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Influence of physical and biochemical constituents on resistance/ susceptibility in sesame genotypes against leaf webber and capsule borer, *Antigastra catalaunalis* Duponchel

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ABSTRACT

Field screening studies against leaf webber and capsule borer, Antigastra catalaunalis, were carried out with sixty sesame genotypes along with a resistant check, SI- 250, and susceptible check, TC 25. The results revealed that, seven sesame genotypes, viz., JCS 3894, JCS 3594, JCS 3593, JCS 3265, SI 9050, JCS 3910, and JCS 3605, were categorized as resistant based on grading, and 22 genotypes were moderately resistant; thirty-one sesame genotypes were categorized as susceptible. Among different categories of genotypes, physical parameters and biochemical constituents were assessed in selected genotypes. Physical parameters, trichome density, showed a significantly negative correlation (-0.932) with per cent leaf damage, and capsule wall thickness showed a significant negative correlation (-0.898) with per cent capsule damage caused by A. catalaunalis. Biochemical constituents viz., chlorophyll (0.748), total sugars (0.745) showed significant positive correlation, and phenols (-0.888) showed significant negative correlation with per cent leaf damage. Regarding, chlorophyll (0.797), total sugars (0.886), and reducing sugars (0.814) showed significant positive correlation, and phenols (-0.878) showed significant negative correlation with A. catalaunalis capsule damage. The multiple step-down regression studies showed that, physical and biochemical factors together influenced the leaf and capsule damage to an extent of 94 and 99 per cent, respectively.

Keywords: *Sesame, Genotypes, Resistance, Susceptibility, Antigastra catalaunalis, Screening, Biochemical*

1. Introduction

Sesame, *Sesamum indicum* (L.), is one of the tropical edible oilseed crops of the world, cultivated throughout India and considered as 'Queen of oilseeds' because of its superior oil quality. In India, it is grown in the entire crop growing seasons and due to the presence of potential antioxidants, sesame seeds are known as "the seed of immortality". Seeds of sesame contain 38-54 per cent oil, 18-25 per cent protein, phosphorus, calcium, and oxalic acid [14]. Sesame seed oil has a long shelf life due to the presence of lignans (Sesamin, Sesaminol, Sesamolinol), which have a remarkable antioxidant function [3].

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Among the several cardinal factors responsible for the low yield of sesame, damage by insect pests is considered as one of the vital factors causing substantial yield loss under field conditions. Out of 67 insect pests damaging the sesame crop, leaf webber and capsule borer (*Antigastra catalaunalis* Duponchel) are considered as major insect pests [4]. It is an important pest because it attacks the crop at all the growth stages, starting from two weeks after emergence [24]. It feeds on tender foliage by webbing the top leaves, feeds on flowers, and bores into the pods [11]. This insect pest causes 10-70 per cent infestation on leaves, 34-62 per cent on flowers, and 10-44 per cent infestation on pods, resulting in about 72 per cent loss in yield [1]. Host plant resistance against insect pests is useful in complete control or as a part of an Integrated Pest Management (IPM) programme with other components of pest control. Resistant varieties play a major role in IPM by reducing the insecticidal application against insect pests and improving the performance of natural enemies.

Even a low level of resistance is also effective, which in turn reduces the number of sprays on the crop and the cost of spraying [23]. It is also important to identify resistance mechanisms and associated factors responsible for resistance. Morphological characters and biochemical components of the plants play an important role in offering resistance to insect pests by making the plants less preferable to insect pests, as these plant characters interfere with the feeding, oviposition, movement, and development, *etc.* Selected resistant sesame varieties can be used in combination with other control methods, providing an eco-friendly, cost-effective, and environmentally safe strategy for effective management of insect pests in sesame [15]. In this context, the present study was performed to elucidate the influence of physical and biochemical constituents on resistance or susceptibility in sesame genotypes against leaf webber and capsule borer, *Antigastra catalaunalis.*

2. Materials and methods

The investigation on screening of sesame genotypes was carried out at the Regional Agricultural Research Station, Polasa, Jagtial (18°15'15.8'' N, 78°58'51.6'' E), physical parameters *viz.,* trichome density at Central Instrumentation Cell and biochemical analysis of samples was carried out at Quality Control Laboratory and Department of Crop Physiology, College of Agriculture, Rajendranagar, PJTAU, Hyderabad.

2.1 Experiment protocol

A total of 60 genotypes, along with a resistant check, SI-250, and a susceptible check, TC-25, were screened during late *kharif* 2018 and 2019. Each genotype was sown in 5 m row length with a spacing of 30 x 15 cm, and all recommended agronomic practices as per the package of practices were adopted. Sesame genotypes were sown in three blocks, and twenty genotypes were accommodated in each block, along with resistant and susceptible checks, and an augmented design was adopted. No plant protection chemicals were sprayed against insect pests, and screening was done under natural field conditions only. Observations on leaf, flower, and capsule damage by *A. catalaunalis* were recorded on 10 designated plants at 30 days after sowing (leaf damage), 45 DAS (flower damage), and 60 DAS (capsule damage). The healthy and damaged leaves, flowers, and capsules were counted, and finally, per cent of leaf, flower, and capsule damage was calculated. Further, the sesame genotypes were grouped into five different categories based on grade (1 to 9), as highly resistant (1 grade), resistant (3 grade), moderately resistant (5 grade), susceptible (7 grade) and highly susceptible (9 grade) as per the ratings [22].

