Screening of *Gossypiumhirsutum*cotton varieties/genotypes for resistance tojassid, *Amrascabiguttulabiguttula*(Ishida) under rainfed conditions

ABSTRACT

Screening of *Gossypiumhirsutum* cotton varieties/genotypes against jassid, *Amrascabiguttulabiguttula* (Ishida) was carried out under rainfed conditions during *kharif*seasons of 2016-17, 2018-19 and 2019-20 at Regional Cotton Research Station, Navsari Agricultural University, Maktampur farm, Bharuch, Gujarat. Among thirteen cotton varieties/genotypes screened, none of variety/genotype was categorized as resistant by considering jassid population as well asJassid Resistance Index.Six cotton varieties/genotypes*viz.*, NH-615, GBHV-201, GBHV-209, GBHV-204, G.N.Cot-26, GBHV-206 and two checks *i.e.* DHY-286 and NDLH-1938 were categorized as moderately resistant based on maximum jassid population ranged from 4.40 to 7.40 jassids/3 leaves.Three cottonvarieties/genotypes*viz.*, Suraj, Bunny BG II and Bunny Non *Bt*were categorized assusceptible with population of 12.50 to 13.70 jassids/3 leaves. The cotton variety G.Cot-16(16.70 jassids/3 leaves) and check DCH-32(24.60 jassids/3 leaves) were categorized as highly susceptible to jassids.Five cottonvarieties/genotypes *viz.*,NH-615, GBHV-201, GBHV-204, GBHV-209, G.N.Cot-26 and two checks *i.e.* DHY-286 and NDLH-1938 were categorized as moderately resistant based onmaximumJassid Resistance Index in range of 1.10 to 2.00.Only the genotype GBHV-206 was found susceptible with 2.20 JRI. Four cotton varieties/genotypes *viz.*,G.Cot-16, Bunny BG II, Suraj, Bunny Non *Bt* and check DCH-32 were categorized as highly susceptible to jassidbasedonmaximumJRI of 3.10 to 4.00.Overall five varieties/genotypes of *G. hirsutum*cotton*viz.*, NH-615, GBHV-201, GBHV-209, GBHV-204 and G.N.Cot-26 were found moderately resistant to jassids under rainfed conditions.

Keywords:
Screening, cotton varieties/genotypes,*Gossypiumhirsutum*, jassid, *Amrascabiguttulabiguttula*,Jassid Resistance Index (JRI)

1. Introduction

Cotton is an important cash crop cultivated in diverse agro ecosystems in tropical and subtropical regions of the world for both domestic consumption and export purpose.Cotton is one of the most important commercial crop in India.*Gossypiumhirsutum* is the most widely cultivatedcotton species in India because of its wide range of adaptation and high yield potential.The global cotton production was 116.64 million bales (1 bale= 480 lb.) from 31.75 million hectares with a productivity of 800 kg/ha in 2022-23.India ranks second in cotton production (26.30 million bales) after China (30.70 million bales). India ranks first in cotton cultivated area (12.93 million hectares)however, the productivity of cotton crop in India (443 kg/ha) is still far less than world average (800 kg/ha) as well as many other cotton growing

countries (highest in China*i.e.* 2122 kg/ha) of the world in 2022-23[1].Gujarat leads in production and productivity among cotton growing states of India.The provisional cotton production of Gujarat was 87.12 lakh bales(1 bale= 170 kg) from an area of 25.49 lakh hectares with a productivity of 581 kg/ha in 2022-23 [2].A decline in cotton production has several reasons in which the insect pests played an important role. Cotton is highly vulnerable to bollworm (Pink, Spotted and American bollworm)and sucking pest complex (jassids, whitefly, thrips, aphids, mealybug and mites). The avoidable losses due to major insect-pests (sucking pests + bollworms) were 2.94 q/ha or 28.13 per cent [3].

Jassid *Amrasca biguttula biguttula* (Homoptera: Cicadellidae), is a major sap sucking insect pest which causes losses in cotton crop.Both nymphs and adults suck the plant sap and apparently introduce salivary toxins that impair photosynthesis in proportion to the amount of feeding.The attacked leaves turn pale and then rust-red. With change in appearance, the leaves also turn downwards, dry up and fall to the ground.The extent of avoidable losses due to leafhopper and whitefly were 263 kg/ha (11.2%) to 290 kg/ha (16.2%) in three *Bt* cotton hybrids [4].The management practices used for insect pest of cotton, chemical control is the most used method among farmers.The indiscriminate use of chemical pesticides for control major pests on cotton led to development of pesticide resistance in pests, disruption oftheir natural enemies, resurgence of minor pests, pollution of the crop ecosystem, health and economic risks and development of sucking pest resistance.Resistant cotton cultivar is the cheapest and most harmless strategy to managing sucking pest infestations in an integrated pest management programme. It is play an important role in a long-term agricultural system. 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 jassid under field condition.

