The Bioscan 11(1): 85-91, 2016
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

SCREENING FOR SUCKING PESTS (THRIPS AND JASSIDS) RESISTANCE/TOLERANCE IN COTTON GERMPLASM LINES (*GOSSYPIUM HIRSUTUM* L.)

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KEYWORDS
Cotton
Germplas
Thrips
Phenol
Gossypol

Received on :
11.09.2015

Accepted on :
21.01.2016

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ABSTRACT

During 2011-12 although the experiment was conducted under protected condition the presence of large phenotypic variability for jassids reaction was noticed, therefore observations are made on jassids damage and identified jassids resistant, tolerant and susceptible germ plasm lines. Selected germplasm lines were taken up during 2012-13 by evaluating in protected and unprotected conditions. Identification of resistant and susceptible germ plasm lines for thrips and jassids are carried out based on biochemical and average pest load/ leaf. Under protected condition experimental mean of thrips load was 1.70/leaf and in unprotected condition mean thrips load was 6.91/leaf. Highest mean value for phenols is observed on SEC-6 (4.21 mg/g) and lowest on RDT-31 (1.98 mg/g) in protected conditions and in unprotected conditions highest mean value observed on SEC-6 (3.12 mg/g) and lowest mean value on RDT-1 (1.35 mg/g). Mean of the germ plasm lines for reducing sugar content was 2.41 mg/g and 3.57 mg/g in protected and un-protected conditions respectively. Mean of the germ plasm lines for gossypol content was 31.73 µg/g and 28.72 µg/g in protected and un-protected conditions respectively. CPD-1015 identified as resistance to thrips, SEC-6, FQT-36 show resistance to jassids and CPD-1015 recorded as resistant to both jassids and thrips.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.), a crop of prosperity, is an industrial commodity of worldwide importance. It is one of the most ancient and important commercial crop next only to food grains. India accounts for 33 per cent (10.7 mha) of world cotton area and 22 per cent (5.4 mt) of world cotton production. In India, about 70 per cent area is covered by hybrids, 20 per cent by upland varieties and 10 per cent by diploid cultivars (Anon, 2012).

Cotton is infested by a large number of insect pests right from the sowing till harvest. In the early stages, sucking pests like aphids, thrips, leaf hoppers and white flies cause serious problem and resulting reduction in yield and quality of cotton. The sucking pests cause 22.58 per cent reduction in cotton yield (Satpute *et al.,* 1990).

Due to the reduction of broad-spectrum insecticides, in cotton because of use of insect resistant, genetically-engineered (GE) varieties, non-target pests, with piercing-sucking mouth-parts, such as, leaf bugs, cotton spider mites, cotton aphids and whiteflies, survive better and occasionally, reach a pest status (Xu *et al.*, 2008).

Keeping in view, the existing situation of outbreaks of piercing sucking insects on cotton, there is a direct need to develop sucking pest resistant varieties or hybrids on this side, the present study was undertaken to find out the sucking pest resistant or tolerant germ plasm lines based on pest population and biochemical observations.

MATERIALS AND METHODS

In the present study material comprising of 480 germ plasm lines of *G.hirsutum* cotton which includes collections (indigenous and exotic collection), released varieties and lines developed from different breeding strategies are used. Seeds are hand dibbled in rows of each 6m length with spacing of 90cm between rows and 20cm between plants within a row. Sowing was done in Augmented Design-II (Extended form of RBD) with 20 blocks to obtain minimum of 12 error degrees of freedom and six checks repeated in each block. Package of practice recommended for cotton under assured rain fed conditions is followed.

During 2011-12 although the experiment was conducted under protected condition the presence of large phenotypic variability for jassid reaction was noticed, therefore observations are made on jassids damage and identified jassid resistant, tolerant and susceptible germ plasm lines in order to validate this pest reaction status. Twenty germ plasm lines were taken up during 2012-13 with five checks by evaluating in two experiments protected and unprotected conditions using RBD with four replications. Among these four replications two replications are maintained as protected and another two as un-protected.

During 2011-12 observations are recorded based on jassids symptoms while during 2012-13 along with jassids reaction scoring, thrips reaction scoring and pest population count was also done. To determine the basis of resistance in cotton to sucking pests' biochemical components of different genotypes are studied in both protected and unprotected conditions. The amount of phenol, gossypol and reducing sugar are estimated from the leaf samples at 120 days after sowing in two replications. Observations on yield and yield related traits viz., plant height (cm), number of mono podia, number of sympodia, boll number, boll weight (g), seed cotton yield (kg/ha), was also recorded. The data was analyzed using the standard statistical package.