The physical factors and biochemical constituents in selected sesame genotypes, along with resistant and susceptible checks, were studied to investigate their role against *A. catalaunalis* infestation in sesame.

2.2 Physical factors

Physical parameters like trichome density, capsule length and capsule wall thickness were recorded on selected eight sesame genotypes.

2.2.1 Trichome density

To examine the trichome density, the second leaf from the tip of 25 day old plants was sampled from each selected genotype in each replication.

Standard procedure for obtaining clear leaves for microscopic study was adopted for the observation of leaf trichome density as described by (9) and the number of trichomes per microscopic field and converted to number per centimetre square area.

2.2.2 Capsule length

The capsule length of ten randomly selected capsules per each selected genotype from each replication was measured with a measuring scale in centimetres and finally average was computed.

2.2.3 Capsule wall thickness

The capsule wall thickness, ten randomly selected capsules per each selected genotype from each replication was measured with the help of vernier callipers in millimetres and the average was calculated.

2.3 Biochemical factors

A total of eight genotypes were selected against *A. catalaunalis* were having various levels of resistance for studying the biochemical constituents *viz.,* chlorophyll, total sugars, reducing sugars, total phenols, crude protein, and total free amino acids in leaves and capsules by maintaining three replications for each treatment.

2.3.1 Chlorophyll

Chlorophyll content was estimated in leaves and capsules of selected genotypes at 30 and 60 DAS, respectively. Chlorophyll content in leaves was worked out using a SPAD meter, and in capsules using a Spectrophotometer.

2.3.2 Total sugars and reducing sugars

Estimation of total sugars and reducing sugars in leaves and capsules of selected genotypes was done using the Nelson-Somogyi method [21].

2.3.2 Total phenols

Total phenolic contents of sesame leaves and capsules extract were determined by Flin-Ciocalteu method [8].

2.3.3 Crude protein

Estimation of crude protein in sesame leaves and capsules was done using AOAC 992.23 - Generic combustion method (Leco FP-528 nitrogen analyser).

2.3.4 Total free amino acids

The estimation of total free amino acids of sesame leaves and capsules was determined by the HPLC method.

2.4 Statistical analysis

The correlation study was undertaken to find out the relationship between physical and biochemical parameters with insect pest resistance/ susceptibility. The correlation coefficient was worked out by using the equation.

$$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x)^2 \times N\sum y^2 - (\sum y)^2}}$$

Where,

r = Simple correlation coefficient

x = Independent variables, *i.e.,* Physical and biochemical parameters

y = Dependent variables, *i.e.* per cent infestation

N = Number of observations

To find out the combined influence of physical and biochemical factors on mean per cent leaf, flower, and capsule infestation, multiple step-down regression analysis was done by using the following formula.

$Y= a +bx_1+bx_2+......bx_n$

Y- Mean of per cent leaf or flower, or capsule infestation

a -Interception value; x_1, x_2....x_n– Regression coefficient values of various physical and biochemical factors.

3. Results and Discussions

3.1 Screening of sesame genotypes

Screening of sesame genotypes against *A. catalaunalis* during late *kharif* 2018 and 2019, the results (Table 1) showed that, none of the genotypes were highly resistant to *A. catalaunalis*. Seven sesame genotypes, *viz*., JCS 3894, JCS 3594, JCS 3593, JCS 3265, SI 9050, JCS 3910, and JCS 3605, were categorized as resistant based on grading. The twenty two genotypes *viz.,* DT 116, JCS 3886, DT 97, JCS 3992, JCS 3893, JCS 3884, JCS 2477, RF2, JCS 3596, JCS 2420, TK 4-22, GT 50, JCS 1020, ES-5, KMR 14-A, SI 248, ES-7, SI 885, JCS 3981, JCS 3881, JCS 4018 and JCS 4013 were categorized as moderately resistant genotypes. The thirty one sesame genotypes GPC 13-12, JCS 3895, JCS 3889, JCS 3739, DT 112, JCS 3755, JCS 3872, JCS 3898, JCS 3890, RF4, JCS 3578, JCS 3605, JCS 3599, JCS3751, JCS 2611, JCS 2696, JCS 3287, DT 26, JCS 3202, SI 72-A, SI 1036, NIC 8011, SI 253, SI 1125, SI 1052, ES -15, ES-10, NIC 16226, JCS 2698, PVT 224 and JCS 3880 were categorized as susceptible (Table 2). In the present study, none of the genotypes was highly resistant against *A. catalaunalis,* which is in accordance with earlier reports [13], [10]), [2], [17].

3.2 Physical and biochemical constituents of selected sesame genotypes associated with leaf and capsule damage by *A. catalaunalis*

The physical and biochemical constituents studied in the leaves and capsules of selected eight sesame genotypes *viz.,* three resistant (SI 250, JCS 3894 and JCS 3265), two moderately resistant (DT 97 and DT 116), two susceptible (JCS 2696 and DT 26) and one highly susceptible genotype (TC 25).

