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Host plant resistance against sesame leaf webber and capsule borer, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera)

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A study was conducted to identify a resistance source against sesame leaf webber and capsule borer, *Antigastra catalaunalis* (Dup.) among 43 sesame genotypes under field and laboratory conditions. The reaction of genotypes was categorized using 0 to 9 scoring methodology. The genotypes KMR 14 and TKG 22 were found as moderately resistant with the score of 3 and grade 5 while SI 250, ES 22 and UMA were rated to be resistant with the score 1.6 and grade 3. Among 23 genotypes tested for biophysical (non-preference) and biochemical basis (antibiosis) of resistance three genotypes *viz.,* ES 22, UMA, SI 250 and KMR 14 were identified as less preferred for oviposition with the lowest number of eggs laid on UMA. The egg laying of *A. catalaunalis* was positively correlated with the trichome density on the leaf. The low growth index of *A. catalaunalis* in the resistant genotypes ES 22, SI 250 and UMA indicates the presence of antibiosis mechanism in the genotypes. Hence, these genotypes could be used as resistant source in hybridization programmes for transferring leaf webber and capsule borer resistance.

Key words: Sesame genotypes, screening, non-preference, antibiosis, *Antigastra catalaunalis.*

INTRODUCTION

Sesame (*Sesamum indicum* Linn.) from family Pedaliaceae, is an old and important oilseed crop being cultivated in tropics, subtropical region of India and other parts of world. It gained impetus because of high quality edible oil, rich source of carbohydrate, protein, calcium and phosphorous (Seegeler, 1983) and it also known as “queen of oil seeds”. It is also used in confectioneries, cookies, cake, margarine and bread making. The oil is used in the manufacture of soaps, cosmetics, perfumes, insecticides and pharmaceutical products. The cake is also used in compounding livestock feed (Mbah and Akueshi, 2009). India ranks first in area under cultivation but the productivity of sesame is very low (332 kg/ha) as compared to the world average (389 kg/ha) (Singh, 2003). The states Rajasthan, Maharastra, Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Uttar Pradesh, West Bengal, Orissa, Punjab and Tamil Nadu are the major sesame growing states in India. Other major sesame producing countries are China, Myanmar, Sudan, Uganda, Nigeria, Pakistan, Ethiopia and Bangladesh (Ogbonna and Umar-Shaba 2012). There are various factors responsible for poor yield of sesame in India; with respect to this, insect pests are of prime importance. The pest attack tolls a heavy loss (25 to 90%) in seed yield (Ahuja and Kalyan, 2002). Among the various insect pests, the sesame leaf webber and capsule borer, *Antigastra catalaunalis* Duponchel (Lepidoptera: Pyraustidae) was the potential constraint toproduction from seedling stage to maturity (Choudhary et al., 1987; Selvanarayanan and Baskaran, 1996). Management of this pest using insecticides though effective is discouraged in view of environmental

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Table 1. Methodology for scoring sesame genotypes for *A. catalaunalis* resistance.

Score chart			
Per cent damage (Mean of three replications)			
Leaf (A)	**Flower bud (B)**	**Pod (C)**	**Cumulative Score (A+B+C)/3**
0 – 10	0-5	0-2	1
10 - 20	5-10	2-4	3
20 - 30	10-15	4-6	5
30 - 40	15-20	6-8	7
>40	20	8	9

considerations (Rai et al., 2002) and adverse effect of insecticides on non-target organisms. Cultivar resistance has been recognized as the most desirable and economic tactic in the management of *A. catalaunalis* and is the best alternative to synthetic insecticides, providing an eco-friendly, environmentally safe strategy for effective management of *A. catalaunalis* (Dup) in sesame. The potential value of genetic diversity of *Sesamum* spp. is often exploited by breeders to develop insect resistant cultivars or for enhancing yield attributes. It can be integrated into ecologically sound integrated pest management programmes. In this context, the present study aimed at identifying the probable source of resistance to *A. catalaunalis* in diverse sesame genotypes.

