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Field evaluation of cotton genotypes against Jassid resistance

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Abstract
Field experiment on evaluation of cotton genotypes against Jassid resistance was conducted at All India Coordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, during *kharif* season of the year 2020 and 2021. The 23 cotton genotypes were selected from the All India Coordinated Cotton Improvement Project, MPKV, Rahuri and studied for categorizing this selected cotton genotypes for jassids resistance by comparing to standard checks i.e., Resistant checks (Ajeet 155 and NDLH 1938) and susceptible check (DCH - 32). Results are based upon Jassids count where among 26 genotypes, 19 cotton genotypes are moderately resistant, 4 genotypes are susceptible and 3 genotypes are highly susceptible cotton genotypes. Jassid injury grade also recorded for particular genotype.

Keywords: cotton, jassids, moderately resistant, susceptible, highly susceptible, Jassid injury grade

Introduction
Cotton is one of the economically and socially important cash crops in the world and a raw material for the textile industry. Cotton is an important fibre yielding crop hence called king of fibres or white gold. This is grown in tropical and subtropical regions of more than 80 countries of the world. The major cotton producing countries are USA, China, India, Pakistan, Uzbekistan, Egypt, Argentina, Australia, Greece, Brazil and Turkey. India is the second largest producer of cotton. The area, production and productivity of cotton during 2019 - 20 are 133.7 lakh hectares, 35.5 million tonnes and 451 kg per hectare respectively (Anonymous, 2020) [1].
Cotton is attacked by a large number of insect pests right from sowing till harvest. In India, the cotton ecosystem harbours about 162 species of insects which are known to devour cotton at various stages of growth, of which 15 are considered to be key pests. In the early stage, sucking pests like aphids, thrips, jassids and whiteflies and in the later stage, different kinds of bollworms cause reduction in yield and quality of cotton. The monetary value of yield losses due to insect pests has been estimated to be about Rs. 2, 87,000 million, annually (Dhawan *et al.*, 2008) [2].
Sucking pests have become quite serious from seedlings stage to harvesting and their heavy infestation at times reduces the crop yield to a great extent. The estimated loss due to sucking pests is up to 21.20% (Dhawan *et al.*, 1988) [3]. Leafhopper A. biguttula biguttula (Hemiptera: Cicadellidae), is a sap sucking insect pest which causes losses due to injection of toxins. 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. Owing to the loss of plant vitality, the cotton bolls also drop off, causing up to 35 per cent reduction in yield (Atwal and Dhaliwal, 2010) [4]. ("Insect Pest of Cotton (Fiber crop) Cotton Jassid (*Amrasca biguttula*"). So, the present study carried out for identifying natural resistance in cotton genotypes against jassid infestation.

Material and Methods
The present field experiment was conducted at All India Coordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, during *kharif* season of the year 2020 and 2021. The geographical situation of Rahuri is on 19.38°N latitude and 74.65°E longitude, with an elevation of 511 metres above mean sea level. The experiment was laid out in Randomized Block Design replicated thrice. The field experiment was conducted with gross plot size of 7.20 m x 1.80, whereas net plot size of 5.40 m x 3.60 m.
In present research, 23 cotton genotypes were selected from the All India Coordinated Cotton

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Improvement Project, MPKV, Rahuri and studied for categorizing this selected cotton genotypes for jassid resistance by comparing to standard checks i.e., Resistant checks (Ajeet 155 and NDLH 1938) and susceptible check (DCH - 32). The treatment details are mentioned below.

Treatment / Cotton Genotypes details			
T_1	RHC - 03	T_{14}	RHC - 1430
T_2	RHC - 04	T_{15}	RHC - 1629
T_3	RHC - 014	T_{16}	RHC - 1446
T_4	RHC - 06	T_{17}	RHC - 1438
T_5	RHC - 208	T_{18}	RHC - 1433
T_6	RHCr - 0712	T_{19}	RHC - 688
T_7	RHC - 513	T_{20}	RHC – Hd - 1312
T_8	RHCr - 515	T_{21}	RHC – Hd - 1433
T_9	RHC – 566/1-1	T_{22}	RHC – Hd - 1406
T_{10}	RHC – 577/3-3	T_{23}	RHC - 717
T_{11}	RHC - 1416	T_{24}	Ajeet - 155
T_{12}	RHC - 1217	T_{25}	DCH - 32
T_{13}	RHC - 1409	T_{26}	NDLH - 1938