RESULTS AND DISCUSSION

During 2011-12 Based on the jassid reaction 480 germ plasm lines classified in to resistant, tolerant and susceptible under natural condition. Among the 480 germ plasm lines 44, 310,

Table 1: Classification of *G. hirsutum* germplasm lines for jassid reaction in natural condition evaluated during 2011-12

Class	Genotypes
Resistant	IC358782, EC137593 (TxORHW-1-78), EC560322, EC560328, EC560370, 543385A03N86, 543413A03N123, 543416A03N132, 543417A03N133, 543419A03N135, 543420A03N136, 126663, 1283361-10-B, 493754PSB-CT8, 493753CRD-2, 493751UPL C-2, 129014, 126625, 144798, AKA-8828, AKA-081, AK-053B, AK-23B, PH-1009, PH-93, JK-4, LH-2076, F-2226, F-2036, F-2188, F-2086, SEC-2, SEC-4, SEC-5, CPD-1015, CCH-1831, ADL-903, NO-4, NO-15, CNH-120MB, RDT-18, CPD-424, RDT-2, Khandwa-2.
Tolerant	IC357196 (EL-508), IC359059 (BTRTK-97-16-4), IC356874 (Blight Master), IC357200 (EL592), IC358249 (XABS*Sanganich), IC359087 (B4 empire), IC359088 (DCI 108), EC141725 (Deltapine-66), EC141294 (Reba PVT-9), EC141679 (AC-241-1), IC35834562-2 (S)-2-3, IC359027 (AH-777), TBWR-7 (JK-345), SIMA-1, IC359036-Nimkar-1, EC138569-TamlotSP-215, EC143506 (NC-177-166-30), EC559022, EC560325, EC560327, EC560347, EC560351, EC560355, EC560357200, EC560362, EC560375, 543382A03N83, 543384A03N85, 543386A03N87, 543387A03N88, 543388A03N89, 543389A03N90, 543392A03N92, 543395A03N98, 543396A03N99, 543398A03N101, 543399A03N102, 543368A02N58, 543370A02N62, 543371A02N64, 543372A02N65, 543374A02N68, 543375A02N71, 543376A02N75, 543377A02N76, 543403A03N106, 543404A03N107, 141725-Deltapine66, 132021 B-163, 191952, 126617, 180748H+C79-6, 200759WIR7178 (H3090 MEXICO), 128333 Acala 44, Cat 4186ALAPO-40, Cat 4225GP284, LRA5166, CNH-36, EC296596, EC296770,EC408326, EC548182, EC548183, EC559012, EC559013, EC559014, EC559020, EC559021, EC559031, EC560346, EC560358, EC560362, EC560376, EC560379, EC560380, EC560382, EC560383, EC560384, EC560387, EC560389, EC560390, EC560392, EC560393, EC560395,EC560399, EC560400 , EC560403, EC560404, EC560406,EC560411, EC560415, EC560419, EC560421, EC560422, EC560423, EC560426, EC560427, EC560428, EC560430, EC560431, FQT-14, FQT-16, FQT-21, FQT-25, FQT-26, FQT-33, FQT-38, CPD-819, CPD-817, CPB-812, HAG-1055, ARBH-818, RB-760, GISV-103, CNH-120MB, HLS-4-1, HBS-13-1, HBS-148, HBS-4-1, CPD-921, TSH-9975, GBHV-156, GJHV-358, GISV-206, CPD-821, CPD-423, CPD-812, CPD-813, CPD-1019, CPD-1050,CPD-817, CPD-821, ARB-08-822, ARB-08-4/15, HAG-1015, HAG-08-823, HAG-08-1002, HAGH-819, Abadhita , JK-119, LRA-5166, Laxmi, AK-32, CAK-023A, PUK-Rajat, NH-615, NH-152, Khandwa-3, TCH-1218, SVPR-2, F-2164, PSHEC-15, CPD-1002, CPD-1009, CPD-1011, CPD745, MCU-5VT, BN, RAH-221, HBS-123, HBS-201, CNH-012, HBS-102, HBS-110, HBS-122, HBS-103, NH-545, HBS-128, NISD-3, SRT-1, JK-119, LRA-5166, CNH-120MB, CCHL-76, BN-15, BN-9, BN-13,127, BN-8, BN-13, RAH-110, RAH-162, UASD-260903, UASDSB-2003, CPD-2007-4, CPD-2011, GPDWD442, GPDWD443, GPDWD444, GPDWD447, GPDWD448, CPD-817, CPD-814, NDC-762, ADL-903, L-761, CPD-787, RAH-3, TSH-2005, DTC-72-1, DTC-72-2, DTC-72-3, NH-630, NH-111-1, RS-2013/SGNR, RST-9/SGNR, RS-810/SGNR, BN/SGNR, RS-875/SGNR, G.Cot-16/Surat, CSHH-198F/Sirsa, CSHH-198M/Sirsa, CSHH-243F/Sirsa, CSHH-243M/Sirsa, Khandwa-4, HAGH-819, NO-2, CPD-817, CPD-814, CPD-821, BCS-23, CPD-745, ADB-39, HLS-321729, RDT-1, RDT-3EC560438, FQT-1, FQT-2, FQT-3, 543407A03N111, 543408A03N112, 543409A03N119, 543410A03N120, 543412A03N122, 126618, 141667 Pee Dee-695, 126619, RDT-6, RDT-7, RDT-25, RDT-26, RDT-10, RDT-11, RDT-12, RDT-13, RDT-14, RDT-15, RDT-16, RDT-17, RDT-19, RDT-20, RDT-21, RDT-22, RDT-28, RDT-32, RDT-33, RDT-34, RDT-35, RDT-36, RDT-37, RDT-39, RDT-41, NH-2211, NH-111/1, JK-119, CPD-425, PRS-74, CPD-468, CPD-436, CPD-423, CPD-433, AH-107, ACP-71, CPD-435, CPD-418, CPD-476, CPD-420, RAS-303, CPD-467, Sharada, CPD-475, CPD-448, Pusa-2-93, CPD-445, PS-20-2-1, CPD-466, CPD-431, CPD-465, CPD-469, CPD-464, CPD-446, CPD-443, CPD-457, CPD-460, CPD-463, CPD-461, CPD-470, C-6030-P1, C-6030-P5, C-6030-P3, C-6030-P4, C-6030-P2, C-6030-P8, GPDWD622, GPDWD623, GPDWD624, GPDWD627, GPDWD628, GPDWD629, GPDWD630, SEC-6.
Susceptible	IC356543 (A678), IC35700 (Coker 100 Stable), IC357226 (EWLSxTide water sp), IC35701 (Coker 417-68), IC356780 (B58-1290), IC358790 (SRT 1), EC138566 (Coker 310), EC128334 (Steninile-20), IC359047 (Soubagya), IC357599-Limkard-57, EC137805-Stonelive-213, EC559023, EC559031, EC560321, EC560323, EC560324, EC560349, EC560350, EC560350, EC560354, EC560356, EC560359, EC560360, EC560369, EC560371, 543381A02N82, 543383A03N84, 543390A03N91, 543397A03N100, 543400A03N103, 543401A03N104, 543369A02N59, 543373A02N67, 543379A02N78, 543380A02N80, 543402A03N105, 543405A03N108, 543406A03N109, EC559023, EC560325, EC560342, EC560350, EC560354, EC560356, EC560359, EC560360, EC560369, EC560375, EC560377, EC560385, EC560386, EC560388, EC560397, EC560413, EC560424, EC560432, EC560433, EC560435, EC560437, FQT-4, FQT-7, FQT-13, FQT-18, FQT-19, FQT-20, FQT-28, FQT-29, FQT-32, FQT-24, FQT-34, FQT-35, FQT-36, FQT-37, FQT-39, Vikram, MCU-13, T-7, Sumangala, CCH-510-4, CPD-1013, BCS-23, 706m, CPD-745, HBS-101, HBS-124, ADB-39, CPD-2007-B, CPD-1050, CPD-1019, CPD-821, CPD-812, HAGH-101, HAGH-148, HAGH-819, ARB-760, DTC-72-4, RDT-4, RDT-5, RDT-8, RDT-9, RDT-23, RDT-27, RDT-29, RDT-30, RDT-31, RDT-38, RDT-42, RDT-40, CPD-426, CPD-419, DRC-305, CPD-436, CPD-435, CPD-428, CPD-429, CPD-437, CPD-418, CPD-432, CPD-447, CPD-424, CPD-462, C-6030-P7, C-6030-P8, C-6030-P9, GPDWD625, GPDWD626