3.3 Physical parameters

3.3.1 Trichome density

The trichome density number per square centimeter on leaf of different genotypes ranged from 103.33 to 165.53 trichomes per cm^2 (Table 3). The data revealed that, significantly, the maximum number of trichome density (165.53/cm^2) was registered in genotype JCS 3265 and it was on par with other resistant genotype JCS 3894 (159/cm^2). The resistant check SI 250 and susceptible check TC 25 recorded the trichome density of 141.10/cm^2 and 103.33/cm^2, respectively (Fig.1).

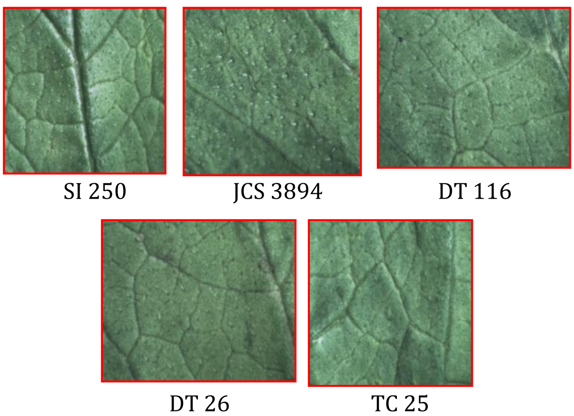

Fig 1. Trichome density in different sesame genotypes

3.3.2 Capsule length (cm)

The capsule length in the selected eight sesame genotypes ranged from 2.74 to 3.07 cm (Table 4). The lowest capsule length was recorded in resistant genotype JCS 3265 (2.74 cm), and it was on par with other resistant genotypes SI 250 (2.74 cm) and JCS 3894 (2.80 cm). The susceptible check TC 25 and resistant check SI 250 recorded 3.07 and 2.74 cm and were significantly different from each other.

3.3.3 Capsule wall thickness (mm)

Significant difference was not present between resistant and moderately resistant genotypes in relation to capsule wall thickness. The resistant genotype JCS 3894, JCS 3265 and SI 250 recorded 0.63, 0.63 and 0.64 mm capsule wall thickness and there was no significant difference with moderately resistant genotypes DT 97 and DT 116 with 0.63 and 0.65 mm, respectively. The physical characters like trichome density and capsule wall thickness showed significant negative correlation with per cent leaf and capsule damage, respectively. The results were in agreement with earlier workers [17], [12] who observed that trichome density was negatively significant with leaf webber and capsule borer damage in sesame. These results were in accordance with [10], who reported that morphological characters such as trichome density on sesame varieties had a negative correlation with *A. catalaunalis* larval population. These findings were in agreement with [7], who revealed that pod length was positively correlated with per cent pod damage, whereas pod wall thickness had a significant negative correlation with pod fly damage in redgram.

3.4 Biochemical constituents

3.4.1 Total chlorophyll

The lowest chlorophyll in leaf samples of sesame genotypes was recorded in resistant genotype JCS 3894 (30.15), and this genotype was significantly different from resistant check SI 250 (32.50) and other resistant genotype JCS 3265 (33.12) (Table 4). Regarding total chlorophyll in capsules ranged from 0.98 to 1.32. The lowest chlorophyll was recorded in resistant genotype JCS 3265 (0.98 mg/g) and on par with other resistant genotypes SI 250 (1.05 mg/g) and JCS 3894 (1.07 mg/g). The results indicated that there was a significant difference between chlorophyll content in leaves and capsules of resistant and susceptible sesame genotypes. The data in the present study indicate that total chlorophyll in leaves and capsules of sesame genotypes showed a positive significant correlation with leaf webber and capsule borer, and the present findings were in agreement with earlier findings [18] [16] [19].

3.4.2 Total sugars (g/100g)

The total sugars in leaves of selected sesame genotypes ranged from 1.21 to 3.28 g per 100g. The resistant genotype JCS 3265 (1.21 g/100g) is significantly different from the resistant check SI 250 (1.50 g/100g) and the other resistant genotype JCS 3894 (1.66 g/100g). The total sugar content analysed in the capsules of sesame genotypes ranged from 8.07 to 16.34 g/100g. The resistant genotype JCS 3265 recorded the lowest total sugar content of 8.07 g/100g as compared to the resistant check SI 250 (10.65 g/100g) and other resistant genotype JCS 3894 with 11.32 g/100g. The results of total sugars in sesame genotypes indicated that, resistant genotypes recorded the lowest total sugars, while, susceptible genotypes recorded a high amount of total sugars. [5] reported that, total sugars showed a positive and significant correlation with per cent leaf and capsule damage by *A. cataunalis.*

This might be due to the role of sugars as a vital nutrient in plants. Further, the difference in relative amount of sugars between different genotypes with the difference in susceptibility, indicated that these compounds might act as phagostimulants to the insect. The results of the present investigation were in accordance with [20] who reported that reducing sugars in leaves of sesame genotypes had a significant and positive impact on per cent leaf and pod damage by *A. catalaunalis.*