2. Materials and Methods

The experiment was conducted under rainfed conditions at Regional Cotton Research Station, Navsari Agricultural University, Maktampur, Bharuch, Gujarat during *kharif*2016-17, 2018-19 and 2019-20.Thirteen varieties/genotypes of *G. hirsutum* cotton were screened against jassid, which were common among three seasons, selected from AICRP as well as State trials.Cotton varieties/genotypes were screened with two jassid resistant checks and one susceptible check.During season 2016-17, the crop was sown on 9th and 13thJuly, 2016, whereas it was sown on 5th July, 2018 and 6th July, 2019 during 2018-19 and 2019-20, respectively.The experiment was laid out in Randomized Block Design replicated twice. Two rows of each cotton variety/genotypewith ten dibbles in each row were sown in an individual treatment. Okra crop was grown with cotton for population buildup of jassid. One infester row of okra was sown in between each two treatment *i.e.*four rows of cotton. The crop was sown under a spacing of 120 x 45 cm with 120 kg/ha nitrogen fertilizer application. The field experiment was conducted with cotton crop grown in gross plot size of 2.40 m x 4.50 m and net plot size of 2.40 m x 3.60 m in each treatment. All recommended agronomic practices were adopted for raising good crop condition.Okra crop was removed after 60-75 days after sufficient population buildup of cotton jassid. Both cotton and okra crop were kept free from insecticidal spray during entire crop period.The data on incidence of jassid in cotton varieties/genotypes including checks for three

seasons under open field conditions were used for pooled analysis in evaluating the performance against pest.The treatment details are as under.

List 1 : List of Cotton varieties/genotypes

Cotton varieties/genotypes			
T_1	GBHV-201	T_8	NH-615
T_2	GBHV-204	T_9	DHY-286 (Jassid resistant check)
T_3	GBHV-206	T_{10}	NDLH 1938 (Jassid resistant check)
T_4	GBHV-209	T_{11}	DCH-32 (Jassid susceptible check)
T_5	G.Cot-16	T_{12}	Bunny BG II
T_6	G.N.Cot-26	T_{13}	Bunny Non *Bt*
T_7	Suraj		

2.1 Method of recording observations

Observations on population of jassid were recorded during peak infestation of the pest.The number of nymphs and adults of jassid were recorded from five randomly selected plants in each replication of different cotton varieties/genotypes. The numbers of jassids were recorded from three leaves *i.e.* top, middle and bottom of each selected plant. Cotton variety/genotype, which was screened more than one time in a season, the maximum pest infestation was taken into account. The observations of Jassid Injury Grade (JIG) were also recorded.

2.2 Categorization based on population of jassid

The maximum data out of three seasons were taken for categorization. For the purpose, the mean value of individual genotype ($\bar{X}i$) was compared with mean value of all genotypes ($\bar{X}$) and standard deviation (SD) following the scale adopted by Patel *et al*. [5]. The scale used for categorizing different genotypes was as under.

List 2 : Categorization based on population of jassid

	Category of resistance	Scale of resistance
1	Resistant (R)	$\bar{X}I < (\bar{X} - SD)$
2	Moderately Resistant (MR)	$\bar{X}I > (\bar{X} - SD) < \bar{X}$
3	Susceptible (S)	$\bar{X}I > \bar{X} < (\bar{X} + SD)$
4	Highly Susceptible (HS)	$\bar{X}I > (\bar{X} + SD)$

2.3 Assessment of cotton jassid severity

The observation of Jassid Injury Grade (JIG) was recorded as per following [6].

Grade 0 : Healthy plants free from leafhopper infestation
Grade I : Entire foliage free from crinkling or curling with no yellowing
Grade II : Crinkling and curling of few leaves in the lower portion of plant + marginal yellowing of leaves
Grade III : Crinkling and curling of leaves almost all over the plant. Plant growth

hampered

Grade IV : Extreme curling, crinkling, yellowing, bronzing and drying of leaves

2.4 Categorization based on Jassid Resistance Index

The cotton varieties/genotypes were classified into different categories based on jassid resistance index as proposed by Nageswara Rao [7].

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

Where, P_1, P_2, P_3 and P_4 are the number of plants with G_1, G_2, G_3 and G_4 grades, respectively.

After indexing, the varieties/genotypes were categorized as under.