Table 2: Performance of selected *G. hirsutum* germplasm lines for yield and related traits for protected condition over unprotected condition during 2012-13

Genotype	Plant height (cm)			No. of monopodia			No. of sympodia			No. of bolls			Seed Index (g)		
	P	UP	% diff	P	UP	% diff	P	UP	% diff	P	UP	% diff	P	UP	% diff
IC358782	77.50	74.00	4.73	2.00	1.57	27.39	9.40	8.90	5.62	1.90	1.70	11.76	9.85	9.26	6.37
IC358790	68.53	63.80	7.41	1.22	0.95	28.42	13.00	12.00	8.33	2.30	2.05	12.20	9.10	8.15	11.66
EC138566	71.20	68.20	4.40	1.40	1.20	16.67	12.60	12.15	3.70	2.00	1.74	14.94	9.05	9.00	0.56
IC359047	67.60	58.80	14.97	2.05	1.85	10.81	12.60	12.00	5.00	1.70	1.48	14.48	9.12	9.05	0.77
IC35799	68.50	65.30	4.90	1.35	1.30	3.85	11.00	10.60	3.37	1.90	1.72	10.14	8.90	8.60	3.49
EC137805-	76.75	75.60	1.52	1.35	1.30	3.85	11.40	10.80	5.56	2.50	2.45	2.04	9.80	9.30	5.38
543372A02N65	73.00	71.85	1.60	1.44	1.26	14.29	13.50	12.95	4.25	2.10	1.95	7.69	8.95	8.70	2.87
543377A02N76	71.85	71.70	0.21	1.40	1.32	6.06	11.80	11.60	1.72	3.50	3.32	5.42	9.67	9.12	6.03
543416A03N132	87.53	83.50	4.83	1.23	1.20	2.50	12.40	11.75	5.53	2.80	2.65	5.66	10.00	9.22	8.46
543417A03N133	71.00	70.00	1.43	1.32	1.30	1.54	10.90	10.55	3.32	1.85	1.71	8.19	9.20	8.89	3.49
EC560433	80.10	78.50	2.04	1.44	1.20	20.00	12.60	12.00	5.00	2.20	1.945	13.11	10.37	8.99	15.35
FQT-28	93.24	85.50	9.05	1.22	1.20	1.67	11.80	10.90	8.26	2.60	2.36	9.94	9.30	8.20	13.41
FQT-35	72.40	69.70	3.87	0.87	0.76	14.47	12.30	11.50	6.96	1.01	0.90	12.22	9.05	8.30	9.04
FQT-36	80.30	80.10	0.25	1.10	1.01	8.91	10.80	10.60	1.89	2.80	2.62	6.87	9.50	8.75	8.57
SEC-6	81.32	76.95	5.68	1.40	1.33	5.26	11.80	11.50	2.61	3.90	3.10	25.81	9.75	8.40	16.07
CPD-1015	76.54	71.00	7.80	1.40	1.34	4.48	13.50	12.80	5.47	2.20	2.10	4.76	9.45	9.20	2.72
ADB-39	89.70	86.70	3.46	1.40	1.30	7.69	11.90	10.10	17.82	2.50	2.35	6.38	9.30	8.57	8.52
RDT-1	79.00	75.90	4.08	1.39	1.30	6.92	10.80	8.99	20.13	1.20	1.02	17.65	9.45	8.70	8.62
RDT-31	54.62	52.70	3.64	1.00	0.90	11.11	8.70	8.20	6.10	2.20	2.10	4.76	10.30	9.00	14.44
CPD-425	62.30	54.30	14.73	1.11	0.92	20.65	10.90	10.35	5.31	2.80	2.41	16.18	9.35	7.90	18.35
Sahana	73.25	70.80	3.46	1.30	1.27	2.36	12.60	11.50	9.57	3.07	2.57	19.22	9.90	9.70	2.06
Abadita	77.70	72.00	7.92	1.50	1.41	6.38	13.70	11.60	18.10	2.60	2.50	4.00	9.35	8.80	6.25
MCU-5	88.50	86.20	2.67	1.68	1.45	15.86	13.20	12.20	8.20	3.70	3.10	19.35	9.70	8.20	18.29
Khandwa-2	84.80	77.00	10.13	1.05	0.95	10.53	11.70	11.10	5.41	2.55	2.30	10.87	8.80	8.70	1.15
Laxmi	80.60	76.30	5.64	1.75	1.55	12.90	12.50	11.15	12.11	2.50	2.25	11.11	9.85	8.95	10.06

Table 2: Cont.....