Method of recording observations
The cotton genotypes are categorized based upon the jassid count/number per three leaves. The infestation of Jassids were recorded at 30, 60 and 90 days after sowing during morning hours from five plants per plot of each genotype. The plants were selected randomly and tagged in each plot to record the population of jassids from three leaves, each one from top, middle and bottom canopies and mean populations per three leaves were worked out. Mean Jassid infestation of each cotton genotypes were calculated and the grouping of

genotypes was made into four classes *viz.*, 1) Resistant 2) Moderately resistant 3) Susceptible 4) Highly susceptible. The scale of categorization of cotton genotypes are done based on level of jassids infestation (Aueskar, 2020) as under.

Sr. No	Level of jassids infestation/3 leaves	Category	Grades
1	2.00 and below	Resistant	R
2	2.01 to 4.00	Moderately resistant	MR
3	4.01 to 6.00	Susceptible	S
4	6.01 and above	Highly susceptible	HS

Leafhopper injury grade
Leafhopper injury grade was recorded for all the genotypes as follows.
Grade I: Leaves free from crinkling and yellowing at the leaf margins.
Grade II: Few leaves on lower portions of plant curling, crinkling and slight yellowing at the leaf margins.
Grade III: Crinkling and curling overall. Yellowing, bronzing and browning of leaves in the middle and lower portions, plant growth hampered.
Grade IV: Extreme curling, yellowing, bronzing, browning, and drying of leaves, defoliation and stunted growth.

Results and Discussion
The data pertaining to jassids population are presented in Table 1 and fig 1. The season wise results are discussed hereunder.

Table 1: Average jassids population of cotton genotypes (Jassids count/3 leaves)

Average jassids population per 3 leaves				Category
Genotypes	Kharif 2020	Kharif 2021	Pooled mean	
RHC - 03	2.83 (1.83)	2.81 (1.82)	2.82 (1.83)	MR
RHC - 04	2.86 (1.84)	2.82 (1.83)	2.84 (1.83)	MR
RHC - 014	3.01 (1.88)	2.98 (1.87)	3.00 (1.87)	MR
RHC - 06	3.76 (2.07)	3.73 (2.06)	3.74 (2.06)	MR
RHC - 208	4.67 (2.28)	4.65 (2.27)	4.66 (2.28)	S
RHCr - 0712	12.43 (3.60)	12.39 (3.60)	12.41 (3.60)	HS
RHC - 513	3.72 (2.06)	3.68 (2.05)	3.70 (2.05)	MR
RHCr - 515	4.15 (2.16)	4.12 (2.15)	4.14 (2.16)	S
RHC - 566/1 - 1	3.52 (2.01)	3.48 (2.00)	3.50 (2.00)	MR
RHC - 577/3 - 3	2.98 (1.87)	2.95 (1.86)	2.97 (1.87)	MR
RHC - 1416	2.96 (1.86)	2.93 (1.86)	2.95 (1.86)	MR
RHC - 1217	3.84 (2.09)	3.80 (2.08)	3.82 (2.08)	MR
RHC - 1409	2.92 (1.85)	2.87 (1.84)	2.89 (1.85)	MR
RHC - 1430	6.00 (2.55)	5.97 (2.55)	5.99 (2.55)	S
RHC - 1629	3.54 (2.01)	3.49 (2.00)	3.52 (2.01)	MR
RHC - 1446	3.82 (2.08)	3.77 (2.07)	3.80 (2.08)	MR
RHC - 1438	3.90 (2.10)	3.85 (2.09)	3.88 (2.10)	MR
RHC - 1433	3.60 (2.03)	3.56 (2.02)	3.58 (2.02)	MR
RHC - 688	2.81 (1.82)	2.77 (1.81)	2.79 (1.82)	MR
RHC- Hd - 1312	3.28 (1.95)	3.24 (1.94)	3.26 (1.94)	MR
RHC- Hd - 1433	5.34 (2.42)	5.30 (2.41)	5.32 (2.42)	S
RHC- Hd - 1406	14.23 (3.84)	14.19 (3.84)	14.21 (3.84)	HS
RHC - 717	3.86 (2.09)	3.81 (2.08)	3.84 (2.09)	MR
Ajeet - 155	2.65 (1.78)	2.62 (1.77)	2.63 (1.77)	MR
DCH - 32	16.16 (4.09)	16.12 (4.08)	16.14 (4.08)	HS
NDLH - 1938	2.67 (1.78)	2.62 (1.77)	2.65 (1.78)	MR
SEM	0.26	0.22	0.24	
CD 5%	0.73	0.61	0.68	
CV	7.40	6.22	6.84	