List 3 : Categorization based on Jassid Resistance Index

	Jassid Resistance Index (JRI)	Category/ Reaction
1	0.1 – 1.0	Resistant (R)
2	1.1 – 2.0	Moderately Resistant (MR)
3	2.1 – 3.0	Susceptible (S)
4	3.1 – 4.0	Highly Susceptible (HS)

3. Results and Discussion

The results obtain during present studies are presented in Table 1 to 3 and illustrated in Figure 1 and 2.

3.1 Population of jassid

The data on population of jassid on different cotton varieties/genotypespresented in Table 1 indicated that none of the cotton genotype was found completely free from the attack of jassid during 2016-17.Significantly the lowest population of jassid was recorded in resistant check DHY-286 (3.60 jassids/3 leaves) which was statistically at par with NH-615 (3.80 jassids/3 leaves), GBHV-204 (4.60 jassids/3 leaves), GBHV-209 (4.70 jassids/3 leaves), GBHV-201 (4.90 jassids/3 leaves), G.Cot-16 (5.10jassids/3 leaves), NDLH 1938 (5.20jassids/3 leaves) and G.N.Cot-26 (5.40jassids/3 leaves). The highest jassid population (24.60 jassids/3 leaves) was recorded in susceptible check DCH-32.Jassid population was above economic thresholdlevel (> 6 jassids/ 3 leaves) in GBHV-206, Suraj, Bunny BG II, Bunny non *Bt* and DCH-32.

During 2018-19, the jassid population was lowest in cotton genotype GBHV-201 (2.40 jassids/3 leaves) which was statistically at par with GBHV-209 (2.90 jassids/3 leaves), NH-615 (4.10 jassids/3 leaves), DHY-286 (4.40jassids/3 leaves) and G.N.Cot-26 (4.90jassids/3 leaves). The population of jassid was also recorded below economic threshold level in GBHV-204 (5.80

jassids/3 leaves) as well as in resistant check *i.e.*NDLH-1938 (5.90 jassids/3 leaves).The highest jassid population (23.20 jassids/3 leaves) was recorded in susceptible check DCH-32.

Jassid population was lowest in cotton genotype GBHV-204 (3.70 jassids/3 leaves) during 2019-20 and it was statistically at par with GBHV-201, resistant check DHY-286, NH-615, Suraj, GBHV-209, G.N.Cot-26, GBHV-206, NDLH 1938 and G.Cot-16with jassid population of 4.00, 4.10, 4.40, 4.40, 5.10, 5.80, 6.30, 6.60 and 7.50 per 3 leaves, respectively. The highest jassid population (18.90 jassids/3 leaves) was recorded in susceptible check DCH-32which was statistically at par with Bunny non *Bt* (12.50jassids/3 leaves).

The pooled data of three seasons presented in Table 1 and illustrated in Figure 1demonstrated that jassid population was lowest in cotton genotype GBHV-201 (3.77 jassids/3 leaves) which was statistically at par with resistant check DHY-286, NH-615, GBHV-209, GBHV-204, G.N.Cot-26, resistant check NDLH-1938, GBHV-206, Suraj and G.Cot-16 with jassid population of 4.03, 4.10, 4.23, 4.70, 5.37, 5.90, 6.57, 9.27 and 9.77 per 3 leaves, respectively. The highest jassid population (22.23 jassids/3 leaves) was recorded in susceptible check DCH-32.Jassid population was above economic thresholdlevel (> 6 jassids/ 3 leaves) in GBHV-206, Suraj, G.Cot-16, Bunny BG II, Bunny non *Bt* and DCH-32. The ascending order of jassid population on different cotton varieties/genotypes was GBHV-201<DHY-286<NH-615<GBHV-209<GBHV-204<G.N.Cot-26<NDLH-1938<GBHV-206<Suraj<G.Cot-16<Bunny BG II<Bunny non *Bt*<DCH-32. The interaction (Treatment x Year) was showed significant effects which indicated non-consistent performance of cotton varieties/genotypes over the year.

Table 1: Population of jassid in cotton varieties/genotypes under rainfed conditions at Bharuch