MATERIALS AND METHODS

Field screening methodology

The 43 sesame entries were collected from Regional Research Station, Virddhachalam, Tamil Nadu, India and Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry, India to study their susceptibility and resistance level against the leaf webber and capsule borer *A. catalaunalis.* The field screening trials were set up in a Randomized Complete Block Design (RCBD) with three replications. Each genotype had three rows (fifteen plants per row and each row were treated as a replication) with plant spacing of 30 x 30 cm in 4.5 x 3 m plots. A row of the susceptible check TC 25 was planted at every 5 m of experimental field or after every 12 rows of plants to create an attractive environment for leaf webber infestation. The recommended crop management practices were followed uniformly except plant protection. Observation of leaf, flower and pod damage was recorded at 30, 45 and 60 days after sowing from the five selected plants per replication and 15 plants per genotype. The percent damage was calculated at each developmental stage of the crop according to the equation.

$$\text{Per cent leaf / flower / pod damage} = \frac{\text{Number of damaged leaf/flower/pod}}{\text{Total number of leaf/flower/pod}}$$

The reaction of genotypes against *A. catalaunalis* was categorized by using 0-9 scoring methodology (Tables 1 and 2) as described by Sridhar and Gopalan (2002). The genotypes that showed promising reaction were taken for the non-preference and antibiosis studies. Out of 43 genotypes 23 genotypes were selected to study the biophysical and biochemical basis of resistance.

Ovipositional preference

The genotypes were sown inside a wire net cage under controlled conditions with temperature of 25±1°C and 80-85 RH (12 h photo and 12 h scotophase). Fifteen days after emergence of plants, a small transparent Mylar cage (20 × 10) cm was used to cover the single sesame plant. Each genotype was replicated three times. A pair of mated adults was released into Mylar cage and moth was replaced if any death occurred within five days. Cotton soaked with 10% honey solution was placed inside the Mylar cage to provide the adequate nourishment to the egg laying adults. The number of eggs laid was recorded consecutively for five days from the date of release.

Estimation of trichomes

To examine the trichome density, the second leaf from the tip of 25 days old plants was sampled in each genotype. Standard procedure for obtaining clear leaves for microscopic study was adopted for the observation of leaf trichome density as described by Maiti et al. (1980).

Assessment of antibiosis

Individual sesame lines were sown inside a wire net cage. Fifteen days after the emergence of plants, five newly emerged larvae from the laboratory culture were transferred to each plant with the help of a moist camel hair brush. The individual plants were covered with Mylar film cage. Each accession was replicated three times. The observations on larval and pupal development and weight were recorded from the date of release of larvae till pupation at two day intervals. Growth indices were calculated by dividing the percent pupation with average larval period as described by Sridhar and Gopalan (2002).

$$\text{Growth index} = \frac{\text{\% pupation}}{\text{Average larval duration}}$$

RESULTS AND DISCUSSION

The infestation of *A. catalaunalis* was observed from early vegetative phase to pod maturation phase and none of the genotypes were free from attack by the leaf webber and capsule borer. Among the 43 genotypes, SI 250 and ES 22 were categorized as resistant by securing a score of 1.6 with corresponding grade 3. The results are in conformity with Baskaran et al. (1994); Ahuja and Kalyan (2001); Manisegaran et al. (2001) and Singh (2002). The genotypes KMR 14 and TKG 22 were recorded as moderately resistant with grade 5 (Table 3). The

Table 2. Methodology for grading sesame genotypes for *A. catalaunalis* resistance.

