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RELATIVE RESISTANCE OF SOME COTTON CULTIVARS AGAINST INSECT PESTS WITH REFERENCE TO PHYSICO-CHEMICAL CHARACTERS

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Sixteen varieties/advanced lines of cotton were tested at Faisalabad for their relative resistance against insect pests complex of cotton with reference to physico-chemical factors, like number of hairs on leaf vein and leaf lemina, length of hair, number of gossypol glands on various plant parts, total minerals, Ca, Fe, K, Mg, protein, fats and reducing sugars in the leaf tissue. Out of these varieties, AU-14 proved comparatively resistant to cotton Jassid whereas NL-11-62-1, Stone Ville 731-N and CIM-10 were very susceptable to it. The varieties did not reveal any significant difference among themselves with regard to whitefly and thrips populations. The minimum number of cotton aphids/leaf was recorded on Stone Ville 731-N whereas it was maximum on MNS-79.

Maximum attack of pink bollworm was on MNS-79 and was minimum on NL-11-62-1, MNH-49, CIM-10 and A-89/FM. Maximum number of hibernating larvae were found in the seeds of NL-11-62-1, whereas it was minimum in MNH-93.

The spotted bollworm attack was minium on MNH-93 and maximum on CIM-10. AU-14 gave the highest yield. Jassid was observed to be the key pest having negative correlation with yield.

INTRODUCTION

Cotton crop is attacked by a number of insect pests of which cotton jassid, cotton whitefly, pink and spotted bollworms are very important in Pakistan. Work done on varietal resistance of cotton against insect pest complex in the past has shown that hairy cotton varieties were attacked more by thrips (Wardle & Simpson, 1927), aphid (Peat, 1928; Karimullah, 1978) and whitefly (Omran & El-Khidir, 1978) but were resistant to jassid (Afzal eand Ghani, 1953) and PBW (Smith *et. al.* (1975).

Varieties resistant to jassid, irrespective of hairiness character, have also been reported to contain greater amounts of lipids, total minerals, silica, iron and magnesium whereas varieties susceptible to this insect were high in reducing sugars, (Riaz *et al.*, 1986) and the varieties resistant to PBW possessed high gossypol contents (Agarwal *et al.*, 1978).

The present studies were plan-

ned with a view to finding out the reponse of different varieties of cotton to insect pests attack and to determine the relative role of physico–chemical factors in contributing resistance/susceptibility.

MATERIALS AND METHODS

The experiment was laid out in Randomized Complete Block Design in three replications, at the University of Agriculture Faisalabad, by cultivating 16 promising cotton varieties advanced lines viz., A–89/FM, AU–14, AU–59, B–90, B–161, B–183, B–193, B–557, CIM–10, LH–62, MNH–49, MNH–93, MNS–79, NL–11–62–1, Rachna and Stone Ville 731–N. Populations of *Amrasca devastans* (Dist.), *Bemisia tabaci* (Gennadius), *Aphis gossypii* (Glov.), *Thrips tabaci* (Lind.) and per cent damage by *Pectinophora gossypiella* (Saund.), *Earias insulana* (Boisd.) and *E. fabia* (Stoll.) on these varieties of cotton were recorded. The bio–physical and chemical characters of these varieties were also studied and cotton yield recorded.

a. Bio–physical characters: Hair density and length on leaf vein (per cm length) and leaf lamina (3 mm^2), number of leaf nectaries and gossypol glands (3 mm^2) and nature of brackets were record.

b. Chemical characters: These included cell sap acidity, water, minerals, fat contents, proteins and reducing sugars in the leaves. Water percentage in the leaves was determined by drying them in the oven at 110–120°C to a constant weight. The cell sap acidity of the fresh leaves was observed with the help of pH meter.

Total mineral percentage in leaves was determined by burning to ashes three grammes of ground leaves in the muffle furnace at 550°C, firstly for 6 hours, followed by another 3 hours. Calcium, iron, magnesium, phosphorus and potassium in the leaves were determined by digesting one gm dried and ground leaves in the mixture of nitric acid (20 ml) and perchloric acid (10 ml), on the hot plate, till the material become clear and light dreenish white. Calcium and potassium were determined with Atomic Absorption Spectrophotometer and phosphorus with Unicam spectrophotometer. Fat contents were estimated using Soxhlet's extraction apparatus while protein was determined with Kjeldahl apparatus and reducing sugars were determined following Ting (1956).