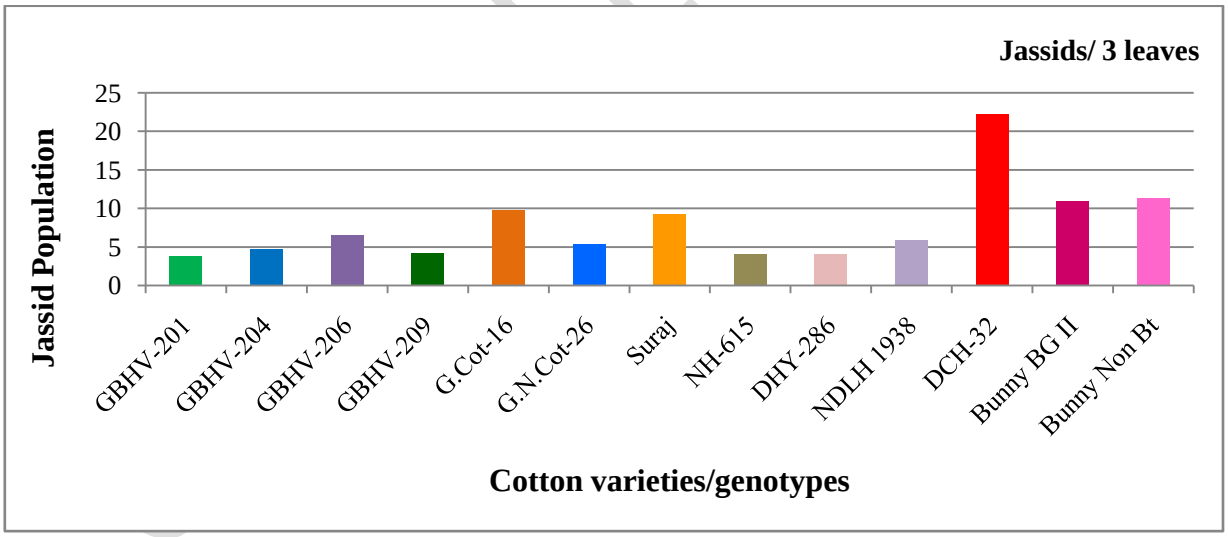
Sr. No.	Cotton varieties/genotypes	Mean number of jassids/ 3 leaves			
		2016-17	2018-19	2019-20	Pooled
1	GBHV-201	2.32^{ab} (4.90)*	1.70^{a} (2.40)	2.11^{a} (4.00)	2.05^{a} (3.77)
2	GBHV-204	2.26^{a} (4.60)	2.51^{b} (5.80)	2.05^{a} (3.70)	2.27^{ab} (4.70)
3	GBHV-206	2.81^{bc} (7.40)	2.55^{b} (6.00)	2.61^{abc} (6.30)	2.66^{abc} (6.57)
4	GBHV-209	2.28^{a} (4.70)	1.84^{ab} (2.90)	2.37^{a} (5.10)	2.16^{a} (4.23)
5	G.Cot-16	2.36^{ab} (5.10)	4.14^{cd} (16.70)	2.83^{abc} (7.50)	3.11^{abc} (9.77)
6	G.N.Cot-26	2.42^{ab} (5.40)	2.32^{ab} (4.90)	2.51^{ab} (5.80)	2.42^{abc} (5.37)
7	Suraj	3.22^{c} (9.90)	3.74^{c} (13.50)	2.20^{a} (4.40)	3.06^{abc} (9.27)
8	NH-615	2.07^{a} (3.80)	2.14^{ab} (4.10)	2.15^{a} (4.40)	2.12^{a} (4.10)
9	DHY-286 (JR)	2.02^{a} (3.60)	2.21^{ab} (4.40)	2.14^{a} (4.10)	2.13^{a} (4.03)
10	NDLH 1938 (JR)	2.39^{ab}	2.53^{b}	2.66^{abc}	2.53^{abc}

		(5.20)	(5.90)	(6.60)	(5.90)
11	DCH-32 (JS)	5.01^{d} (24.60)	4.86^{d} (23.20)	4.40^{d} (18.90)	4.76^{d} (22.23)
12	Bunny BG II	2.98^{c} (8.40)	3.75^{c} (13.70)	3.37^{bc} (10.90)	3.37^{bc} (11.00)
13	Bunny Non *Bt*	3.16^{c} (9.50)	3.50^{c} (11.80)	3.60^{cd} (12.50)	3.42^{c} (11.27)
Mean		2.72 (7.47)	2.91 (8.87)	2.69 (7.25)	2.77 (7.86)
S. Em.±	Treatment (T)	0.10	0.16	0.18	0.23
	Year (Y)				0.04
	T x Y	--	--	--	0.15
C.D. at 5%	T	Sig.	Sig.	Sig.	Sig.
	T x Y	--	--	--	0.44
C.V. %		5.36	7.83	9.55	7.77

Note:

1. *Figures in the parentheses are original mean values and those outside are $\sqrt{X+0.5}$ transformed values.
2. Treatment mean(s) with the letter(s) in common are not significant by DNMRT at 5 % level of significance.
3. Significant interactions: T, T x Y, where T=Treatment and Y=Year
4. Check varieties: DHY 286 (Jassid resistant), NDLH 1938 (Jassid resistant), DCH 32 (Jassid susceptible)

Figure 1: Jassid population on different cotton varieties/genotypes (Pooled of three seasons)