Grade chart		
Cumulative score	**Grade**	**Degree of resistance**
0 – 1	1	Highly resistant (HR)
1.1 – 2	3	Resistant (R)
2.1 – 3	5	Moderately Resistant (MR)
3.1 – 5	7	Susceptible (S)
5.1 – 9	9	Highly Susceptible (HS)

Table 3. Reaction of sesame genotypes against leaf webber and capsule borer, *A. catalaunalis.*

S/No	Genotype	Leaf damage (%)	Score	Flower damage (%)	Score	Pod damage (%)	Score	Mean score	Grade	Reaction
1	PKDS 40	26.97(31.29)^{df}	5	29.14(32.67)^{rs}	9	17.45(24.69)^{opq}	9	7.6	9	HS
2	MACSS 1	22.82(28.54)^{lmn}	5	15.12(22.88)^{ij}	7	15.34(23.06)^{nop}	9	7	9	HS
3	LTK 4	10.89(19.26)^{b}	3	26.67(31.73)^{r}	9	20.13(26.66)^{q}	9	7	9	HS
4	TKG 201	27.00(31.30)^{p}	5	18.32(25.34)^{klmn}	7	8.01(16.44)^{hijk}	9	7	9	HS
5	TKG 356	11.25(19.59)^{bc}	3	12.19(20.39)^{fg}	5	6.48(14.74)^{bcd}	7	5	9	HS
6	TKG 314	16.00(23.57)^{gh}	3	9.93(18.36)^{de}	3	5.88(14.03)^{bc}	5	3.6	7	S
7	TC SI-94-20	10.98(19.33)^{b}	3	5.31(13.31)^{a}	3	5.97(14.14)^{bc}	5	3.6	7	S
8	MT-19-03	23.79(29.18)^{o}	5	20.65(27.02)^{no}	9	11.25(19.59)^{ijkl}	9	7.6	9	HS
9	MT-20-03	20.40(26.85)^{jk}	5	21.16(27.38)^{op}	9	14.69(22.53)^{mno}	9	7.6	9	HS
10	CST 2001-5	21.28(27.46)^{lmn}	5	18.20(25.25)^{klmn}	7	10.36(18.78)^{hijk}	9	7	9	HS
11	RT 341	24.43(28.95)no	5	16.15(23.69)^{ijk}	7	11.28(19.61)^{ijkl}	9	7	9	HS
12	RT 342	21.21(27.42)^{klmn}	5	12.97(21.10)^{gh}	7	11.03(19.37)^{ijkl}	9	7	9	HS
13	RT 343	20.27(26.75)^{jkl}	5	18.28(25.31)^{klmn}	7	5.92(14.04)^{bc}	5	5.6	9	HS
14	TMV 3	21.21(27.42)^{klmn}	5	17.43(24.67)^{kl}	7	9.20(17.65)^{efghij}	9	7	9	HS
15	TMV4	21.77(27.70)^{lmno}	5	17.16(24.44)^{jk}	7	9.48(17.87)^{ghij}	9	7	9	HS
16	TMV 5	21.62(27.78)^{lmno}	5	14.01(24.47)^{hi}	5	6.88(15.22)^{bcdef}	7	5.6	9	HS
17	TMV 6	23.16(28.76)^{mno}	5	20.00(26.56)^{mno}	7	8.12(16.53)^{cdefgh}	9	7	9	HS
18	VRI 1	20.61(26.99)^{klm}	5	17.62(24.81)^{klm}	7	3.44(10.65)^{a}	3	5	7	S
19	VS 9701	21.15(27.38)^{klm}	5	22.19(28.10)^{opq}	9	9.45(17.92)^{ghij}	9	7.6	9	HS
20	KS 95010	22.76(28.49)^{mno}	5	17.91(20.03)^{klm}	7	6.99(15.32)^{bcdefg}	7	6.3	5	HS
21	KMR 14	12.89(21.08)^{cde}	3	8.33(16.72)^{cd}	3	3.68(11.03)^{a}	3	3	9	MR
22	KMR 85	19.59(26.26)^{jkl}	3	21.77(27.80)^{op}	9	6.37(14.52)^{bcd}	7	6.3	9	HS
23	KMR 79	11.71(20.00)^{bc}	3	20.59(26.98)^{no}	9	5.94(14.07)^{bc}	5	5.6	9	HS
24	KMR 75	12.82(20.98)^{cde}	3	24.30(29.53)^{q}	9	8.56(16.11)^{defghi}	9	7	9	HS
25	KMR 92	17.26(24.53)^{hi}	3	19.72(26.36)^{lmno}	7	7.90(16.11)^{bcdefgh}	7	5.6	9	HS

Table 3. Contd.