3.4.3 Reducing sugars (g/100g)

The reducing sugar content analysed in the leaves of eight selected sesame genotypes ranged from 0.64 to 1.02 g/100g. The resistant genotype JCS 3265 recorded the lowest reducing sugar content of 0.64 g/100g as compared with the susceptible check TC 25 (1.02 g/100g). Reducing sugars in capsules of the selected eight sesame genotypes ranged from 2.13 to 5.25 g/100g. The resistant genotype JCS 3894 (2.25 g/100g) significantly differs from the other resistant genotype JCS 3265 (2.58 g/100g). The moderately resistant genotypes DT 97 and DT 116 recorded 2.82 and 3.76 g/100g of reducing sugars. JCS 2696, which was a susceptible genotype, recorded 3.85 g/100g, which was significantly different from the other susceptible genotype, DT 26, with 3.02 g/100g. Since, reducing sugars are considered to be an essential component in insect nutrition, it play a vital role in host selection by phytophagous insects. Hence, their concentration in plants is positively associated with the feeding behavior of insects.

3.4.4 Crude protein (%)

The crude protein per cent in leaves ranged from 18.44 to 26.01. The significant difference was observed between the resistant check SI 250 and susceptible check TC 25, which recorded 18.44 and 26.01 per cent crude protein. The percentage of crude protein in capsules ranged from 9.12 to 11.58 and significant difference was observed between the resistant check SI 250 and the susceptible check TC 25, which recorded 10.65 and 11.46 per cent crude protein. The resistant genotypes JCS 3894 and JCS 3265 recorded 9.74 and 9.12 per cent crude protein and they were significantly different from each other. Crude protein per cent in leaves and capsules of selected genotypes showed a positive correlation between leaf and capsule infestation. These results were in agreement with [20] and [5] who reported that crude proteins in sesame had a significant and positive impact on per cent pod damage by *A. catalaunalis.* In the majority of plants, proteins are considered to be an essential component in insect nutrition and it play a vital role in insect growth, development, survival and reproduction.

3.4.5 Total phenols (mg/100g)

The total phenol content in leaves ranged from 103.28 to 148.33 mg/100g. The data revealed that, significantly highest phenol content was recorded in the resistant sesame genotype JCS 3894 (148.33 mg/100g) followed by other resistant genotypes SI 250 (131.30 mg/100g) and JCS 3265 (130.12 mg/100g). The total phenol content in capsules ranged from 101.77 to 245.83 mg/100g. The results indicated that the highest phenol content was recorded in the resistant sesame genotype JCS 3265 (245.83 mg/100g) followed by other resistant genotypes JCS 3894 (234.04 mg/100g) and SI 250 (232.75 mg/100g). These results of the present investigations were in accordance with the earlier findings (5) who reported that total phenols showed positive and significant correlation with per cent leaf and capsule damage by *A. catalaunalis,* in contrast [6] reported that total phenols in the leaves, flowers and pods were negatively correlated with damage of *A. catalaunalis*. The present results were in conformity with the findings of [20] who reported a significant negative correlation between total phenols and per cent pod damage by *A. catalaunalis* in sesame. In the majority of plants, phenols act as a prime biochemical factor for resistance due to their anti-feedant as well as antibiosis properties on growth and reproduction.

3.4.6 Total free amino acids (g /100g of protein)

The results revealed that, significantly the lowest free amino acids were recorded in the resistant genotype JCS 3265 (22.58 g/100g of protein) followed by another resistant genotype JCS 3894 (24.20 g/100g of protein). The moderately resistant genotypes DT 97 and DT 116 recorded 24.69 and 24.50 g/100g of protein and were on par with each other. The total free amino acids in capsules ranged from 31.30 to 35.84 g/100g of protein. Significantly lowest free amino acids in resistant genotype JCS 3894 (31.30 g/100g of protein) followed by other resistant genotypes SI 250 (32.30 g/100g of protein), and JCS 3265 (34.27 g/100g of protein). There was a significant difference between the resistant check SI 250 and susceptible check TC 25, which recorded 32.30 and 35.84 g/100g of protein. These results of total free amino acids were in conformity with [5], who reported that amino acids showed a significant positive relationship with per cent leaf and pod damage against *A. catalaunalis* in sesame.

3.5 Correlation and Multiple Regression Studies

The correlation coefficients worked out between leaf and capsule damage by *A. catalaunalis* (Table 5) to know the influence of physical parameters and biochemical constituents on resistance or susceptibility. Among physical parameters, trichome density showed a significant negative correlation (-0.932**), capsule lengthhad non-significant positive correlation (0.682), while capsule wall thickness showed a negative and significant correlation (-0.898**) with per cent damage. Regarding the biochemical constituents, *viz.,* total chlorophyll in leaves and capsules showed a significant positive correlation (0.748*, 0.794*). Total sugars in the leaves and capsules of sesame genotypes had a significant positive correlation (0.745*, 0.886). A positive non-significant correlation (0.635) was observed between reducing sugars in leaf damage and a significant positive correlation with the per cent capsule damage by *A. catalaunalis* (0.814*). Crude protein content in leaves and capsules of sesame genotypes shows a positive non non-significant correlation damage (0.624, 0.618) with the per cent leaf and capsule damage, respectively. Remaining biochemical constituents *viz.,* phenol content in leaves and capsules had highly significant negative correlated (-0.888, -0.878**), while total free amino acids (0.659, 0.533) showed positive non-significant correlations, respectively.