MR – Moderately Resistant, S – Susceptible and HS – Highly Susceptible
*Figures in the outside are original mean values and those in brackets are square root transformed values

Fig 1: Average jassids population of cotton genotypes (Crop seasons 2020 & 2021)

Population of Jassid (Crop season 2020)
Among all the cotton genotypes lowest number of jassids per three leaves recorded in moderately resistant cotton genotypes as NDLH -1938 (2.67 per 3 leaves), Ajeet - 155 (2.65 per 3 leaves) followed by RHC - 688 (2.81 per 3 leaves), RHC- 03 (2.83 per 3 leaves), RHC - 04 (2.86 per 3 leaves), RHC -1409 (2.92 per 3 leaves), RHC - 1416 (2.96 per 3 leaves), RHC - 577/3-3 (2.98 per 3 leaves), RHC - 014 (3.01 per 3 leaves), RHC -Hd -1312 (3.28 per 3 leaves), RHC – 566/1-1 (3.52 per 3 leaves), RHC - 1629 (3.54 per 3 leaves), RHC - 1433 (3.60 per 3 leaves), RHC - 513 (3.72 per 3 leaves), RHC - 06 (3.76 per 3 leaves), RHC - 1466 (3.82 per 3 leaves), RHC - 1217 (3.84 per 3 leaves), RHC - 717 (3.86 per 3 leaves) and RHC - 1438 (3.90 per 3 leaves) respectively. The number of jassids recorded in certain cotton genotypes as RHCr - 515 (4.15 per 3 leaves), RHC - 208 (4.67 per 3 leaves), RHC - Hd – 1433 (5.34 per 3 leaves) and RHC -1430 (6.00 per 3 leaves) were classified as susceptible cotton genotypes. Among all the cotton genotypes the highest number of jassids were recorded in RHCr - 0712 (12.43 per 3 leaves), RHC - Hd -1406 (14.23 per 3 leaves) and DCH - 32 (16.16 per 3 leaves) are considered as highly susceptible genotypes.

Population of Jassid (Crop season 2021)
Among all the cotton genotypes lowest number of jassids per three leaves recorded in moderately resistant cotton genotypes as NDLH -1938 (2.62 per 3 leaves), Ajeet - 155 (2.62 per 3 leaves) followed by RHC - 688 (2.77 per 3 leaves), RHC- 03 (2.81 per 3 leaves), RHC - 04 (2.82 per 3 leaves), RHC -1409 (2.87 per 3 leaves), RHC - 1416 (2.93 per 3 leaves), RHC - 577/3-3 (2.95 per 3 leaves), RHC - 014 (2.98 per 3 leaves), RHC -Hd -1312 (3.24 per 3 leaves), RHC – 566/1-1 (3.48 per 3 leaves), RHC - 1629 (3.49 per 3 leaves), RHC - 1433 (3.56 per 3 leaves), RHC - 513 (3.68 per 3 leaves), RHC - 06 (3.73 per 3 leaves), RHC - 1466 (3.77 per 3 leaves), RHC - 1217 (3.80 per 3 leaves), RHC - 717 (3.81 per 3 leaves) and RHC - 1438 (3.85 per 3 leaves) respectively. The number of jassids recorded in certain cotton genotypes as RHCr - 515 (4.12 per 3 leaves), RHC - 208 (4.65 per 3 leaves), RHC - Hd – 1433 (5.30 per 3 leaves) and RHC -1430 (5.97 per 3 leaves) were classified as susceptible cotton genotypes. Among all the

cotton genotypes the highest number of jassids were recorded in RHCr - 0712 (12.39 per 3 leaves), RHC - Hd -1406 (14.19 per 3 leaves) and DCH - 32 (16.12 per 3 leaves) are considered as highly susceptible genotypes.