26	KMR 95	13.91(21.89)^{def}	3	23.33(28.88)^{pq}	9	5.58(13.66)^{b}	5	5.6	9	HS
27	YLM 66	14.19(22.13)^{efg}	3	9.28(17.74)^{d}	3	5.67(13.74)^{b}	5	3.6	5	S
28	JCS 399	11.56(19.85)^{bc}	3	11.00(19.36)^{ef}	5	8.62(17.06)^{defghi}	9	5.6	7	S
29	TKG 306	14.13(22.07)^{efg}	3	19.94(26.51)^{mno}	7	9.43(17.87)^{ghij}	9	6.3	9	HS
30	TKG 307	18.31(25.33)ij	3	17.66(24.85)^{klm}	7	9.39(17.82)^{fghij}	9	6.3	9	HS
31	TKG 308	15.28(23.00)^{fg}	3	20.01(26.57)^{mno}	9	12.90(21.05)^{klmn}	9	7	9	HS
32	TKG 309	8.49(16.94)^{a}	1	14.26(22.19)^{hi}	5	11.36(19.68)^{ijkl}	9	5	7	S
33	TAC-89-309	13.86(21.82)^{def}	3	29.67(32.99)^{rst}	9	18.51(25.47)^{pq}	9	7	9	HS
34	MT-111	11.69(19.98)^{bc}	3	32.00(34.45)^{t}	9	15.87(23.45)^{nop}	9	7	9	HS
35	CST 2001-3	9.39(17.85)^{a}	1	14.56(22.43)^{hi}	5	13.51(21.56)^{lmn}	9	5	7	S
36	SI 250	9.28(17.73)^{a}	1	4.95(12.65)^{a}	1	3.84(11.29)^{a}	3	1.66	3	R
37	TKG 22	12.26(20.47)^{bcd}	3	8.88(17.33)^{d}	3	2.70(89.54)^{a}	3	3	5	MR
38	TC 25	20.22(26.70)^{jkl}	5	37.83(37.96)^{u}	9	10.10(18.53)^{hijk}	9	7.6	9	HS
39	DT 16-9-306	18.94(25.79)^{ijk}	3	24.58(29.72)^{q}	9	11.89(20.17)^{jlm}	9	7	9	HS
40	ES 22	9.33(17.75)^{a}	1	4.61(12.39)^{b}	1	3.73(11.13)^{bcde}	3	1.6	3	R
41	IC 42549	20.19(26.69)^{jkl}	5	31.33(34.08)st	9	9.55(15.53)^{ghij}	9	7.6	9	HS
42	ES 34	11.63(19.91)^{bc}	3	29.87(33.12)^{rst}	9	7.55(15.53)^{bcdefg}	7	6.3	9	HS
43	UMA	9.42(17.87)^{a}	1	4.24 (11.88)^{bc}	1	3.26(10.08)^{a}	3	1.6	3	R
CD(0.05)		0.91**		0.42**		0.67**				

Values in parentheses are arc sin transformed values,R- Resistant; MR- Moderately Resistant; S- Susceptible; HS- Highly Susceptible,Values in the same column followed by the same letters are not significantly different at P≤0.05.

maximum incidence of leaf webber was recorded in PKDS 40, MT-19-03, MT-20-03, VS 9701, TC 25 and IC 42549. The genotype UMA showed resistance with the score of 1.6 and grade 3.