Genotype	Boll weight (g)			Seed cotton yield per plant (g)			Ginning outturn			Lint index (g)		
	P	UP	% diff	P	UP	% diff	P	UP	% diff	P	UP	% diff
IC358782	2.55	2.25	13.33	5.15	4.42	16.52	33.94	31.06	9.27	4.75	4.47	6.26
IC358790	2.01	1.65	21.82	4.91	3.98	23.37	35.14	31.18	12.70	4.82	4.16	15.87
EC138566	2.66	2.33	14.16	2.34	2.18	7.34	33.64	28.96	16.16	4.45	3.65	21.92
IC359047	2.05	1.94	5.67	3.10	2.58	20.16	35.01	34.03	2.88	4.85	4.70	3.19
IC35799	1.84	1.66	10.84	2.42	2.30	5.22	32.45	27.37	18.56	4.28	4.10	4.39
EC137805-	2.52	2.32	8.62	2.91	2.62	11.07	31.81	30.50	4.30	4.33	4.14	4.59
543372A02N65	1.88	1.56	20.51	4.05	3.77	7.43	33.91	28.28	19.91	4.57	3.95	15.70
543377A02N76	2.69	2.45	9.80	4.68	4.13	13.32	35.68	33.00	8.12	5.46	5.00	9.20
543416A03N132	2.56	2.46	4.07	2.79	2.70	3.33	33.45	31.00	7.90	5.05	4.89	3.27
543417A03N133	1.92	1.82	5.49	3.40	3.31	2.72	34.41	31.32	9.87	4.98	4.68	6.41
EC560433	2.46	2.33	5.58	4.80	4.28	12.15	36.48	31.22	16.85	6.00	5.12	17.19
FQT-28	2.57	2.25	14.22	1.93	1.66	16.27	32.70	27.01	21.07	4.52	4.11	9.98
FQT-35	2.25	2.05	9.76	2.61	2.22	17.57	31.88	28.15	13.25	4.25	4.10	3.66
FQT-36	2.14	2.00	7.00	3.80	3.23	17.65	34.17	30.19	13.18	4.87	4.80	1.46
SEC-6	2.52	2.12	18.87	4.08	3.71	9.97	35.24	29.13	20.97	5.35	4.32	23.84
CPD-1015	2.08	2.00	4.00	2.45	2.30	6.52	34.95	33.00	5.91	5.10	5.00	2.00
ADB-39	2.8.00	2.44	14.75	3.86	3.11	24.12	33.19	27.06	22.65	4.20	3.5	20.00
RDT-1	1.82	1.70	7.06	2.61	2.40	8.75	33.58	30.30	10.83	4.30	4.00	7.50
RDT-31	2.65	2.15	23.26	5.9	5.11	15.46	37.14	30.91	20.16	6.19	5.09	21.61
CPD-425	2.80	2.40	16.67	3.61	3.00	20.33	36.19	29.00	24.79	5.35	4.44	20.50
Sahana	2.25	1.88	19.68	4.69	4.55	3.08	36.82	34.00	8.29	5.72	4.48	27.68
Abadita	2.20	1.87	17.65	4.51	3.90	15.64	33.92	30.38	11.65	4.87	4.10	18.78
MCU-5	2.15	1.96	9.69	3.43	3.00	14.33	35.77	32.94	8.59	4.87	4.05	20.25
Khandwa-2	2.37	2.07	14.49	2.65	2.11	25.59	29.71	26.62	11.61	3.70	3.60	2.78
Laxmi	2.10	1.93	8.81	3.17	3.00	5.67	35.07	29.40	19.29	5.42	4.56	18.86

126 lines recorded as resistant, tolerant and susceptible respectively (Table.1). The perse performance of these different categories of lines recorded ranged variations for seed cotton yield (SCY) for eg. range for seed cotton yield for 44 jassid resistant lines is 908.50kg/ha to 3460.32kg/ha. The range for seed cotton yield in tolerant and susceptible germ plasm lines was 404.00kg/ha to 3472.00 kg/ha and 644.93kg/ha to 3358.59 kg/ha respectively. These results indicates that there is a necessity of evaluating large number of germ plasm lines to identify highly potential lines in terms of seed cotton yield and reactions to sucking pests. Generally speaking there exist negative correlation between pest resistance and yield level. However in the present study lines like EC560351, HAGH-101, EC560328, FQT-26, FQT-14, GPDWD447, EC560395, EC559023, EC560438, EC560411 recorded optimal yield than yield checks.

