPD 1902, CCH 19-2, ZC (Phule Yamuna/BGDS 1063), RB 614, RHC 1419, GISV 323, RAH 1046 , BS 7-19, SHS 234, CCH 19-1, SVPR 5, TSH 383, BS 4-18, CPD 1701, TSH 357, TCH 1837, Suraj, SVPR 6, SIMA-5, Suraj , BS 1, DHH 1902, ARBHH 1901 RAHH 455, RHC HD 1433
Grade 4	Highly susceptible	3.93 to 5.83	RAH 1047, CPD 1901, RAH 1075, ARBHH 1902

Conclusion

Among the 67 genotypes screened, 9 genotypes were found to be highly resistant (LHIG1), 29 genotypes were categorized as resistant (LHIG 2), 25 genotypes Susceptible (LHIG 3) and 4 genotypes highly susceptible against leafhopper with a population ranged from 0.57 to 3.57, 0.63 to 3.97, 1.43 to 4.90 and 3.93 to 5.83 leafhopper/3 leaves/plant respectively based on the standard deviation value.

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