Multiple step down linear regression analysis was done to find out the combined influence of physical and biochemical parameters on leaf damage (Table 6) by *A. catalaunalis* showed that all other parameters influenced the leaf damage to an extent of 94 per cent (R^2 = 0.94) except total free amino acids. Regarding capsule damage, except capsule length, crude protein, and total free amino acids together influenced the capsule infestation to an extent of 99 per cent (R^2 = 0.99) (Table 7).

Conclusion

Leaf webber and capsule borer, which are major pests of sesame, causing more damage in terms of yields. In this context, identification of resistant sources against this pest is very important. Physical parameters, *viz.,* trichome density and capsule wall thickness, showed significantly negative correlation with per cent leaf damage and capsule damage, respectively caused by *A. catalaunalis* and biochemical parameters *viz.,* chlorophyll, total sugars, reducing sugars showed significant positive correlation and phenols showed significant negative correlation with per cent leaf and capsule damage. Hence, select genotypes which are having above said characters and may be used in a crossing programme for the development of resistant varieties. Hence, we can introduce these developed varieties in the IPM programme and also reduce the cost of cultivation for farmers.

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Conflict of interest

The authors don't have any conflict of interest regarding the above research work and results discussed.

Future Scope of Study

With the study of resistant mechanisms, we can develop resistant varieties against this insect pest in sesame.

Table 1. Screening data and reaction of sesame genotypes against leaf webber and capsule borer A. catalaunalis during late kharif 2018 and 2019

S. No.	Genotypes	Leaf damage (%) (a)	Score	Flower damage (%) (b)	Score	Capsule damage (%) (c)	Score	Cumulative score ((a+b+c)/3)	Grade	Reaction
1	GPC 13-12	11.78 (20.07)	3	8.58 (17.03)	3	7.48 (15.87)	7	4.3	7	S
2	JCS 3895	11.92 (20.20)	3	6.32 (14.56)	3	6.16 (14.38)	7	4.3	7	S
3	JCS 3889	13.23 (21.33)	3	10.24 (18.66)	5	5.57 (13.64)	5	4.3	7	S
4	JCS 3894	5.97 (14.14)	1	2.73 (9.51)	1	2.14 (8.41)	3	1.7	3	R
5	DT 116	12.67 (20.85	3	6.20 (14.42)	3	3.92 (12.34)	3	3.0	5	MR
6	JCS 3739	13.56 (21.61)	3	8.11 (16.54)	3	6.44 (14.70)	7	4.3	7	S
7	DT 112	14.99 (22.78)	3	8.44 (16.89)	3	7.19 (15.55)	7	4.3	7	S
8	JCS 3886	10.71 (19.11)	3	6.11 (14.32)	3	3.70 (11.08)	3	3.0	5	MR
9	JCS 3755	17.09 (24.42)	3	13.32 (21.41)	5	6.36 (14.61)	7	5.0	7	S
10	JCS 3872	18.07 (25.15)	3	7.43 (15.82)	3	6.56 (14.85)	7	4.3	7	S
11	DT 97	10.28 (18.70)	3	6.27 (14.50)	3	3.81 (11.26)	3	3.0	5	MR
12	JCS 3992	19.69 (26.34)	3	6.94 (15.27)	3	3.85 (11.32)	3	3.0	5	MR
13	JCS 3893	10.34 (18.76)	3	6.57 (14.86)	3	3.23 (10.35)	3	3.0	5	MR
14	JCS 3884	10.69 (19.08)	3	4.31 (11.99)	1	4.68 (12.50)	5	3.0	5	MR
15	JCS 3898	13.48 (21.54)	3	6.00 (14.18)	3	7.17 (15.54)	7	4.3	7	S
16	JCS 3890	13.84 (21.84)	3	10.18 (18.61)	5	7.11 (15.46)	7	5.0	7	S
17	JCS 2477	17.69 (24.87)	3	7.88 (16.30)	3	3.64 (11.00)	3	3.0	5	MR
18	RF4	20.20 (26.71)	5	9.47 (17.92)	3	6.35 (14.60)	7	5.0	7	S
19	RF2	14.81 (22.64)	3	5.77 (13.90)	3	3.84 (11.30)	3	3.0	5	MR
20	JCS 3596	11.76 (20.06)	3	4.03 (11.59)	3	3.05 (10.06)	3	3.0	5	MR
21	JCS 3578	12.37 (20.59)	3	4.32 (12.00)	3	4.92 (12.81)	5	3.7	7	S
22	JCS 3605	15.17 (22.92)	3	9.46 (17.91)	3	6.23 (14.46)	7	4.3	7	S
23	JCS 3599	14.88 (22.69)	3	6.82 (15.13)	3	5.93 (14.09)	5	3.7	7	S
24	JCS 3594	8.70 (17.15)	1	4.95 (12.85)	1	3.53 (10.83)	3	1.7	3	R
25	JCS3751	19.45 (26.17)	3	9.24 (17.70)	3	6.98 (15.32)	7	4.3	7	S
26	JCS 3593	9.09 (17.55)	1	4.33 (12.00)	1	3.41 (10.64)	3	1.7	3	R
27	JCS 2611	14.75 (22.59)	3	9.81 (18.25)	3	6.20 (14.41)	7	4.3	7	S
28	JCS 2696	25.03 (30.02)	5	7.78 (16.19)	3	7.32 (15.70)	7	5.0	7	S
29	JCS 3287	18.38 (25.39)	3	8.56 (17.02)	3	8.74 (17.20)	9	5.0	7	S
30	JCS 3265	8.54 (16.99)	1	2.44 (8.99)	1	2.04 (8.20)	3	1.7	3	R
31	DT 26	21.88 (27.89)	5	8.48 (16.93)	3	6.56 (14.84)	7	5.0	7	S
32	JCS 2420	13.13 (21.14)	3	5.61 (13.70)	3	3.79 (11.22)	3	3.0	5	MR
33	JCS 3202	13.34 (21.42)	3	5.35 (13.38)	3	4.67 (12.48)	5	3.7	7	S
34	TK 4-22	13.02 (21.15)	3	3.68 (11.06)	1	3.01 (10.00)	3	2.3	5	MR
35	GT 50	14.95 (22.74)	3	4.04 (11.60)	1	3.48 (10.74)	3	2.3	5	MR
36	JCS 1020	12.31 (20.54)	3	5.10 (13.05)	3	3.56 (10.88)	3	3.0	5	MR
37	SI 72-A	17.03 (24.37)	3	11.54 (19.86)	5	7.57 (15.97)	7	5.0	7	S
38	SI 1036	14.56 (22.43)	3	14.15 (22.09)	5	5.95 (14.12)	5	4.3	7	S
39	NIC 8011	17.43 (24.68)	3	10.25 (18.67)	5	6.60 (14.89)	7	5.0	7	S

