P. ISSN: 0971-8184 II E. ISSN: 0976-1926
DOI: 10.61949/0976-1926.2024.v37i03.09

Indian Journal of Plant Genetic Resources

RESEARCH ARTICLE

Evaluation of Sesame Genotypes against Leaf Webber and Capsule Borer, *Antigastra Catalaunalis* (Duponchel) Resistance

S Omprakash*, C Narendra Reddy, M Swarna Sree, T Kiran Babu, M Sreedhar and D Padmaja

Abstract

Evaluation of sesame genotypes against leaf webber and capsule borer (*Antigastra catalaunalis)* was carried out under field conditions at the Regional Agricultural Research Station, Polasa, Jagtial, during late *kharif* 2018 and 2019. A total of 60 genotypes, along with a resistant check, SI-250 and a susceptible check, TC-25 were screened. During the two years of screening, none of the genotypes were highly resistant to *A. catalaunalis*. Seven sesame genotypes *viz*., JCS 3894, JCS 3884, JCS 3594, JCS 3265, JCS 3910, JCS 4018 and JCS 3605, were categorized as resistant and two genotypes, JCS 3755 and SI1052 showed highly susceptible reaction based on grading during the year 2018. The genotypes *viz.,* JCS 3894, JCS 3578, JCS 3593, JCS 3265, SI 9050, JCS 3981 and JCS 3605 showed resistant reactions in the year 2019 and none of the genotypes showed highly susceptible reactions against *A. catalaunalis.*

Keywords: Capsule borer, Genotypes, Grading, Leaf webber, Screening, Sesame.

College of Agriculture, Rajendranagar, Professor Jayashankar Telangna State Agriculture University, Hyderabad-500030, Telangana, India.

***Author for correspondence:**

omprakashagrico@gmail.com

Received: 14/08/2023 **Revised:** 04/07/2024

Accepted: 16/07/2024

How to cite this article: Omprakash S, CN Reddy, MS Sree, TK Babu, M Sreedhar and D Padmaja (2024) Evaluation of Sesame Genotypes against Leaf Webber and Capsule Borer, *Antigastra Catalaunalis* (Duponchel) Resistance. *Indian J. Plant Genet. Resour.* 37(3): 467-472.
DOI: 10.61949/0976-1926.2024.v37i03.09

Introduction

Sesame, *Sesamum indicum* (L.) is the oldest oilseed crop of the world cultivated throughout India and considered as 'Queen of oilseeds' because of its superior oil quality. 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. Among 67 insect pests damaging the sesame crop *viz.,* leaf webber and capsule borer (*Antigastra catalaunalis* Duponchel), gall fly (*Asphondylia sesami* Felt) were considered as major insect pests (Choudhary *et al*., 1986). The leaf webber and capsule borer (*A. catalaunalis*) feed on tender foliage by webbing the top leaves, feeding on flowers and boring into the pods (Narayanan and Nadarajan, 2005). This insect pest causes 10 to 70% infestation on leaves, 34 to 62% on flowers and 10 to 44% infestation on pods resulting about 72% loss in yield (Ahirwar *et al.,* 2010). Resistant varieties play a major role in integrated pest management (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 crops and the cost of spraying (Srivastava, 1993). Therefore, it is important to identify genotypes. Knowledge of resistance mechanisms and associated factors is essential for the effective utilization of resistant sources in the crop improvement program. So, the use of resistant varieties is recognized as an environmentally safe and economically sound component of pest management. Insect-resistant varieties provide

pest control at no cost to farmers (Prem Kishore, 2001). So, the present investigation on "evaluation of sesame genotypes against leaf webber and capsule borer, *Antigastra catalaunalis* (Duponchel) resistance was taken up to identify resistant genotypes.

Materials and Methods

The investigation on screening of sesame genotypes against *A. catalaunalis* was carried out under field conditions at Regional Agricultural Research Station, Polasa, Jagtial (18°15′15.8″ N, 78°58′51.6″ E) during late *kharif* 2018 and 2019. A total of 60 genotypes along with resistant check, SI-250 and susceptible check, TC-25 were screened (Average weather of 33.2 (T maximum), 21.0 (T minimum), 90.56 (RH Morning), 66.11 (RH evening)). Each genotype was sown (30.08.2018 and 28.08.2019 in respective years) in 5 m row length with a spacing of 30 x 15 cm. Sesame genotypes were sown in three blocks and 20 genotypes were accommodated in each block along with resistant and susceptible checks. The intercultural operations as well as fertilizer application (N, P_2O_5 and K_2O @ 40, 20 and 20 kg ha^{-1}, respectively) were done as per recommendations. No plant protection chemicals were sprayed against insect pests and screening was done under natural field conditions only. Data on leaf webber and capsule borer *(A. catalaunalis*) infestation in different genotypes was recorded under field conditions during both *late kharif* 2018 and 2019 seasons. Observation of leaf, flower and capsule damage by *A. catalaunalis* was 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 leaf, flower and capsules were counted and finally percent leaf, flower and capsule damage was calculated. Further, the reaction of genotypes against *A. catalaunalis* was categorized by using 0 to 9 scale as suggested by Sridhar and Gopalan (2002) (Tables 1 and 2).