Pooled data (crop season 2020 & 2021)
Among all the cotton genotypes lowest number of jassids per three leaves recorded in moderately resistant cotton genotypes as NDLH -1938 (2.65 per 3 leaves), Ajeet - 155 (2.63 per 3 leaves) followed by RHC - 688 (2.79 per 3 leaves), RHC- 03 (2.82 per 3 leaves), RHC - 04 (2.84 per 3 leaves), RHC -1409 (2.89 per 3 leaves), RHC - 1416 (2.95 per 3 leaves), RHC - 577/3-3 (2.97 per 3 leaves), RHC - 014 (3.00 per 3 leaves), RHC -Hd -1312 (3.26 per 3 leaves), RHC – 566/1-1 (3.50 per 3 leaves), RHC - 1629 (3.52 per 3 leaves), RHC - 1433 (3.58 per 3 leaves), RHC - 513 (3.70 per 3 leaves), RHC - 06 (3.74 per 3 leaves), RHC - 1466 (3.80 per 3 leaves), RHC - 1217 (3.82 per 3 leaves), RHC - 717 (3.84 per 3 leaves) and RHC - 1438 (3.88 per 3 leaves) respectively. The number of jassids recorded in certain cotton genotypes as RHCr - 515 (4.14 per 3 leaves), RHC - 208 (4.66 per 3 leaves), RHC - Hd – 1433 (5.32 per 3 leaves) and RHC -1430 (5.99 per 3 leaves) were classified as susceptible cotton genotypes. Among all the cotton genotypes the highest number of jassids were recorded in RHCr - 0712 (12.41 per 3 leaves), RHC - Hd -1406 (14.21 per 3 leaves) and DCH - 32 (16.14 per 3 leaves) are considered as highly susceptible genotypes.

Jassid injury grade
The Jassid injury grade is recorded for all the selected cotton genotypes based upon on the symptoms observed in cotton leaves as mentioned in material and methods and classified them into Grade I, II, III, IV. The pertaining to jassid injury grade is depicted in table 2.
The number of jassids population were seen more in susceptible genotypes than the moderately resistant genotypes. Jassid injury grade also depends on the jassids population infestation. Present results are in conformity with the findings of Patel (2014) [6], Sarwar *et al.* (2013) [7] and Khan *et al.* (2011) [8].
In conclusion, from the present research on "field evaluation

of cotton genotypes against jassid resistance", the selected 26 cotton genotypes from cotton improvement project MPKV Rahuri were categorized based upon jassid population. Among selected genotypes, the 19 genotypes such as 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 respectively are Moderately Resistant genotypes. Whereas 4 genotypes such as RHCr - 515, RHC - 208, RHC – Hd-1433 and RHC-1430 are susceptible genotypes and remaining 3 genotypes such as RHCr - 0712, RHC - Hd -1406 and DCH - 32 are highly susceptible genotypes.

Table 2: Jassid injury grade of cotton genotypes

Genotypes	Jassid Injury grade
RHC - 03	I
RHC - 04	I
RHC - 014	II
RHC - 06	II
RHC - 208	II
RHCr - 0712	IV
RHC - 513	II
RHCr - 515	II
RHC - 566/1 - 1	II
RHC - 577/3 - 3	II
RHC - 1416	II
RHC - 1217	II
RHC - 1409	I
RHC - 1430	II
RHC - 1629	II
RHC - 1446	II
RHC - 1438	II
RHC - 1433	II
RHC - 688	I
RHC- Hd - 1312	II
RHC- Hd - 1433	II
RHC- Hd - 1406	IV
RHC - 717	II
Ajeet - 155	I
DCH - 32	IV
NDLH - 1938	I

Acknowledgement

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