The genotype UMA showing the least capsular borer incidence was earlier reported by Patra (2001). The lines VS 9701 and ES 22 were found to be superior for seed yield and shoot webber resistance with favourable mean performance shows these genotypes could be the good parental choice for the both the traits (Gnanasekaran et al., 2010). Significant variation (p≤ 0.05) was observed among the genotypes studied for ovipositional preference. The genotypes UMA, SI 250, TKG 22, KMR 14 and ES 22 were less preferred for oviposition compared with the susceptible check TC 25. The maximum number of eggs laid was recorded in the genotype KMR 85 (31.00) (Figure 1).

The variation might be due to the presence of antibiosis and/ or less number of trichomes in the leaf. Singh (2002) reports that the ovipositional preference of *A. catalaunalis* was nil on the genotype ES 22 and very low on SI 250. The same trend was noticed in thepresent investigation. A highly significant positive correlation (r = 0.749) (Figure 2) was noticed between the number of trichomes on the leaf and the eggs laid by the moth. The maximum numbers of trichomes were observed in the genotypes KMR 79 (n=49 /microscopic field) and KMR 85 (n=31.66/microscopic field) (Figure 1). Sridhar and Gopalan (2002) observe that the sesame genotypes susceptible to *A. catalaunalis* had higher number of trichomes on the leaf and minimum oviposition occurred on the genotypes with glabrous nature in *Sesamum allatum*. Susceptibility of hairy varieties to *A. catalaunalis* has also been reported elsewhere (Anonymous, 1996). Genotypes that had a higher density of trichomes on the leaf surface, pod and flowers exhibited less damage relative to the other genotypes reported by Singh et al. (1990). The pubescent leaf surface might have provided a better foothold for female as suggested for *Heliothis zea* (Broddie) (Callahan, 1957). Present

