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Evaluation of sesame genotypes for resistance to sesame leaf roller and capsule borer, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera)

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In this study, 43 sesame genotypes were tested against the sesame leaf roller and capsule borer *Antigastra catalaunalis* (Dup) using 0–9 scale scoring technique. The differential response of the genotypes was noticed at the various crop growth stages. The genotypes, SI 250, ES 22 and UMA showed resistance at all the three stages, i.e. vegetative, flowering and pod maturity. However, TKG 309 and CST 2001-3 showed resistance only at the vegetative stage; KMR 14 and VRI 1 exhibited resistance only at the pod maturity stage. Based on the overall grading, SI 250 and UMA genotypes were found resistant, and ES 22 was highly resistant.

Keywords: sesame; resistance; field screening; *Antigastra catalaunalis*

Introduction

Sesame (*Sesamum indicum* Linn.) from the family Pedaliaceae is an oldest and important oilseed crop being cultivated in the tropical and sub-tropical regions of India. It gained momentum because of the requirement of high-quality edible oil. It contains proteins and minerals, and also called as 'queen of oil seeds'. India ranks first in area (29%), production (26%) and export (40%) of sesame among other countries in the world (Duhoon et al. 2003). Rajasthan, Maharastra, Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Uttar Pradesh, West Bengal, Orissa, Punjab, Tamil Nadu and Puducherry are the major sesame-cultivating states in India. One of the reasons for the low productivity of this crop in India is because of the infection caused by the sesame leaf webber and capsule borer *Antigastra catalaunalis* Duponchel (Lepidoptera: Pyraustidae), which causes a heavy seed yield loss of up to 90% (Ahuja and Kalyan 2002), as it causes damage right from the seedling stage till the maturity of pod (Choudhary et al. 1987). This leaf webber feeds on tender foliage by webbing the top leaves, and bores into the flower buds and pods.

The management of this pest using insecticides has been discouraged in view of the environmental considerations (Rai et al. 2002). The export of sesame grains and oil is affected due to the presence of residues of the insecticides. Relying solely on chemical pesticides is not only ecologically unsustainable but is also becoming

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economically unviable. Host plant resistance is one of the major components of integrated pest management (IPM) as it is eco-friendly, sustainable, easy to adopt and it has been recognised as the most desirable and economic tactic in the management of *A. catalaunalis*. The potential value of genetic diversity of *Sesamum* spp. is often exploited by breeders to enhance the yield attributes. But developing insect-resistant sesame line requires good resistant genotypes, which need to be identified, to mitigate the loss caused by this pest. In this article, we report the resistance source of sesame lines to *A. catalaunalis*.

Materials and methods

Field screening

The 43 sesame entries were collected from the Regional Research Station, Tamil Nadu Agricultural University, Virudhachalam and Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, India to study their susceptibility and resistant level against *A. catalaunalis*. The experiment was conducted under randomised complete block design with three replications. Each genotype had three rows with plant spacing of 30 cm × 30 cm and 4.5 m × 3 m plot size. Row susceptible check TC 25 was planted at every 5 m of the plot or at every 12 rows of sesame plants to make an attractive environment for leaf webber infestation. The recommended crop management practices were followed uniformly except plant protection. Observation of leaves, flowers and pods' damage was recorded at 30, 45 and 80 days after sowing from the five selected plants per replication and 15 plants/ genotypes. The per cent damage was computed at each stage of crops. The performance of genotypes at different growth phases, viz. vegetative, flowering and pod formation and the overall reaction against *A. catalaunalis* was done using 0–9 scoring methodology (Table 1). The per cent leaves damaged and the internal content of capsule fed were taken for overall scoring and grading the genotypes' reaction to *A. catalaunalis* (Table 2). The intensity of feeding on capsule was quantified by calibrating per cent locule damaged, which directly affects the seed yield. The whole multicapsule was considered as 100% (Table 3). The cumulative score was worked out to categorise the entries into either susceptible or resistant (Muralibaskaran et al. 1994; Gupta 2004).

$$\text{Cumulative score} = \frac{a+b}{2}$$

Table 1. Methodology for categorising the reaction of sesame genotypes at different crop stages based on per cent mean damage.

Leaf damage	Reaction	Flower damage	Reaction	Pod damage	Reaction
0–10	R	0–5	R	0–5	R
10.1–20	MR	5.1–10	MR	5.1–10	MR
20.1–30	S	10.1–15	MS	10.1–15	MS
30.1–40	HS	15.1–20	S	15.1–20	S
		>20	HS	>20	HS

HR, highly resistant; R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible; HS, highly susceptible.