Performance of selected *G. hirsutum* germplasm lines for yield and related traits evaluated in protected and un-

Table 3: Classification of selected germplasm lines for thrips and jassids reaction evaluated in protected condition during 2012-13

Sl. No..	Genotypes	Thrips Reaction	Grade	Average pest load/leaf	Jassids Reaction	Grade	Average pest load/leaf
1	IC358782	Tolerant	2	1.33	Resistant	1	0.6
2	IC358790	Tolerant	2	1.33	Tolerant	2	0.67
3	EC138566	Tolerant	2	2.13	Tolerant	2	1.40
4	IC359047	Tolerant	2	2.40	Susceptible	3	1.73
5	IC35799	Tolerant	2	1.40	Tolerant	2	0.93
6	EC137805	Resistant	1	1.27	Tolerant	2	0.73
7	543372A02N65	Resistant	1	2.60	Resistant	1	0.93
8	543377A02N76	Resistant	1	1.27	Tolerant	2	0.78
9	543416A03N132	Tolerant	2	1.60	Resistant	1	0.73
10	543417A03N133	Resistant	1	1.13	Tolerant	2	0.87
11	EC560433	Tolerant	2	2.27	Tolerant	2	1.13
12	FQT-28	Tolerant	2	2.27	Tolerant	2	1.20
13	FQT-35	Tolerant	2	1.40	Tolerant	2	0.53
14	FQT-36	Tolerant	2	1.33	Tolerant	2	0.93
15	SEC-6	Resistant	1	1.20	Resistant	1	1.00
16	CPD-1015	Resistant	1	0.87	Resistant	1	0.80
17	ADB-39	Tolerant	2	2.40	Tolerant	2	1.33
18	RDT-1	Tolerant	2	2.53	Tolerant	2	1.30
19	RDT-31	Resistant	1	2.07	Susceptible	3	2.21
20	CPD-425	Tolerant	2	2.07	Tolerant	2	0.93
21	Sahana	Resistant	1	1.20	Resistant	1	0.93
22	Abadita	Resistant	1	1.73	Tolerant	2	1.00
23	MCU-5	Resistant	1	1.73	Resistant	1	0.38
24	Khandwa-2	Resistant	1	2.20	Resistant	1	1.00
25	Laxmi	Resistant	1	0.93	Resistant	1	0.67

Table 4: Classification of selected germplasm lines for thrips and jassids reaction evaluated in un protected condition during 2012-13

Sl. No..	Genotypes	Thrips Reaction	Grade	Average pest load/leaf	Jassidss Reaction	Grade	Average pest load/leaf
1	IC358782	Susceptible	3	6.67	Tolerant	2	1.40
2	IC358790	Susceptible	3	6.80	Susceptible	3	1.53
3	EC138566	Susceptible	3	9.00	Susceptible	4	2.00
4	IC359047	Susceptible	4	9.40	Susceptible	3	2.00
5	IC35799	Susceptible	3	4.93	Susceptible	3	1.20
6	EC137805	Susceptible	3	7.60	Tolerant	2	1.20
7	543372A02N65	Tolerant	2	9.47	Susceptible	3	1.73
8	543377A02N76	Resistant	1	5.87	Tolerant	2	0.80
9	543416A03N132	Tolerant	2	7.33	Tolerant	2	1.33
10	543417A03N133	Resistant	1	6.07	Tolerant	2	1.80
11	EC560433	Susceptible	4	11.07	Susceptible	3	2.60
12	FQT-28	Susceptible	4	5.40	Tolerant	2	0.53
13	FQT-35	Susceptible	3	5.67	Susceptible	3	2.20
14	FQT-36	Resistant	1	7.07	Susceptible	3	1.93
15	SEC-6	Resistant	1	3.73	Tolerant	2	1.20
16	CPD-1015	Resistant	2	3.80	Resistant	1	1.07
17	ADB-39	Susceptible	4	6.27	Susceptible	4	2.10
18	RDT-1	Susceptible	4	5.93	Susceptible	4	1.87
19	RDT-31	Susceptible	3	10.07	Susceptible	4	3.27
20	CPD-425	Susceptible	3	7.93	Tolerant	2	1.13
21	Sahana	Resistant	1	5.33	Tolerant	2	1.33
22	Abadita	Tolerant	2	7.13	Tolerant	2	1.60
23	MCU-5	Susceptible	3	8.47	Tolerant	2	1.20
24	Khandwa-2	Susceptible	3	5.60	Resistant	1	1.40
25	Laxmi	Tolerant	2	6.27	Tolerant	2	1.13

protected condition during 2012-13

The year 2012-13 has experienced severe drought by receiving about 28 per cent less rainfall with very erratic distribution. Therefore the yield level of this experiment is very poor. The performance of protected condition over unprotected conditions was worked out to know the positive performance of the characters of protected condition over unprotected condition (Table.2). Raza *et al.* (1999), Bashir *et al.* (2001), Muhammad *et al.* (2004), Pathan *et al.* (2007), Ashfaq *et al.* (2010), Kalyan *et al.*(2012), Bharpoda *et al* (2014) conducted series of experiments in upland cotton under sprayed and un sprayed conditions for sucking pest complexes