$$\text{Percent leaf/flower/capsule damage} = \frac{\text{No. of damaged leaves/flowers/capsules}}{\text{Total no. of leaves/flowers/capsules}} \times 100$$

Results and Discussion

Screening results of sesame genotypes during late *kharif* 2018 (Table 3) revealed that leaf damage ranged from 6.16 - 30.43%, flower damage 3.22 to 16.67% and capsule damage 2.06 to 9.05% among the screened genotypes. Out of 60 genotypes screened against *A. catalaunalis*, none of the genotypes recorded a highly resistant reaction. Seven genotypes *viz.,* JCS 3894, JCS 3884, JCS 3594, JCS 3265, JCS 3910, JCS 4018 and JCS 3605 were categorized as resistant, eighteen genotypes *viz.,* DT116, JCS 3886, JCS 3893, JCS 2477, RF2, JCS 3596, JCS 3593, JCS 2420, JCS 3202, TK4-22, GT 50, JCS 1020, SI 1125, ES 5, ES 15, ES 7, SI 9050 and JCS 3881 were categorized as moderately resistant, 33 genotypes *viz.,* GPC 13-12, JCS 3895, JCS 3889, JCS 3739, DT 112, JCS 3872, DT 97, JCS 3992, JCS 3898, JCS 3890, RF4, JCS 3578, JCS 3605, JCS 3599, JCS 3751, JCS 2611, JCS 2696, JCS 3287, DT 26, SI 72-A, SI 1036, NIC 8011, SI 253, KMR 14-A, ES-10, NIC 16226, SI 248, SI 885, PVT 224, JCS 3981, JCS 3880, JCS 2698 and JCS 4013 were categorized as susceptible and two sesame genotypes JCS 3755 and SI1052 showed highly susceptible reaction based on grading during the year 2018.

During the year 2019 same set of sesame genotypes (Table 4) was screened against *A. catalaunalis*. The leaf damage among sesame genotypes ranged from 5.78 to 21.12%, flower damage 1.64 to 13.33% and capsule damage 2.01 to 8.43. Among 60 sesame genotypes screened during 2019, none of the genotypes showed highly resistant reactions and seven entries *viz.,* JCS 3894, JCS 3578, JCS 3593, JCS 3265, SI 9050, JCS 3981 and JCS 3605 showed resistant reactions. The 21 sesame genotypes *viz.,* DT 116, JCS 3886, DT 97, JCS 3992, JCS 3893, JCS 3884, JCS 3596, JCS 2420, TK 4-22, GT 50, JCS 1020, ES-5, KMR 14-A, SI 248, ES-7, SI 885, JCS 3910, JCS 3881, JCS 2698, JCS 4018 and JCS 4013 showed moderately resistant reaction and 32 genotypes *viz.,* GPC 13-12, JCS 3895, JCS 3889, JCS 3739, DT 112, JCS 3755, JCS 3872, JCS 3898, JCS 3890, JCS 2477, RF4, RF2, JCS 3605, JCS 3599, JCS 3594, JCS 3751, JCS 2611, JCS 2696, JCS 3287, DT26, JCS 3202, SI 72-A, SI 1036, NIC 8011, SI 253, SI 1125, SI 1052, ES-15, ES-10, NIC 16226, PVT 224, JCS 3880 showed susceptible reaction against *A. catalaunalis.*

These results were in accordance with Panday *et al.* (2014), who reported that none of the entry was recorded as tolerant against *A. catalaunalis*. Mamta Devi Choudhary *et al.* (2018) who reported that, among 15 varieties of sesame against *A. catalaunalis* and, none were found

Table 1: Scoring method for evaluation of sesame genotypes against *A. catalaunalis*

Percent damage			
Leaf (A)	*Flower (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

Table 2: Grading method for evaluation of sesame genotype against *A. catalaunalis*

Cumulative score	*Grade*	*Degree of resistance*
0–1.0	1	Highly resistant (HR)
1.1–2.0	3	Resistant (R)
2.1–3.0	5	Moderately resistant (MR)
3.1–5.0	7	Susceptible (S)
5.1–9.0	9	Highly susceptible (HS)