40	SI 253	20.33 (26.80)	5	7.88 (16.31)	3	5.65 (13.75)	5	4.3	7	S
41	SI 1125	14.76 (22.59)	3	7.49 (15.89)	3	5.41 (13.45)	5	3.7	7	S
42	ES-5	13.91 (21.90)	3	5.83 (13.97)	3	3.48 (10.75)	3	3.0	5	MR
43	SI 1052	24.78 (29.85)	5	9.56 (18.01)	3	6.58 (14.85)	7	5.0	7	S
44	KMR 14-A	18.22 (25.27)	3	6.15 (14.36)	3	3.66 (11.04)	3	3.0	5	MR
45	ES -15	11.33 (19.67)	3	10.24 (18.66)	5	4.31 (11.98)	5	4.3	7	S
46	ES-10	11.91 (20.19)	3	8.41 (16.85)	3	6.09 (14.29)	7	4.3	7	S
47	NIC 16226	10.90 (19.28)	3	9.74 (18.19)	3	6.14 (14.34)	7	4.3	7	S
48	SI 248	15.16 (22.91)	3	4.81 (12.66)	1	4.39 (12.09)	5	3.0	5	MR
49	ES-7	12.97 (21.11)	3	4.11 (11.70)	1	3.21 (10.32)	3	2.3	5	MR
50	SI 885	17.76 (24.92)	3	4.33 (12.01)	1	5.50 (13.56)	5	3.0	5	MR
51	SI 9050	9.76 (18.20)	1	4.45 (12.18)	1	3.41 (10.64)	3	1.7	3	R
52	PVT 224	22.31 (28.18)	5	5.23 (13.22)	3	7.02 (15.36)	7	5.0	7	S
53	JCS 3981	7.84 (16.26)	1	5.71 (13.83)	3	4.45 (12.17)	5	3.0	5	MR
54	JCS 3910	9.61 (18.05)	1	2.96 (9.91)	1	2.95 (9.90)	3	1.7	3	R
55	JCS 3881	10.61 (19.01)	3	6.80 (15.11)	3	3.42 (10.65)	3	3.0	5	MR
56	JCS 3880	19.64 (26.30)	3	10.99 (19.36)	5	6.74 (15.05)	7	5.0	7	S
57	JCS 2698	15.03 (22.81)	3	5.05 (12.99)	3	5.30 (13.31)	5	3.7	7	S
58	JCS 4018	12.63 (20.82)	3	3.62 (10.97)	1	3.00 (9.97)	3	2.3	5	MR
59	JCS 3605	7.94 (16.37)	1	3.20 (10.30)	1	3.90 (11.39)	3	1.7	3	R
60	JCS 4013	18.82 (25.71)	3	8.72 (17.17)	3	3.19 (10.28)	3	3.0	5	MR
	TC 25 (S. check)	27.15 (31.40)	5	11.75 (20.05)	5	8.22 (16.66)	9	6.3	9	HS
	SI 250 (R. check)	7.15 (15.51)	1	3.41 (10.64)	1	3.27 (10.42)	3	1.7	3	R
	CD (p=0.05)	1.43		1.33		1.27				

Figures in parentheses are angular transformed values
HR: Highly Resistant, R: Resistant, MR; Moderately Resistant, S: Susceptible, HS: Highly Susceptible

Table 1. Screening data and reaction of sesame genotypes against leaf webber and capsule borer A. catalaunalis during late kharif 2018 and 2019