The data recorded were subjected to analysis of variance technique and Duncan's Multiple Range Test as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The variety AU–14 was found to be comparatively more resistant to jassid with an average population of 1.15 insects per leaf followed by AU–59, MNS–79, B–557, B–183, MNH–93, B–193, B–161 and MNH–49 with per leaf population ranging from 1.43 to 2.04 (Table 1). These varieties, however, did not differ significantly from one another at 0.05 probability level. The most susceptible group of varieties included NL–11–62–1, Stone Ville 731–N and CIM–10 with an average jassid pop-

TAble 1. Cotton insect population/damage and yield

Variety	Per leaf population of sucking insects				Bollworm damage (percentage)				
	Jassid	Whitefly	Thrips	Aphids	Flowering stage	PBW	SBW	Total boll damage (PBW+SBW)	Yield per plot (Kg)
AU–14	1.15 a	0.54NS	0.18NS	17.77 b–d	7.77[NS]	4.16 fg	34.19 f	38.32 f	0.75 a
AU–59	1.43 a	0.63	0.22	14.49 b–d	11.48	2.87 g	39.79 e	42.66 f	0.49 ab
MNS–79	1.58 a–c	0.49	0.14	21.80 d	12.08	15.02 a	23.25 g	38.27 f	0.35 b
B–557	1.59 a–c	0.56	0.23	11.33 a–d	8.18	10.85 bc	66.68 bc	77.52 b	0.40 b
B–183	1.64 a–c	0.69	0.40	10.91 a–d	10.03	4.01 fg	25.97 g	29.96 g	0.58 ab
MNH–93	1.70 a–d	0.52	0.20	18.78 c–d	9.95	0.00 h	31.48 f	31.47 g	0.50 ab
B–193	1.73 a–d	0.74	0.28	20.30 d	13.91	8.90 de	39.65 e	29.96 g	0.57 ab
B–161	1.86 a–d	0.65	0.25	10.91 a–d	12.89	7.48 e	33.83 f	41.31 f	0.55 ab
MNH–49	2.04 a–d	0.75	0.40	12.71 a–d	9.73	0.00 h	48.11 d	48.11 e	0.49 ab
Rachna	2.25 b–d	0.56	0.19	12.59 a–d	13.39	7.60 e	70.51 b	78.11 b	0.45 ab
LH–62	2.44 cd	0.47	0.24	8.54 a–c	6.12	4.87 f	64.45 c	68.60 c	0.32 b
B–90	2.46 cd	0.83	0.21	6.85 a–b	15.28	10.26 cd	51.30 d	61.56 d	0.34 b
A–89/FM	2.67 cd	0.58	0.31	15.11 b–d	5.70	0.00 h	47.61 d	47.61 e	40.34 b
NL–11–62–1	2.93 e	0.45	0.17	4.82 a–b	13.81	0.00 h	78.33 a	78.33 b	0.01 c
Stoneville 731–N	3.51 ef	0.40	0.31	1.91 a	8.33	12.63 b	79.50 a	92.13 a	0.01 c
CM–10	3.77 f	0.74	0.14	6.35 a–b	13.56	0.00 h	81.77 a	8.77 b	0.03 c

Variety marked with the same letter do not differ significantly from one another.

ulation ranging from 2.93 to 3.77 per leaf. Jassid population ranging from 2.25 to 2.67 per leaf was found on Rachna, LH–62, B–90 and A–89/F.M. Anonymous (1979) also found AU–14 followed by AU–59 comparatively resistant to jassid. The variety AU–14 had the highest number of 221 hairs per cm of leaf vein and the lowest number of 101.3 hairs per cm on CIM–10, leaf vein. AU–14 was followed by AU–59, MNS–79, MNH–93, MNH–49, B–557, B–183 and B–193 with hair density ranging from 186.0 to 212 per cm. on leaf vein. In the most susceptible group, the hair density ranged between 101.3 and 128. The hair density in the group including Rachna, LH–62 and A–89/FM ranged between 146.6 and 166.3 per cm. (Table 3). Except B–557 (186/cm) and MNH–49 (204/cm), a negative correlation exists between jassid population and hair density. A close examination of other factors, however, show no correlation with jassid population. The results are similar to that of Afzal and Ghani (1953) and Batra and Gupta (1974). However, Agarwal *et al.* (1978) reported that resistance was not governed by any single mechanism but that several physical and biochemical factors combine and complement one another to produce it.

The varieties under trial did not differ significantly from one another in respect of resistance to cotton whitefly and thrips. In general the white fly population was higher on hairy varieties. However, it does not seem true in case of CIM–10 which had the lowest hair density on leaf vein and leaf lamina. Therefore, some other characters in combination with hairiness might be the cause of the preferential behaviour of whitefly for hairy varieties. Smooth leaved varieties had comparatively low population of thrips per leaf. Wardle and Simpson (1927) also reported similar results.

Stone ville 731–N was found to be the most resistant variety against aphid (1.91 aphid per leaf) followed by NL–11–62–1 (4.82) and CIM–10 while MNS–79 was found to be the most susceptible variety with 21.80 aphids per leaf, followed by B–193 (20.30), MNH–93 (18.78) and AU–14 (17.77). Further, varieties having comparatively low population of aphid, had lesser number of hairs on leaf vein and leaf lamina compared to the susceptible ones. Peat (1928) also reported that hairly cottons suffered more than glabrous ones from aphid attack. Karimullah (1978) reported contrary results in this respect. In the present study, it has been found that less susceptible varieties had comparatively lower percentage of total minerals and higher quantities of total reducing sugars (Table 2).