Table 3: Screening data and reaction of sesame genotypes against leaf webber and capsule borer *A. catalaunalis* during late *kharif* 2018

S. No.	*Genotypes*	*Leaf damage (%)*	*Score (a)*	*Flower damage (%)*	*Score (b)*	*Capsule damage (%)*	*Score (c)*	*Cumulative score ((a+b+c)/3)*	*Grade*	*Reaction*
1	GPC 13-12	11.08	3	10.89	5	7.25	7	5.0	7	S
2	JCS 3895	14.95	3	6.87	3	6.21	7	4.3	7	S
3	JCS 3889	16.16	3	8.14	3	4.65	5	3.7	7	S
4	JCS 3894	6.16	1	3.56	1	2.12	3	1.7	3	R
5	DT 116	13.16	3	6.78	3	3.94	3	3.0	5	MR
6	JCS 3739	10.13	3	9.12	3	6.10	7	4.3	7	S
7	DT 112	14.93	3	10.71	5	7.62	7	5.0	7	S
8	JCS 3886	18.51	3	8.06	3	3.47	3	3.0	5	MR
9	JCS 3755	14.86	3	16.53	7	7.57	7	5.7	9	HS
10	JCS 3872	18.09	3	8.66	3	7.38	7	4.3	7	S
11	DT 97	10.48	3	5.16	3	4.41	5	3.7	7	S
12	JCS 3992	21.19	5	6.90	3	3.94	3	3.7	7	S
13	JCS 3893	7.12	1	8.12	3	3.57	3	2.3	5	MR
14	JCS 3884	8.87	1	3.71	1	3.87	3	1.7	3	R
15	JCS 3898	13.21	3	6.00	3	6.59	7	4.3	7	S
16	JCS 3890	16.53	3	8.12	3	7.58	7	4.3	7	S
17	JCS 2477	16.25	3	9.12	3	3.22	3	3.0	5	MR
18	RF4	20.51	5	7.02	3	6.70	7	5.0	7	S
19	RF2	16.93	3	5.48	3	3.27	3	3.0	5	MR
20	JCS 3596	11.88	3	3.31	1	3.04	3	2.3	5	MR
21	JCS 3578	15.85	3	5.94	3	6.00	5	3.7	7	S
22	JCS 3605	17.83	3	6.19	3	7.14	7	4.3	7	S
23	JCS 3599	15.66	3	8.12	3	4.11	5	3.7	7	S
24	JCS 3594	7.27	1	3.08	1	2.98	3	1.7	3	R
25	JCS3751	18.89	3	8.66	3	5.16	5	3.7	7	S
26	JCS 3593	9.98	1	4.12	1	4.57	5	2.3	5	MR
27	JCS 2611	14.45	3	12.07	5	5.53	5	4.3	7	S
28	JCS 2696	26.01	5	10.00	3	7.66	7	5.0	7	S
29	JCS 3287	16.77	3	7.69	3	9.05	9	5.0	7	S
30	JCS 3265	8.96	1	3.22	1	2.06	3	1.7	3	R
31	DT 26	21.65	5	9.94	3	6.34	7	5.0	7	S
32	JCS 2420	13.25	3	6.68	3	3.73	3	3.0	5	MR
33	JCS 3202	13.35	3	3.81	1	4.56	5	3.0	5	MR
34	TK 4-22	10.30	3	4.24	1	3.70	3	2.3	5	MR
35	GT 50	11.69	3	4.32	1	2.26	3	2.3	5	MR
36	JCS 1020	11.41	3	6.56	3	3.35	3	3.0	5	MR
37	SI 72-A	14.06	3	10.77	5	7.14	7	5.0	7	S
38	SI 1036	16.15	3	16.67	7	5.90	5	5.0	7	S
39	NIC 8011	13.81	3	8.00	3	7.43	7	4.3	7	S
40	SI 253	20.16	5	7.43	3	7.17	7	5.0	7	S
41	SI 1125	12.50	3	3.73	1	3.80	3	2.3	5	MR
42	ES-5	16.06	3	6.40	3	3.57	3	3.0	5	MR
43	SI 1052	30.43	7	12.34	5	7.46	7	6.3	9	HS

Cont....