S. No.	Category	Grade	No. of Genotypes	Name of the genotypes
1	Highly Resistant (HR)	1	0	-
2	Resistant (R)	3	7	JCS 3894, JCS 3594, JCS 3593, JCS 3265, SI 9050, JCS 3910, JCS 3605, SI 250*
3	Moderately Resistant (MR)	5	22	DT 116, JCS 3886, DT 97, JCS 3992, JCS 3893, JCS 3884, JCS 2477, RF2, JCS 3596, JCS 2420,TK 4-22, GT 50, JCS 1020, ES-5, KMR 14-A, SI 248, ES-7, SI 885, JCS 3981, JCS 3881, JCS 4018, JCS 4013
4	Susceptible (S)	7	31	GPC 13-12, JCS 3895, JCS 3889, JCS 3739, DT 112, JCS 3755, JCS 3872, JCS 3898, JCS 3890, RF4, JCS 3578, JCS 3605, JCS 3599, JCS3751, JCS 2611, JCS 2696, JCS 3287,DT 26, JCS 3202, SI 72-A, SI 1036, NIC 8011, SI 253, SI 1125, SI 1052, ES -15, ES-10, NIC 16226, JCS 2698, PVT 224, JCS 3880
5	Highly Susceptible (HS)	9	0	TC-25**

Table 2. Categorization of sesame genotypes-based screening studies conducted against A. catalaunalis during late kharif 2018 and 2019

Genotypes	Trichome density (No./cm²)	Total chlorophyll (SPAD reading)	Total sugars (g/100g)	Reducing sugars (g/100g)	Crude protein (%)	Total phenols (mg of GAE/100g)	Total free amino acids (g/100g of protein)
SI 250 (R)	141.10 (11.90)	32.50 (5.74)	1.50 (1.41)	0.80 (1.14)	18.44 (25.43)	131.30 (11.48)	24.63 (5.01)
JCS 3894 (R)	159.00 (12.63)	30.15 (5.54)	1.66 (1.47)	0.79 (1.14)	21.28 (27.47)	148.33 (12.20)	24.20 (4.97)
JCS3265 (R)	165.53 (12.89)	33.12 (5.80)	1.21 (1.31)	0.64 (1.07)	22.51 (28.32)	130.12 (11.43)	22.58 (4.80)
DT 97 (MR)	140.00 (11.85)	34.50 (5.92)	1.25 (1.32)	0.73 (1.11)	21.67 (27.74)	128.57 (11.36)	24.69 (5.02)
DT 116 (MR)	145.53 (12.08)	33.80 (5.86)	1.69 (1.48)	0.75 (1.12)	21.80 (27.83)	124.5 (11.18)	24.50 (5.00)
JCS 2696 (S)	111.00 (10.56)	36.20 (6.06)	1.93 (1.56)	0.76 (1.12)	23.38 (28.92)	112.51 (10.63)	24.86 (5.04)
DT 26 (S)	119.00 (10.93)	35.92 (6.03)	1.72 (1.49)	0.85 (1.16)	21.85 (27.87)	123.50 (11.14)	25.02 (5.05)
TC 25 (HS)	103.33 (10.19)	35.80 (6.02)	3.28 (13.94)	1.02 (1.23)	26.01 (30.66)	103.28 (10.19)	33.82 (5.86)
CD (p=0.05)	0.49	0.12	0.08	0.03	1.09	0.29	0.11
SEm (±)	0.16	0.04	0.03	0.01	0.35	0.09	0.04

**Resistant check, **Susceptible check*

Table 3. Physical characters and biochemical constituents analysed in the leaves of selected sesame genotypes

Genotypes	Capsule length (cm)	Capsule wall thickness (mm)	Total chlorophyll (mg/g)	Total sugars (g/100g)	Reducing sugars (g/100g)	Crude protein (%)	Total phenols (mg of GAE/100g)	Total free amino acids (g/100g of protein)
SI 250 (R)	2.74 (1.80)	0.64 (1.07)	1.05 (1.24)	10.65 (3.34)	2.13 (1.62)	10.65 (19.05)	232.75 (15.27)	32.30 (5.73)
JCS 3894 (R)	2.80 (1.82)	0.63 (1.06)	1.07 (1.25)	11.32 (3.29)	2.25 (1.66)	9.74 (18.19)	234.04 (15.31)	31.30 (5.64)
JCS3265 (R)	2.74 (1.80)	0.63 (1.06)	0.98 (1.22)	8.07 (2.93)	2.58 (1.75)	9.12 (17.58)	245.83 (15.69)	34.27 (5.90)
DT 97 (MR)	2.99 (1.87)	0.63 (1.06)	1.29 (1.34)	9.08 (3.10)	2.82 (1.82)	9.91 (18.35)	178.66 (13.39)	33.40 (5.82)
DT 116 (MR)	3.00 (1.87)	0.65 (1.07)	1.37 (1.37)	9.76 (3.20)	3.76 (2.06)	8.20 (16.64)	144.7 (12.05)	35.29 (5.98)
JCS 2696 (S)	3.06 (1.89)	0.56 (1.03)	1.46 (1.40)	15.93 (4.05)	3.85 (2.09)	10.03 (18.46)	154.70 (12.46)	33.59 (5.84)
DT 26 (S)	3.08 (1.89)	0.54 (1.02)	1.45 (1.40)	11.42 (3.45)	3.02 (1.88)	11.58 (19.89)	140.36 (11.87)	33.83 (5.86)
TC 25 (HS)	3.07 (1.89)	0.54 (1.02)	1.32 (1.35)	16.34 (4.10)	5.25 (2.40)	11.46 (19.79)	101.77 (10.14)	35.84 (6.03)
CD (p=0.05)	0.06	0.03	0.10	0.13	0.06	0.56	1.03	0.12
SEm (±)	0.02	0.01	0.03	0.04	0.02	0.18	0.33	0.04