Table 2. Methodology for scoring genotypes for leaf webber and capsule borer resistance based on the intensity of damage (score chart).

Score	Leaf damage (%)	Internal content of capsule fed	Cumulative score	Grade	Category
1	0–10	0–5	0–1	1	HR
3	10.1–20	5.1–10	1–3	3	R
5	20.1–30	10.1–15	3–5	5	MR
7	30.1–40	15.1–20	5–7	7	S
9	> 40	> 20	7	9	HS

HR, highly Resistant; R, resistant; MR, moderately resistant; S, susceptible; HS, highly susceptible.

Table 3. Methodology to quantify the intensity of feeding based on locule damage.

Number of locules fed by larvae	Per cent fed
1	25
2	50
3	75
4	100

where $a =$ corresponding score for per cent leaf damage and b = corresponding score for per cent internal content of capsule fed.

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

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 the attack of leaf roller and capsule borer. During vegetative stage, the genotypes TKG 309, SI 250, ES 22, CST 2001-3 and UMA exhibited resistance reaction; ES 22, UMA and SI 250 showed resistance at the flowering phase. At pod maturation stage, the genotypes TKG 22, UMA, VRI 1, ES 22, KMR 14 and SI 250 showed resistance. However, genotypes SI 250, UMA and ES 22 exhibited resistant reaction in all the three stages (Table 4). The results revealed the variations in the expressions of reactions among the tested genotypes, and it also differed with the crop stage. The differentiation in response indicates that the factors like phytochemicals and environment also play a role in the expression of the resistance mechanism. In this study, the genotypes TKG 309 and CST 2001-3 showed resistance at the vegetative stage, but these were grouped as susceptible during flowering and maturation phases. The host evasion or escapism in the vegetative stage might be the reason for this alternating reaction. The genotypes KMR 14 and VRI 1 were categorised as resistant at the maturation stage and susceptible during the vegetative and flowering phases. This may be due to the changes in the phytochemicals, which impart resistance mechanisms. The genotypes SI 250, UMA and ES 22 exhibiting resistance at the vegetative stage as well as at the pod maturation stage (Gupta 2004) and CST 2001-3 showing tolerance to *A.*

Table 4. Field reaction of sesame genotypes to *A. catalaunalis* at different growth phases.

Genotypes	Mean damage	Reaction
I. Vegetative phase (30 days)		
TKG 309, SI 250, ES 22, CST 2001-3, UMA	0–10	R
LTK 4, TCSI 94-20, TKG 356, JCS 399, ES 34, MT-111, KMR 79, TKG 22, KMR 75, KMR 14, TAC 89–309, KMR 95, TKG 306, YLM 66, TKG 308, TKG 314, KMR 92, TKG 307, DT16-9-306, KMR 85	10.1–20	MR
IC 42549, TC 25, RT 343, MT-20-03, VRI 1, VS 9701, RT 342, TMV 3, CST 20015, TMV 5, TMV 4, KS 95010, MACSS 1, TMV 6, RT 341, MT-19-03, PKDS 40, TKG 201	20.1–30	S
NIL	30–40	HS
II. Flowering stage (45 days)		
UMA, ES 22, SI 250	0–5	R
TCSI-94-20, KMR 14, TKG 22, YLM 66, TKG 314	5.1–10	MR
JCS 399, TKG 356, RT 342, TMV 5, TKG 309, CST 2001-3	10.1–15	MS
MACSS 1, RT 341, TMV 4, TMV 3, VRI 1, TKG 307, KS 95010, CST 2001-5, RT 343, TKG 201, KMR 92 TKG 306, TMV 6	15.1–20	S
TKG 308, KMR 79, MT-19-03, MT-20-03, KMR 85, VS 9701, KMR 95, DT 16-9-306, KMR 75, LTK 4, PKDS 40, TAC 89-309, IC 42549, MT-111, TC 25	>20	HS
III. Pod maturation stage (80 days)		
TKG 22, UMA, VRI 1, ES 22, KMR 14, SI 250	0–5	R
KMR 95, YLM 66, TKG 314, TC-SI-94-20, KMR 79, RT 343, KMR 85, TKG 356, TMV 5, KS 95010, ES 34, KMR 92, TKG 201, TMV 6, KMR 75, JCS 399, TMV 3, TKG 307, VS 9701, TKG 306, IC 42549, TMV 4	5.1–10	MR
TC 25, CST 2001-5, RT 342, MT-19-03, RT 341, TKG 309, DT 16-9-306, TKG 308, CST 2001-3, MT-20-03	10.1–15	MS
MACSS 1, MT-111, PKDS 40, TAC 89-309	15.1–20	S
LTK 4	>20	HS