The present results are in agreement with the findings of many researchers. Manivannan *et al*. [8] conducted screening of 350 cotton genotypes against leafhopper, *A. biguttula biguttula* (Ishida) and found no genotypes were resistant, 50 genotypes were categorized as tolerant, 158 genotypes moderately tolerant, 91 genotypes susceptible and 51 genotypes highly susceptible with a population ranged from 0.10 to 0.78, 0.79 to 1.57, 1.58 to 2.36 and 2.37 to 6.25 leafhopper/3 leaves/plant respectively based on the standard deviation value. Patel and Radadia [9] screened sixteen cotton varieties/genotypes against *A. biguttula biguttula* and revealed that

none of the cotton variety/genotype was totally free from attack ofjassidsand categorized as resistant based on population of jassid. Eleven varieties/genotypes *viz.*, G.Cot.-12, GSHV-01/1338, GISV-267, G.N.Cot.-22, GSHV-159, GISV-272, GBHV-177, GBHV-170, GBHV-180, GBHV-164 and G.Cot.-16 were designated as moderately resistant to jassid by recording the population ranged from 2.41 to 6.37 jassids/3 leaves.The susceptible cotton varieties/genotypes comprised G.Cot.-10, LRA-5166 and G.Cot.-100which registered population ranged from 8.11 to 11.38 jassids/3 leaves. However, genotype Cocker-310 and GSB-21 were categorized as highly susceptible to jassid with population of more than 11.73 jassids/3 leaves.

In past, Guru PN *et al*. [10] screened 17 *Bt* cotton hybrids with susceptible check (Bunny Non-*Bt*) against major sucking pests and revealed that the incidence of leafhoppers was least on Bio HY. 15-2 BGII (2.96 per 3 leaves) and Ankuryesh BGII, 72SS 66 BGII and BIO HY. 1101-2 BGII were on par with it whereas, higher incidence was recorded on VBCH 1545 BGII (7.61 per 3 leaves). Patel and Radadia [11] recorded peak population of jassid in the susceptible cotton cultivar GSB-21 was 37.22 jassids/3 leaves and 38.48 jassids/ 3 leaves during *kharif* seasons of 2015-16 and 2016-17, respectively. The present findings are close in conformity with the findings of Appala *et al*. [12] screened fourteen cotton genotypes against leafhoppers and showed that the overall mean population of leafhoppersvaried 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).

3.2 Jassid Resistance Index (JRI)

The data presented in Table 2 demonstrated thatjassid resistant check DHY-286 recorded the lowest (1.10) Jassid Resistance Index (JRI) during 2016-17. Six cotton varieties/genotypes*viz.*, NH-615, GBHV-204, GBHV-201, GBHV-209, G.Cot-16, G.N.Cot-26 and NDLH 1938 showed lower JRI of 1.20 to 1.60.Jassid susceptible check DCH-32 recorded the highest JRI of 4.00 followed by Suraj (3.20), Bunny non *Bt*(3.10) and Bunny BG II (2.80).

The DHY-286 also recorded the lowest JRI of 1.00 followed by NH-615 (1.10) during 2018-19. Another five cotton varieties/genotypes*viz.*, GBHV-201, GBHV-209, G.N.Cot-26, NDLH 1938 and GBHV-204 showed below 2.00 JRI. The highest JRI was observed in susceptible check DCH-32 (3.90).

During 2019-20, two cotton varieties/genotypes*i.e..*, NH-615 and DHY-286 indicated the lowest JRI of 1.00. Five cotton varieties/genotypes*viz.*, GBHV-201, GBHV-204, Suraj, GBHV-209 and G.N.Cot-26 demonstrated JRI in range of 1.20 to 1.70. Jassid susceptible check DCH-32 recorded the highest JRI of 4.00 and it was nearly followed by Bunny non *Bt*(3.80). TheBunny BG II showed the JRI of 3.10.