Table 5: Comparison of jassids reactions of selected germplasm lines evaluated during 2011-12 and 2012-13

Sl. No.	Genotypes	2011-12 (P)	Seed cotton yield per ha (kg)	2012-13 (UP)	2012-13 (P)
1	543377A02N76	Resistant	2611.11	Tolerant	Tolerant
2	543416A03N132	Resistant	3194.44	Tolerant	Resistant
3	543417A03N133	Resistant	1653.60	Tolerant	Tolerant
4	CPD-1015	Resistant	1034.98	Resistant	Resistant
5	CPD-425	Resistant	798.94	Tolerant	Tolerant
6	IC358782	Tolerant	1891.11	Tolerant	Resistant
7	FQT-28	Tolerant	2534.72	Tolerant	Tolerant
8	SEC-6	Tolerant	1970.90	Tolerant	Resistant
9	IC358790	Tolerant	2717.39	Susceptible	Tolerant
10	EC138566	Tolerant	644.93	Susceptible	Tolerant
11	IC359047	Susceptible	1446.76	Susceptible	Susceptible
12	IC35799	Susceptible	1017.78	Susceptible	Tolerant
13	EC137805	Susceptible	2131.88	Tolerant	Tolerant
14	543372A02N65	Susceptible	26.19.05	Susceptible	Resistant
15	EC560433	Susceptible	3049.02	Susceptible	Tolerant
16	FQT-35	Susceptible	1051.59	Susceptible	Tolerant
17	FQT-36	Susceptible	2650.00	Susceptible	Tolerant
18	ADB-39	Susceptible	2125.00	Susceptible	Tolerant
1920	RDT-31	Susceptible	1537.04	Susceptible	Susceptible
20	RDT-1	Susceptible	1916.67	Susceptible	Susceptible
21	Sahana	Tolerant	1903.59	Tolerant	Resistant
22	Abadita	Tolerant	2292.40	Tolerant	Tolerant
23	MCU-5	Tolerant	1858.80	Tolerant	Resistant
24	Khandwa-2	Resistant	2067.63	Resistant	Resistant
25	Laxmi	Tolerant	1002.92	Tolerant	Resistant

Table 6: Resistant and susceptible germplasm lines on validation for thrips and jassids reactions evaluated during 2012-13

	Resistant	Susceptible
Jassids	CPD-1015, Khandwa-2,	ADB-39, EC138566 , RDT-1, RDT-31
Thrips	543377A02N76, 543417A03N133, FQT-36, SEC-6, SAHANA	IC359047,EC40633, FQT-28, ADB-39, RDT-1
Jassids and thrips	CPD-1015	ADB-39 and RDT-1

Table 7: Estimates of biochemical components in germplasm lines evaluated in un protected and protected condition during 2012-13

Sl. No..	Genotypes	Un protected condition					Protected condition
		Reducing sugar (mg/g)	Phenols (mg/g)	Gossypol (mg/g)	Reducing sugar (mg/g)	Phenols (mg/g)	Gossypol (mg/g)
1	IC358782	2.60	2.06	22.66	1.80	2.82	24.81
2	IC358790	2.76	2.68	23.28	1.35	3.12	29.80
3	EC138566	3.92	1.89	16.58	2.68	2.98	19.98
4	IC359047	2.60	3.00	17.12	2.25	3.43	21.22
5	IC35799	3.52	2.13	29.82	2.68	2.98	25.20
6	EC137805	2.89	2.34	27.16	2.14	3.21	26.36
7	543372A02N65	3.32	2.04	34.52	3.01	3.05	35.23
8	543377A02N76	4.21	1.52	48.26	3.25	2.25	50.26
9	543416A03N132	4.26	1.63	31.28	4.12	3.12	33.29
10	543417A03N133	3.99	2.08	43.26	3.01	3.33	40.87
11	EC560433	4.21	1.94	18.31	2.88	2.98	18.97
12	FQT-28	2.98	2.65	13.29	2.65	2.69	19.26
13	FQT-35	2.89	2.84	22.38	1.65	3.56	23.29
14	FQT-36	3.21	2.03	49.54	2.08	3.26	54.54
15	SEC-6	1.98	3.12	56.82	1.82	4.21	66.87

and they compared the yield and yield related traits between sprayed and un sprayed conditions and concluded that yield levels of sprayed condition is more than that of the un sprayed conditions it indicates sevior yield loss is caused by sucking pests complexes.