S. No.	Genotypes	Leaf damage (%)	Score (a)	Flower damage (%)	Score (b)	Capsule damage (%)	Score (c)	Cumulative score ((a+b+c)/3)	Grade	Reaction
44	KMR 14-A	24.52	5	8.45	3	3.88	3	3.7	7	S
45	ES -15	8.51	1	9.56	3	3.53	3	2.3	5	MR
46	ES-10	11.43	3	6.56	3	5.77	5	3.7	7	S
47	NIC 16226	12.23	3	8.16	3	5.61	5	3.7	7	S
48	SI 248	10.31	3	7.48	3	5.03	5	3.7	7	S
49	ES-7	14.17	3	3.68	1	2.76	3	2.3	5	MR
50	SI 885	17.63	3	6.28	3	5.63	5	3.7	7	S
51	SI 9050	12.42	3	4.70	1	3.31	3	2.3	5	MR
52	PVT 224	23.49	5	5.10	3	7.57	7	5.0	7	S
53	JCS 3981	8.89	1	7.23	3	6.33	7	3.7	7	S
54	JCS 3910	9.09	1	4.26	1	2.75	3	1.7	3	R
55	JCS 3881	8.11	1	7.59	3	3.77	3	2.3	5	MR
56	JCS 3880	24.22	5	7.87	3	5.63	5	4.3	7	S
57	JCS 2698	13.25	3	6.25	3	5.69	5	3.7	7	S
58	JCS 4018	9.88	1	4.62	1	3.82	3	1.7	3	R
59	JCS 3605	7.12	1	4.76	1	3.85	3	1.7	3	R
60	JCS 4013	18.04	3	11.11	5	3.06	3	3.7	7	S
	TC 25 (S. check)	28.12	5	12.39	5	8.11	9	6.3	9	HS
	SI 250 (R. check)	6.68	1	1.75	1	3.26	3	1.7	3	R

HR: Highly Resistant, R: Resistant, MR; Moderately Resistant, S: Susceptible, HS: Highly Susceptible

Table 4: Screening data and reaction of sesame genotypes against leaf webber and capsule borer *A. catalaunalis* during late *kharif* 2019

S. No.	Genotypes	Leaf damage (%)	Score (a)	Flower damage (%)	Score (b)	Capsule damage (%)	Score (c)	Cumulative score ((a+b+c)/3)	Grade	Reaction
1	GPC 13-12	12.48	3	6.27	3	7.71	7	4.3	7	S
2	JCS 3895	11.89	3	5.77	3	6.12	7	4.3	7	S
3	JCS 3889	14.55	3	13.33	5	6.48	7	5.0	7	S
4	JCS 3894	5.78	1	1.90	1	2.16	3	1.7	3	R
5	DT 116	12.18	3	5.63	3	3.90	3	3.0	5	MR
6	JCS 3739	16.09	3	8.94	3	6.78	7	4.3	7	S
7	DT 112	15.04	3	6.16	3	6.76	7	4.3	7	S
8	JCS 3886	9.92	1	7.14	3	3.92	3	2.3	5	MR
9	JCS 3755	19.31	3	10.12	5	5.15	5	4.3	7	S
10	JCS 3872	18.05	3	8.20	3	5.75	5	3.7	7	S
11	DT 97	10.08	3	6.38	3	3.21	3	3.0	5	MR
12	JCS 3992	18.18	3	6.98	3	3.76	3	3.0	5	MR
13	JCS 3893	13.56	3	6.80	3	2.88	3	3.0	5	MR
14	JCS 3884	12.50	3	4.92	1	5.49	5	3.0	5	MR
15	JCS 3898	13.76	3	6.00	3	7.76	7	4.3	7	S
16	JCS 3890	12.29	3	12.24	5	6.76	7	5.0	7	S
17	JCS 2477	19.12	3	8.49	3	4.06	5	3.7	7	S

Cont....