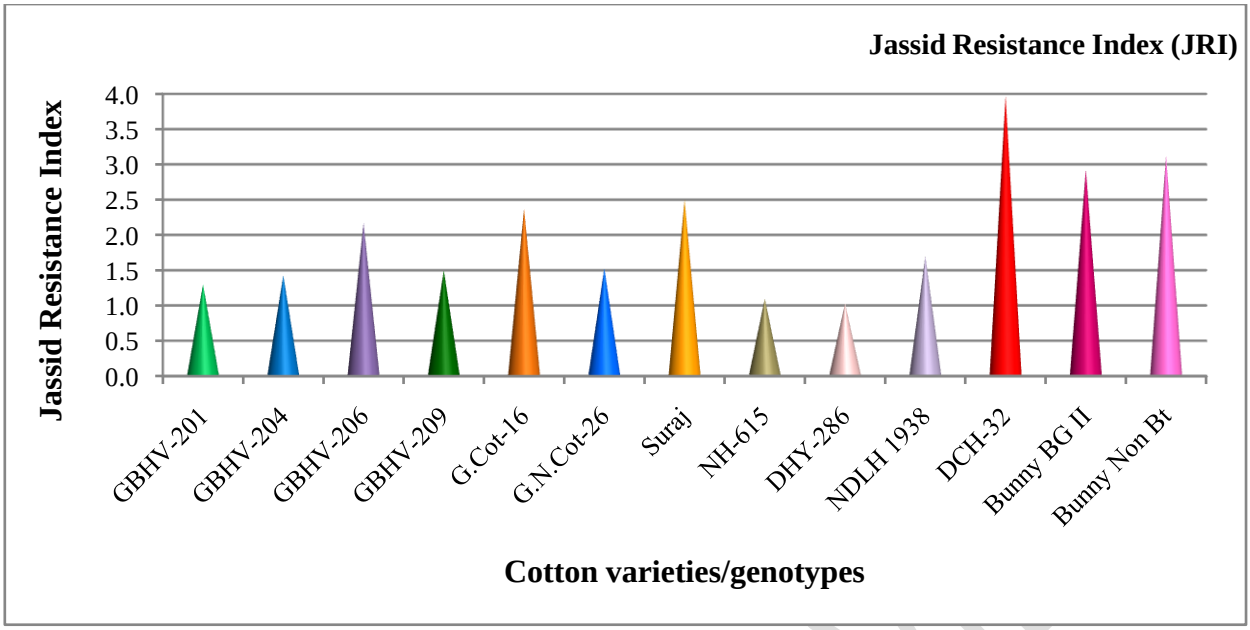
The mean data of three seasons presented in Table 2 and illustrated in Figure 2 indicated that jassid resistant check DHY-286 recorded the lowest Jassid Resistance Index (1.03)and it was nearly followed by NH-615 (1.10). Jassid susceptible check DCH-32 recorded the highest JRI of 3.97.The ascending order of Jassid Resistance Index on different cotton varieties/genotypes was DHY-286<NH-615<GBHV-201<GBHV-204<GBHV-209<G.N.Cot-26<NDLH-1938<GBHV-206<G.Cot-16<Suraj<Bunny BG II<Bunny non *Bt*<DCH-32.

Table 2: Jassid Resistance Index on cotton varieties/genotypes under rainfed conditions at Bharuch

Sr. No.	Cotton varieties/genotypes	Jassid Resistance Index (JRI)			
		2016-17	2018-19	2019-20	Mean
1	GBHV-201	1.50	1.20	1.20	1.30
2	GBHV-204	1.40	1.70	1.20	1.43
3	GBHV-206	2.20	2.10	2.20	2.17
4	GBHV-209	1.50	1.30	1.70	1.50
5	G.Cot-16	1.60	3.10	2.40	2.37
6	G.N.Cot-26	1.60	1.30	1.70	1.53
7	Suraj	3.20	3.10	1.20	2.50
8	NH-615	1.20	1.10	1.00	1.10
9	DHY-286 (JR)	1.10	1.00	1.00	1.03
10	NDLH 1938 (JR)	1.60	1.50	2.00	1.70
11	DCH-32 (JS)	4.00	3.90	4.00	3.97
12	Bunny BG II	2.80	2.90	3.10	2.93
13	Bunny Non *Bt*	3.10	2.50	3.80	3.13
Mean		2.06	2.05	2.04	2.05

Note: Check varieties: DHY 286 (Jassid resistant), NDLH 1938 (Jassid resistant), DCH 32 (Jassid susceptible)

Figure 2:Jassid Resistance Index on different cotton varieties/genotypes (Pooled of three seasons)



3.3 Categorization of cotton varieties/genotypes based on population of jassid

The data presented in Table 3 revealed that none of the cotton varieties/genotypes fall under category as resistant by considering maximum jassid population among three seasons of 2016-17, 2018-19 and 2019-20.Eight cotton varieties/genotypes*viz.,* NH-615, resistant check DHY-286, GBHV-201, GBHV-209, GBHV-204, G.N.Cot-26, resistant check NDLH-1938 and GBHV-206 were designated as moderately resistant to jassid which recorded the population ranged from 4.40 to 7.40 jassids/3 leaves. Among eight moderately resistant varieties/genotypes, NDLH-1938 (6.60 jassids/3 leaves) and GBHV-206 (7.40 jassids/3 leaves) recorded above economic threshold level of jassidpopulation.The susceptible varieties/genotypes comprised Suraj, Bunny BG II and Bunny Non *Bt* which registered population ranged from 12.50 to 13.70 jassids/3 leaves. However, G.Cot-16(16.70 jassids/3 leaves) and susceptible check DCH-32(24.60 jassids/3 leaves) were categorized as highly susceptible to jassids.