At flowering stage, the spotted bollworm infestation (5.70 to 15.28%) did not differ significantly on different varieties. However, with regard to total boll damage by bollworms, the varieties differed significantly among themselves. Stone Ville–731–N showed significantly highr damage (92.13%) followed by a group of four susceptible varieties (CIM–70, NL–11–62–1, Rachna and B557) which did not differ significantly from one another (infestation ranging from 81.77 to 77.53%)

Table 2. Chemical characters of cotton leaf

Variety	Water in leaf (%)	pH of cell sap	Total minerals in leaf (%)	Ca m. eq per 100 g	Fe (%)	K m. eq per 100 gm	Mg m. eq per 100 gm	P (%)	Protein in leaf (%)	Fats in leaf (%)	Total reducing sugars in leaf
A–89/F.M.	70.6	5.8	12.53	142.8	0.12	37.63	42.20	2.18	24.50	5.96	5.27
AU–14	70.6	5.5	15.15	117.7	0.17	34.88	67.40	2.02	26.03	4.87	5.00
AU–59	69.8	5.6	14.88	155.4	0.15	35.70	34.60	1.87	26.03	3.99	4.16
B–90	71.71	5.55	13.60	142.7	0.16	37.63	37.20	1.73	24.72	5.30	5.61
B–161	77.0	5.70	12.91	147.0	0.16	29.82	23.0	1.79	20.34	5.47	5.88
B–183	69.5	5.40	12.90	134.4	0.24	31.50	50.60	1.73	27.53	4.46	5.72
B–193	70.0	5.5	14.47	151.20	0.10	35.70	63.80	1.97	23.19	6.18	6.44
B–557	70.4	5.65	13.35	138.6	0.15	35.70	26.40	2.02	26.03	5.82	5.83
CIM–10	71.3	5.65	12.15	117.6	0.07	36.67	57.40	2.02	24.72	4.97	5.44
LH–62	74.4	5.85	13.44	138.0	0.12	37.63	46.40	1.84	16.63	4.46	5.94
MNH–49	69.57	5.70	13.33	147.0	0.20	34.86	51.0	1.92	19.69	4.46	5.50
MNH–93	58.6	5.60	15.64	159.6	0.17	36.67	45.40	1.82	20.78	7.93	5.50
MNS–79	69.70	5.70	14.64	138.6	0.15	35.70	41.40	2.02	26.53	4.82	5.72
NL–11–62–1	71.0	5.85	12.61	130.2	0.17	35.70	24.80	2.25	24.04	3.73	6.72
Rechna	70.6	5.60	14.85	147.0	0.17	37.63	28.0	1.99	26.78	4.72	5.83
Stone ville 731–N	69.17	5.65	11.75	126.0	0.10	36.67	44.0	2.02	24.72	4.81	6.66

Table 3. Physical characters of cotton varities

Variety	Hairiness (No.)		Length of	No. of	No. of gossypol glands per 9 m m^2 on				Nature
	Hair per cm. leaf vein	Hair per 9 $m.m^2$ leaf lamina	hairs of leaf vein (Micron)	leaf Nec- taries	Leaf	Bract	Sepal	Locule	of Bracts
A-89/F.M.	147	45.3	1158.3	3.0	12	3	4	0	closed
AU-14	221	54.0	1163.3	3.0	7	4	7	3	closed
AU-59	212	51.0	1915.0	2.0	5	3	14	0	closed
B-90	172	60.3	1153.3	2.0	8	2	4	2	closed
B-161	184	33.6	1260.0	1.3	20	8	15	4	closed
B-183	182	37.3	1422.3	1.7	7	3	10	1	closed
B-193	201	63.7	1396.6	3.0	6	3	8	3	closed
B-557	186	57.3	1278.6	1.7	11	2	10	4	closed
CIM-10	101	35.3	1433.3	1.0	92	4	16	4	closed
LH-62	166	49.6	1141.6	1.7	6	0	6	0	closed
MNH-49	204	52.0	1231.6	3.0	8	3	18	2	closed
MNH-93	206	61.6	1300.0	3.0	9	7	6	9	closed
MNS-79	208	65.3	1291.6	3.0	3	3	15	0	closed
NL-11-62-1	128	39.6	1005.0	1.0	14	2	7	3	closed
Rechana	159	40.3	1496.5	2	6	2	14	0	closed
Stone ville 731-N	106	30.3	631.6	0.7	5	3	7	2	closed

LH–62 and B–90 having 68.60 and 61.56% infestation differed significantly from each other and from the rest of the varieties. B–90 (29.96%) and MNH–93 (31.47%) showed a minimum damage.

The highest population of 7.5 PBW larvae per 100 cotton seeds, was found in the seeds of MNS–79 followed by AU–59, B–90 and B–193. However, no physical or chemical plant character appears to have some relationship with hibernating PBW larval population. These results sre similar to those of Smith *et al.* (1975) but are at variance with the findings of Agarwal *et al.* (1976) who reported that absence of bracts or nectaries and smooth leaves are some of the main factors contributing to resistance against pink bollworm. While considering the chemical characters of the plants, the susceptible varieties have lesser amount of total minerals, proteins and higer amounts of total reducing sugars,

The over view of results show that jassid was the key pest of cotton which affected the yield of the crop. The sequence of varieties in respect of yield is almost the same as that in case of jassid population, i.e. lesser the jassid population, more the cotton yield and vice versa.

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