Revalidation of pest reaction status in 2012-13 under protected and unprotected condition

Under protected condition experimental mean of thrips load was 1.70/leaf and thrips count ranged from 0.87/ leaf to 2.60/ leaf where as in unprotected condition mean thrips load was 6.91/leaf and the range observed was 3.73/ leaf to 11.07/leaf. This experimental mean of pest load in both conditions was the average record of 3 stages (60, 90 and 120 days after sowing). The presence of load of sucking pest was very high and it was good enough to screen the germ plasm lines for sucking pest reaction.

For jassids, among the germ plasm lines under protected conditions 0.98/leaf and jassids count ranged from 0.38/leaf to 2.21/leaf where as in unprotected condition mean jassids load was 1.58 /leaf and the range observed was 0.53/leaf to 3.27 /leaf. (Table 3 and 4).

In protected condition the presence of lesser pest load than unprotected condition indicates the effectiveness of pesticide sprays in reducing the insect load than unprotected condition.

In Table.5 the status of sucking pest reaction in 2011-12 under protected condition and 2012-13 both under protected and unprotected condition is mentioned. The germplasm lines basically selected based on seed cotton yield and reaction to jassids resistance. The results presents in Table.5 indicates that germplasm lines which recorded jassid resistant reaction during 2011-12 have also recorded same reaction to jassids for example 543377A02N76, 543416A03N132, 543417A03N133, CPD-1015, CPD-425. However some of them even show resistant reaction to thrips also. Generally germ plasm lines which are resistant to jassids record susceptible to thrips, but the presence of lines showing resistant/tolerant reaction to both sucking pests is more desirable. Germplasm line like CPD-1015 showed resistant to both sucking pests. So based on these three evaluations (2011-12, 2012-13 protected and 2012-13 unprotected) it has clearly differentiated resistant or tolerant and susceptible germplasm lines mentioned in Table.6 and such stable germ plasm lines for both side reaction is also mentioned.

Pathan *et al.* (2007), Muhammad (2009), Jindal *et al.* (2007), Malik, *et al.* (1986), Razaq *et al.* (2004), Ali *et al.* (2007), Kalyan *et al.*(2012), Bharpoda *et al.* (2014) recorded the pest load in different genotypes of upland cotton in both unprotected and protected conditions and concluded that the sucking pest load/leaf was more in un sprayed (unprotected) condition than the sprayed condition.

Estimates of biochemical components in un-protected and protected condition in germplasm lines

Mean of the germplasm lines for phenol content was 3.04 mg/g and 1.91 mg/g in protected and un-protected conditions respectively. Highest mean value for phenols is observed on SEC-6 (4.21 mg/g) and lowest on RDT-31 (1.98 mg/g) in protected conditions and in unprotected conditions highest mean value observed on SEC-6 (3.12 mg/g) and lowest mean value on RDT-1 (1.35 mg/g) (Table 7)

Mean of the germplasm lines for reducing sugar content was 2.41 mg/g and 3.57 mg/g in protected and un-protected conditions respectively. Highest mean value for reducing sugar is observed on 543417A03N133(4.12 mg/g) and lowest on IC358790 (1.28 mg/g) in protected conditions and in unprotected conditions highest mean value observed on RDT-1 (5.02 mg/g) and lowest mean value on SEC-6 (1.98 mg/g) (Table 7)

Mean of the germ plasm lines for gossypol content was 31.73 µg/g and 28.72 µg/g in protected and un-protected conditions respectively. Highest mean value for gossypol observed on SEC-6 (66.87 µg/g) and lowest on ADB-39 (17.84 µg/g) in protected conditions and in unprotected conditions highest mean value observed on SEC-6 (56.82 µg/g) and lowest mean value on FQT-28 (13.29 µg/g) (Table 7).

Many studies on mechanism of antibiosis for pest resistance have recorded that phenolic compounds and gossypol content is generally more in resistant germplasm lines than the susceptible germplasm lines, but on other hand presence of high reducing sugar in susceptible germplasm lines than resistant germplasm lines was recorded. It also mentioned that phenolic compounds and gossypol may act as repellent to insects, to bring insect resistance in such genotypes.

Rhoades and Cates, 1976; Van Sumere *et al.*, 1975, Bhaskaran *et al.* (1925) Ram Singh and Agarwal (1988), Rana and Manzoor Ahmad (1990). Acharya *et al.* (2008), Butter *et al.* (1992) and Rohini *et al.* (2011) studied biochemical estimates like gossypol content, phenol content and reducing sugar content and reported about the role of biochemical components in resistance mechanism for pests. And also concluded that phenol and gossypol content is more in resistant genotypes than the susceptible once.

Germplasm lines which exhibiting resistance or tolerance mechanism to biotic stresses like pest and diseases can be used in introgression breeding for development of superior hybrids or varieties.

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