3.4 Categorization of cotton varieties/genotypes based on Jassid Resistance Index

The data presented in Table 3 indicated that none of the cotton varieties/genotypes fall under category as resistant by considering maximum Jassid Resistance Index (JRI) among three seasons of 2016-17, 2018-19 and 2019-20. Seven varieties/genotypes *viz.*,DHY-286, NH-615, GBHV-201, GBHV-204, GBHV-209, G.N.Cot-26 and NDLH-1938 were grouped into moderately resistant with 1.10 to 2.0 JRI range.Only the genotype GBHV-206 was found susceptible with 2.20 JRI.Five cotton varieties *viz.*,G.Cot-16, Bunny BG II, Suraj, Bunny Non *Bt* and DCH-32 emerged as highly susceptible to jassid by indicating JRI in range of 3.10 to 4.00.

Table 3: Reaction of cotton varieties/genotypes against jassid under rainfed conditions at Bharuch(Maximum jassid population and JRI among three seasons)

Sr. No.	Cotton varieties/genotypes	Jassids/ 3 leaves	Reaction	Jassid Resistance Index	Reaction
1	GBHV-201	4.90	MR	1.50	MR
2	GBHV-204	5.80	MR	1.70	MR
3	GBHV-206	7.40	MR	2.20	S
4	GBHV-209	5.10	MR	1.70	MR
5	G.Cot-16	16.70	HS	3.10	HS
6	G.N.Cot-26	5.80	MR	1.70	MR
7	Suraj	13.50	S	3.20	HS
8	NH-615	4.40	MR	1.20	MR
9	DHY-286 (JR)	4.40	MR	1.10	MR
10	NDLH 1938 (JR)	6.60	MR	2.00	MR
11	DCH-32 (JS)	24.60	HS	4.00	HS
12	Bunny BG II	13.70	S	3.10	HS
13	Bunny Non *Bt*	12.50	S	3.80	HS
Mean ($\bar{X}$):		9.65			
Standard Deviation (SD):		6.16			

	Categorization based on Mean and Standard Deviation	
	Category of resistance	Scale of resistance
1	Resistant (R)	$\bar{X}I < (\bar{X} - SD)$
2	Moderately Resistant (MR)	$\bar{X}I > (\bar{X} - SD) < \bar{X}$
3	Susceptible (S)	$\bar{X}I > \bar{X} < (\bar{X} + SD)$
4	Highly Susceptible (HS)	$\bar{X}I > (\bar{X} + SD)$

	Categorization based on Jassid Resistance Index	
	Jassid Resistance Index (JRI)	Category/ Reaction
1	0.1 – 1.0	Resistant (R)
2	1.1 – 2.0	Moderately Resistant (MR)
3	2.1 – 3.0	Susceptible (S)
4	3.1 – 4.0	Highly Susceptible (HS)

Present studies are more or less in similar with earlier studies.Neelima *et al*. [13] screened fifty six cotton genotypes for their reaction against leafhopper, *A. devastans* under rainfed conditions at Lam, Guntur (AP) and showed that based on Resistance/Injury index, four genotypes of *G. arboreum* and one genotype of *G. hirsutum* were resistant (Injury index: 0.1-1.0), forty genotypes were moderately resistant (1.1-2.0), eleven genotypes were susceptible (2.1-3.0) and one genotype was highly susceptible (3.1- 4.0). However, these investigators screened different cotton genotypes. Appala*et al*. [12] screened fourteen cotton genotypes against leafhoppers and evaluated that the leaf hopper resistance injury index had ranged from 1.26 to 3.65.The lowest resistance injury index exhibited by the genotype GISV-267 (1.26) and

GSHV-173 (1.35).Sasikumar and Rathika [14] screened of 67 cotton genotypes with check entries NDLH 1938 (Resistant), DCH 32(Susceptible) against leafhopper, *Amrascabiguttulabiguttula* (Ishida) and found 9 genotypes were highly resistant (Leaf Hopper Injury Grade 1), 29 genotypes resistant (LHIG 2), 25 genotypes susceptible (LHIG 3) and 4 genotypes highly susceptible (LHIG 3) 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.Avinash*et al*. [15] evaluated 26 cotton genotypes against jassid with resistant (Ajeet-155 and NDLH-1938) and susceptible (DCH-32) checks based on population and Jassid Injury Grade and found 19 genotypes *viz.*, NDLH -1938, Ajeet-155, RHC-688, RHC-03, RHC-04, RHC-1409, RHC-1416, RHC-577/3-3, RHC-014, RHC-Hd-1312, RHC–566/1-1, RHC-1629, RHC-1433, RHC-513, RHC-06, RHC-1466, RHC-1217, RHC-717 and RHC-1438 as moderately resistant, 4 genotypes *viz.*, RHCr-515, RHC-208, RHC– Hd-1433 and RHC-1430 as susceptible and 3 genotypes *viz.*, RHCr-0712, RHC-Hd-1406 and DCH-32 were highly susceptible. Jassid population and Jassid Injury Grade was the lowest in NDLH-1938 (2.65 per 3 leaves, JIG I) and highest in DCH-32 (16.14 per 3 leaves, JIG IV).These findings are in conformity with present studies however they screened different cotton genotypes at different places.