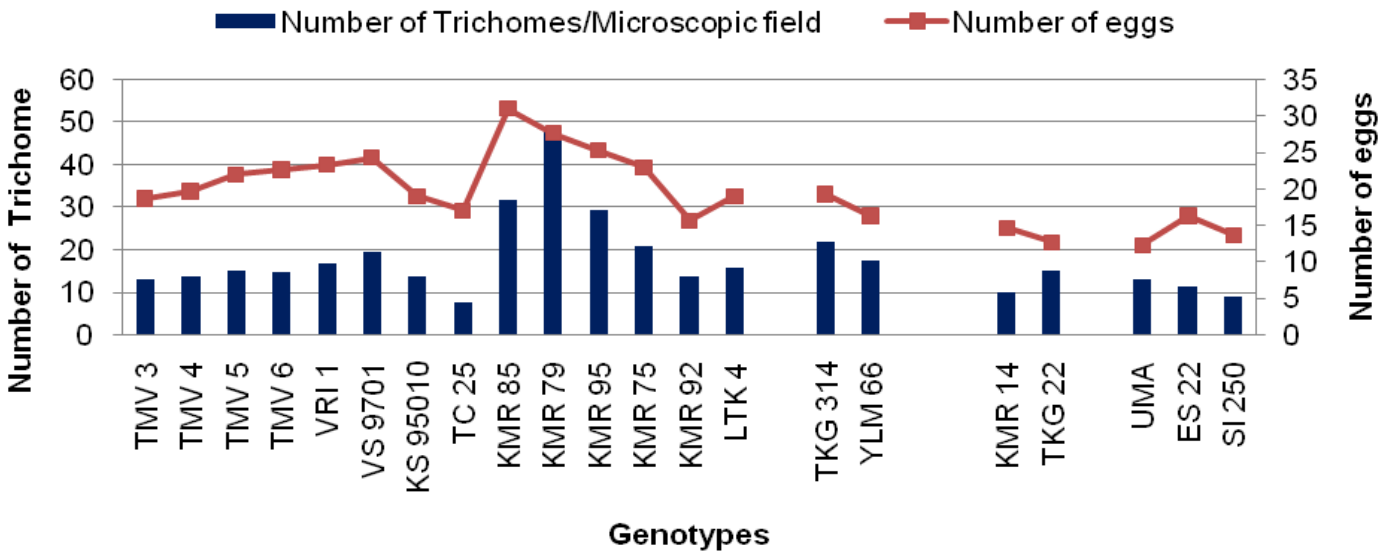

Figure 1. Mean number of Trichomes in different sesame genotypes and mean egg laid by *A.catalaunalis* (HS-Highly Susceptible; S-Susceptible; R-Resistant; MR-Moderately Resistant) **.**

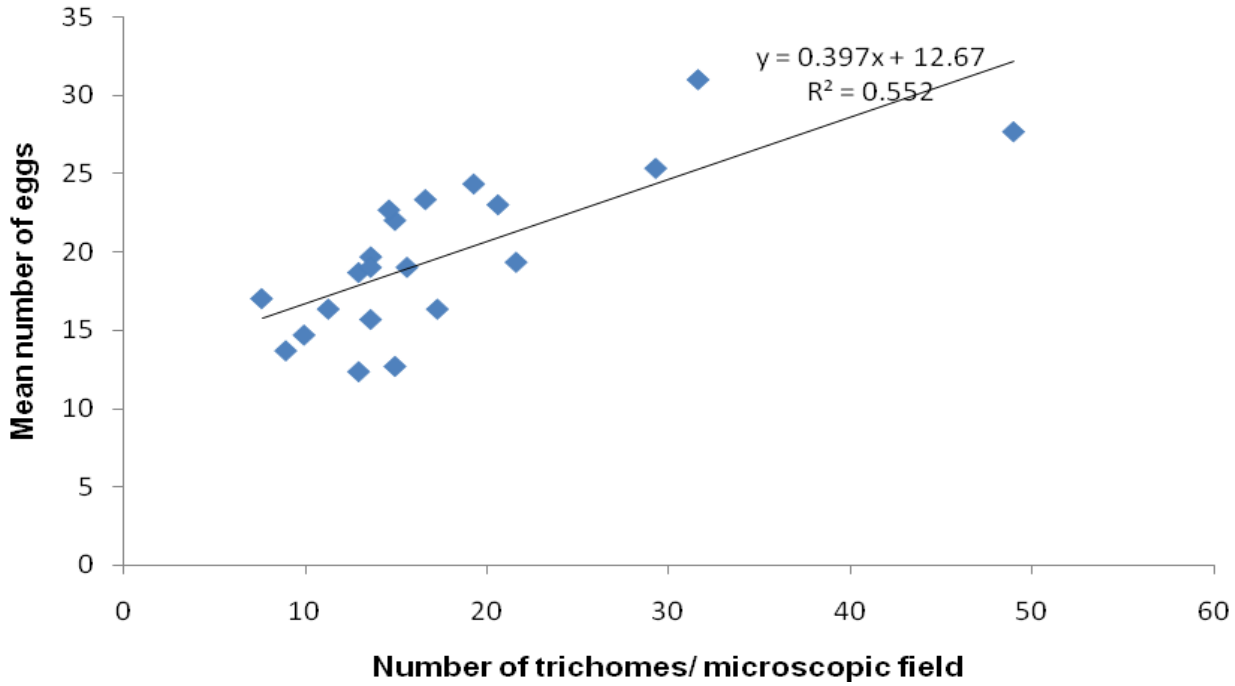

Figure 2. Relationship between the trichomes number and egg laiying of *A. catalaunalis* in sesame genotypes.

results are in conformity with the earlier studies reported. Among genotypes tested for the larval development of shoot webber, ES 22, SI 250, UMA and TKG 22 were found unsuitable exhibiting prolonged larval period, reduction in size, weight, percent pupation and growth index. This indicates that an antibiosis mechanism is at play. Highergrowth index was noticed in the susceptible genotypes TMV 3, TMV 4, TMV 5, TMV 6 and TC 25 (Table 4). The overall development of *A. catalaunalis* was highly reduced in the genotypes ES 22 and SI 250. The lesser growth index and minimum larval length, larval weight, lesser pupation rate and higher larval duration might be explained by the presence of antibiosis mechanism in the promising genotypes.