Figures in parenthesis are square root transformed values
Figures in parenthesis of crude protein are angular transformed values

Table 4. Physical characters and biochemical constituents analysed in the capsules of selected sesame genotypes

Genotypes	Capsule length (cm)	Capsule wall thickness (mm)	Total chlorophyll (mg/g)	Total sugars (g/100g)	Reducing sugars (g/100g)	Crude protein (%)	Total phenols (mg of GAE/100g)	Total free amino acids (g/100g of protein)
SI 250 (R)	2.74 (1.80)	0.64 (1.07)	1.05 (1.24)	10.65 (3.34)	2.13 (1.62)	10.65 (19.05)	232.75 (15.27)	32.30 (5.73)
JCS 3894 (R)	2.80 (1.82)	0.63 (1.06)	1.07 (1.25)	11.32 (3.29)	2.25 (1.66)	9.74 (18.19)	234.04 (15.31)	31.30 (5.64)
JCS3265 (R)	2.74 (1.80)	0.63 (1.06)	0.98 (1.22)	8.07 (2.93)	2.58 (1.75)	9.12 (17.58)	245.83 (15.69)	34.27 (5.90)
DT 97 (MR)	2.99 (1.87)	0.63 (1.06)	1.29 (1.34)	9.08 (3.10)	2.82 (1.82)	9.91 (18.35)	178.66 (13.39)	33.40 (5.82)
DT 116 (MR)	3.00 (1.87)	0.65 (1.07)	1.37 (1.37)	9.76 (3.20)	3.76 (2.06)	8.20 (16.64)	144.7 (12.05)	35.29 (5.98)
JCS 2696 (S)	3.06 (1.89)	0.56 (1.03)	1.46 (1.40)	15.93 (4.05)	3.85 (2.09)	10.03 (18.46)	154.70 (12.46)	33.59 (5.84)
DT 26 (S)	3.08 (1.89)	0.54 (1.02)	1.45 (1.40)	11.42 (3.45)	3.02 (1.88)	11.58 (19.89)	140.36 (11.87)	33.83 (5.86)
TC 25 (HS)	3.07 (1.89)	0.54 (1.02)	1.32 (1.35)	16.34 (4.10)	5.25 (2.40)	11.46 (19.79)	101.77 (10.14)	35.84 (6.03)
CD (p=0.05)	0.06	0.03	0.10	0.13	0.06	0.56	1.03	0.12
SEm (±)	0.02	0.01	0.03	0.04	0.02	0.18	0.33	0.04

Figures in parenthesis are square root transformed values
Figures in parenthesis of crude protein are angular transformed values

Table 5. Correlation coefficients of physical and biochemical characters of sesame genotypes with per cent leaf and capsule damage by A. catalaunalis

Physical and biochemical characters in leaves	Correlation coefficients (r)	Physical and biochemical characters in Capsules	Correlation coefficients (r)
Trichome density on leaf	-0.932**	Capsule length	0.682
Total chlorophyll	0.748*	Capsule wall thickness	-0.898**
Total sugars	0.745*	Total chlorophyll	0.794*
Reducing sugars	0.635	Total sugars	0.886**
Crude protein	0.624	Reducing sugars	0.814*
Total phenols	-0.888**	Crude protein	0.618
Total free amino acids	0.659	Total phenols	-0.878**
		Total free amino acids	0.533

**5% Significance; ** 1% Significance*

Table 6. Multiple step-down linear regression analysis of physical and biochemical characters of sesame genotypes with per cent leaf damage by A. catalaunalis

S. No.	Parameters	R^2 value	R^2 value (%)
1	Y = 3.337 – 0.490X1 + 1.954 X2 + 130.48X3 -89.83 X4 – 0.079 X5 + 0.489 X6	0.94	94
X1 – Trichome density; X2 – Total chlorophyll; X3 – Total Sugars; X4 – Reducing sugars; X5 – Crude protein; X6 – Total phenols			

Table 7. Multiple step-down linear regression analysis of physical and biochemical characters of sesame genotypes with per cent capsule damage by A. catalaunalis

S. No.	Parameters	R^2 value	R^2 value (%)
2	Y = -35.943 + 2.713X2+ 11.059 X3+ 0.011 X4 + 2.199 X5 - 0.040 X6	0.99	99
X2 – Capsule thickness; X3 – Total chlorophyll; X4 – Total sugars; X5 – Reducing sugars; X6 – Total phenols			

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