HR, highly resistant; R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible; HS, highly susceptible.

catalaunalis were reported by All India Co-ordinated Research Project (S&N) (2003). The results are in concordance with Muralibaskaran et al. (1994), Ahuja and Kalyan (2001), Manisegaran et al. (2001), Patra (2001) and Singh (2002). The per cent damage of the internal content of locule was least in the genotype ES 22 (4.98) followed by SI 250 (6.00) and UMA (10.92). The entries TKG 22, KMR 14, KMR 75, KMR 79, KMR 85, KMR 92, KMR 95, YLM 66, TKG 314 and TCSI-94-20 were categorised as moderately resistant. The maximum locule damage was recorded in the susceptible check TC 25 (37.14). The loss of plant growth due to leaf damage during early crop stage and direct damage on locule could be significant, while considering the yield loss caused by the leaf roller and capsule borer. In the overall grading, ES 22, UMA and SI 250 were identified as resistant with corresponding grades of 1 and 3 (Table 5). The pod borer larvae preferred to feed less on the genotypes ES 22 and SI 250; showed just nibbling of the capsule and later a cessation of feeding; both *in vivo* and *in vitro* screening confirmed the present results (Muralibaskaran et al. 1994). The results of this experiments revealed that the genotypes SI 250, ES 22 and UMA could be a probable resistance source against *A. catalaunalis*.

Table 5. Overall grading of sesame genotypes to leaf roller and capsule borer resistance.

Genotype	Leaf damage (%)	Internal content of capsule fed (%)	Mean score	Grade	Reaction	Genotype	Leaf damage (%)	Internal content of capsule fed (%)	Mean score	Grade	Reaction
PKDS 40	26.97	22.88	7	7	S	KMR 79	11.71	18.86	5	5	MR
MACSS 1	22.82	37.76	7	7	S	KMR 75	12.82	19.28	5	5	MR
LTK 4	10.89	18.72	5	5	MR	KMR 92	17.26	18.02	5	5	MR
TKG 201	27.00	28.16	7	7	S	KMR 95	13.91	17.92	5	5	MR
TKG 356	11.25	23.88	6	7	S	YLM 66	14.19	11.12	4	5	MR
TKG 314	16.00	12.38	4	5	MR	JCS 399	11.56	16.76	5	5	MR
TCSI-94-20	10.98	15.56	5	5	MR	TKG 306	14.13	23.82	6	7	S
MT-19-03	23.79	21.86	7	7	S	TKG 307	18.31	22.12	6	7	S
MT-20-03	20.40	24.68	7	7	S	TKG 308	15.28	27.84	6	7	S
CST 2001-5	21.28	32.08	7	7	S	TKG 309	8.49	24.98	5	5	MR
RT 431	24.43	32.84	7	7	S	TAC-89-309	13.86	32.84	6	7	S
RT 342	21.21	35.80	7	7	S	MT-111	11.69	28.78	6	7	S
RT 343	20.27	31.88	7	7	S	CST 2001-3	9.39	21.78	5	5	MR
TMV 3	21.21	28.12	7	7	S	SI 250	9.28	6.00	2	3	R
TMV 4	21.77	30.90	7	7	S	TKG 22	12.26	11.14	4	5	MR
TMV 5	21.62	26.06	7	7	S	TC 25	20.22	37.14	7	7	S
TMV 6	23.16	18.86	6	7	S	DT-16-9-306	18.94	28.84	6	7	S
VRI 1	20.61	30.18	7	7	S	ES 22	9.33	4.98	1	1	HR
VS 9701	21.15	31.90	7	7	S	IC 42549	20.19	32.06	7	7	S
KS 95010	22.76	32.82	7	7	S	ES 34	11.63	17.80	5	5	MR
KMR 14	12.89	13.74	4	5	MR	UMA	9.42	10.92	3	3	R
KMR 85	19.59	17.10	5	5	MR						

HR, highly resistant; R, resistant; MR, moderately resistant; S, susceptible; HS, highly susceptible.

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