Table 4. Growth index of *A. catalaunalis* reared on different sesame genotypes.

Genotype	Larval duration (Days) (A)	Pupation rate (%) (B) rate (%)	Growth index (B/ A)	Field reaction	Genotype	Larval duration (Days) (A)	Pupation rate (%) (B) rate (%)	Growth index (B/ A)	Field reaction
	Mean of three replication of 5 observations each					Mean of three replication of 5 observations each			
TKG 314	9.40 ± 0.42^{abc}	71.42 ± 0.82^{cd}	7.59	S	SI 250	12.25 ± 0.19^{g}	35.71 ± 041^{hj}	2.91	R
YLM66	9.70 ± 0.12b^{cde}	60.00 ± 0.58^{f}	6.18	S	KMR 14	9.30 ± 0.37^{e}	66.66 ± 0.67^{e}	7.17	HS
TMV3	9.00 ± 0.27^{ab}	73.33 ± 1.15^{bc}	8.14	HS	KMR 85	10.20 ± 0.33^{de}	66.66 ± 0.88^{e}	6.53	HS
TMV4	9.10 ± 0.29^{abc}	80.00 ± 0.57^{a}	8.79	HS	ES 22	11.50 ± 0.22^{fg}	33.33 ± 0.38^{j}	2.89	R
TMV 5	9.00 ± 0.22^{ab}	78.57 ± 0.58^{a}	8.73	HS	KMR 79	9.30 ± 0.41^{abc}	64.28 ± 0.41^{e}	6.91	HS
TMV 6	9.00 ± 0.27^{ab}	76.92 ± 0.11^{ab}	8.54	HS	KMR 95	9.00 ± 0.27^{ab}	60.00 ± 0.57^{f}	6.66	HS
VRI 1	9.30 ± 0.20^{abc}	73.33 ± 0.96^{bc}	7.88	HS	KMR 75	9.50 ± 0.27^{bcd}	69.23 ± 1.29^{de}	7.28	HS
VS 9701	9.00 ± 0.22^{ab}	66.66 ± 0.78^{c}	7.41	HS	KMR 92	9.80 ± 0.25^{cde}	76.92 ± 0.54^{ab}	7.85	HS
KS 95010	9.10 ± 0.19^{abc}	71.42 ± 0.82^{cd}	7.84	HS	TKG 22	11.30 ± 0.25^{f}	38.46 ± 0.29^{h}	3.40	MR
UMA	11.30 ± 0.20^{f}	46.15 ± 0.66^{g}	4.08	R	LTK 4	9.30 ± 0.41^{abc}	66.66 ± 0.38^{e}	7.17	HS
TC 25	8.70 ± 0.34^{a}	73.33 ± 0.77^{bc}	8.42	HS					

HS- Highly Susceptible; S-Susceptible; R-Resistant; MR-Moderately Resistant; values in the same column followed by the same letters are not significantly different at p≤0.05.

According to Singh et al. (1990) the genotypes which contained smaller amounts of reducing sugar in the leaves, and higher phenol content in the leaves and flowers showed least damage. Good larval growth was noticed when the larvae fed with the susceptible check TC 25 (Singh, 2002). Sridhar and Gopalan (2002) also report the less growth index when the *A. catalaunalis* fed on the resistance genotypes. The results of this experiments revealed that the genotypes ES 22, SI 250 and UMA could be a probable source of resistance as they showed non preference, antibiosis mechanisms as well the less damage to *A. catalaunalis*.

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