4. Conclusion

Jassid, *A. biguttulabiguttula*infestationwas noticed in all cotton varieties/genotypes of screening studies and none of cotton variety/genotype was categorized as resistant by considering jassid population as well asJassid Resistance Index.Fivevarieties/genotypes of*G.hirsutum*cotton*viz*., NH-615, GBHV-201, GBHV-209, GBHV-204, G.N.Cot-26 and two checks *i.e.*DHY-286 and NDLH-1938were found moderately resistant to jassidsby considering jassid population as well as Jassid Resistance Index under rainfed conditions.

References

1. Anonymous. World Agricultural Production. United States Department of Agriculture (USDA). 2023;pp.36. [fas.usda.gov]
2. Anonymous. All India Coordinated Research Project on Cotton (AICRP), ICAR-Central Institute for Cotton Research, Coimbatore. Annual Report: 2022-23. 2023;A-1-2.
3. Chavan SJ, Bhosle BB, Bhute, NK. Estimation of losses due to major insect-pests in desi cotton (*Gossypium arboreum* L.) in Maharashtra. J Cotton Res Dev. 2010;24(1):95-96.
4. Shera PS. Assessment of avoidable yield losses due to sucking pests in *Bt* cotton hybrids. J Cotton Res Dev. 2012;26(2):254-257.
5. Patel IS, Prajapati BG, Patel GM, Pathak AR. Response of castor genotypes to castor semilooper, *Achaea janata* Fab. J Oilseeds Res. 2002;19(1):153.
6. Anonymous. Integrated Pest Management Package for Cotton. National Centre for Integrated Pest Management on behalf of Directorate of Plant Protection, Quarantine & Storage, Faridabad, Haryana.2014;pp.48.
7. Nageswara Rao P. (1973). An index for jassid resistance in cotton. Madras Agric J.

1973;60(4):264-266. [In: J Cotton Res Dev. 2006;20(1):134]

8. Manivannan A, SridharRP, Karthikeyan S, Pillai AK. Screening of cotton genotypes against leafhopper, *Amrasca biguttula biguttula*(Ishida) (Homoptera: Cicadellidae). Journal of Entomology and Zoology Studies. 2017;5(6):1305-1310.
9. Patel RK, Radadia GG.Screening of cotton varieties/genotypes against jassid, *Amrasca biguttula biguttula* (Ishida) under rainfed conditions. Int J CurrMicrobiol App Sci. 2018;7(12):1099-1110. [https://doi.org/10.20546/ijcmas.2018.712.136]
10. Patil RK, HalappaB, Guru PN. Screening of new *Bt* cotton hybrids against sucking pests. Acta Scientific Agriculture. 2018;2(1):16-19.
11. Patel RK, Radadia GG. Population dynamics of cotton jassid, *Amrasca biguttula biguttula* (Ishida) and natural enemies in relation to weather parameters under rainfed conditions. Journal of Entomology and Zoology Studies. 2018;6(6):664-672.
12. Appala RA, Sesha MM, Sandhya RC, Adinarayana M. Screening of genotypes against cotton leafhopper, *Amarasca devastans*(Cicadellidae: Hemiptera).Journal of Entomology and Zoology Studies. 2019;7(6):861-864.
13. Neelima S, Rao GMVP, Grace ADG, Chalam MSV. Reaction of cotton genotypes to leafhopper, *Amrasca devastans*. Indian J Pl Protec. 2010;38(2):147-151.
14. SasikumarK, RathikaK. Field screening of cotton genotypes against leafhopper, *Amrasca biguttula biguttula* (Ishida) (Homoptera: Cicadellidae) under irrigated condition. Journal of Entomology and Zoology Studies. 2020;8(5):2260-2262.
15. Avinash, Wagh RS, Bhuthe NK, Ingle A, Swami SR. Field evaluation of cotton genotypes against jassid resistance. The Pharma Innovation Journal. 2022;SP-11(8):1487-1490.