S. No.	Genotypes	Leaf damage (%)	Score (a)	Flower damage (%)	Score (b)	Capsule damage (%)	Score (c)	Cumulative score ((a+b+c)/3)	Grade	Reaction
18	RF4	19.88	3	11.92	5	6.00	5	4.3	7	S
19	RF2	12.70	3	6.06	3	4.41	5	3.7	7	S
20	JCS 3596	11.64	3	4.76	3	3.06	3	3.0	5	MR
21	JCS 3578	8.89	1	2.70	1	3.83	3	1.7	3	R
22	JCS 3605	12.50	3	12.73	5	5.32	5	4.3	7	S
23	JCS 3599	14.09	3	5.51	3	7.75	7	4.3	7	S
24	JCS 3594	10.12	3	6.82	3	4.08	5	3.7	7	S
25	JCS3751	20.00	3	9.82	3	8.79	9	5.0	7	S
26	JCS 3593	8.21	1	4.53	1	2.25	3	1.7	3	R
27	JCS 2611	15.05	3	7.55	3	6.86	7	4.3	7	S
28	JCS 2696	24.05	5	5.56	3	6.99	7	5.0	7	S
29	JCS 3287	20.00	3	9.43	3	8.43	9	5.0	7	S
30	JCS 3265	8.12	1	2.00	1	2.01	3	1.7	3	R
31	DT 26	22.10	5	7.02	3	6.78	7	5.0	7	S
32	JCS 2420	13.00	3	4.55	1	3.85	3	2.3	5	MR
33	JCS 3202	13.33	3	6.90	3	4.78	5	3.7	7	S
34	TK 4-22	12.74	3	3.12	1	2.33	3	2.3	5	MR
35	GT 50	18.20	3	4.76	1	4.69	5	3.0	5	MR
36	JCS 1020	13.21	3	3.64	1	3.77	3	2.3	5	MR
37	SI 72-A	20.00	3	12.32	5	8.00	7	5.0	7	S
38	SI 1036	12.96	3	11.63	5	6.00	5	4.3	7	S
39	NIC 8011	21.05	5	12.50	5	5.77	5	5.0	7	S
40	SI 253	20.49	5	8.33	3	4.13	5	4.3	7	S
41	SI 1125	17.02	3	10.26	5	7.02	7	5.0	7	S
42	ES-5	11.76	3	5.26	3	3.39	3	3.0	5	MR
43	SI 1052	19.12	3	6.78	3	5.70	5	3.7	7	S
44	KMR 14-A	11.93	3	3.85	1	3.45	3	2.3	5	MR
45	ES -15	14.16	3	10.92	5	5.08	5	4.3	7	S
46	ES-10	12.39	3	10.26	5	6.41	7	5.0	7	S
47	NIC 16226	9.57	1	11.32	5	6.67	7	4.3	7	S
48	SI 248	20.01	5	2.13	1	3.75	3	3.0	5	MR
49	ES-7	11.77	3	4.55	1	3.66	3	2.3	5	MR
50	SI 885	17.89	3	2.38	1	5.36	5	3.0	5	MR
51	SI 9050	7.09	1	4.20	1	3.51	3	1.7	3	R
52	PVT 224	21.12	5	5.36	3	7.41	7	5.0	7	S
53	JCS 3981	6.80	1	4.20	1	2.56	3	1.7	3	R
54	JCS 3910	10.12	3	1.67	1	3.16	3	2.3	5	MR
55	JCS 3881	13.11	3	6.00	3	3.06	3	3.0	5	MR
56	JCS 3880	17.32	3	14.12	5	7.86	7	5.0	7	S
57	JCS 2698	16.80	3	3.85	1	4.92	5	3.0	5	MR
58	JCS 4018	15.38	3	2.63	1	2.18	3	2.3	5	MR
59	JCS 3605	8.76	1	1.64	1	3.95	3	1.7	3	R

Cont....

S. No.	*Genotypes*	*Leaf damage (%)*	*Score (a)*	*Flower damage (%)*	*Score (b)*	*Capsule damage (%)*	*Score (c)*	*Cumulative score ((a+b+c)/3)*	*Grade*	*Reaction*
60	JCS 4013	19.60	3	6.32	3	3.31	3	3.0	5	MR
	TC 25 (S. check)	26.18	5	11.12	5	8.33	9	6.3	9	HS
	SI 250 (R. check)	7.62	1	5.06	3	1.28	1	1.66	3	R

HR: Highly Resistant, R: Resistant, MR; Moderately Resistant, S: Susceptible, HS: Highly Susceptible

immune. Present results were in agreement with Balaji and Selvanarayan (2009) who reported that among 140 sesame accessions evaluated against leaf webber and capsule borer *A. catalaunalis*, none of the accessions was rated highly resistant (HR), but 14 accessions were categorized as resistant (R), while 110 accessions were susceptible (S) and 16 accessions were highly susceptible (HS). These results were also in accordance with Karuppaiah and Nadarajan (2013) who reported that the two genotypes as moderately resistant with a score of 3 and grade 5. These findings in agreement with Mishra *et al*. (2016) reported, based on the cumulative scoring, 13 accessions and resistant check SI-250 were rated as resistant.

Based on two years of screening data, it was summarized that the sesame genotypes *viz.,* JCS 3824, JCS 3265 and JCS 3605 consistently showed resistant reactions in both years. So, these genotypes can be useful in resistant breeding programs.

Acknowledgment

The authors would like to thank Professor Jayashankar Telangana State Agricultural University for providing financial assistance.

References

Ahirwar RM, MP Gupta and B Smita (2010) Bio ecology of leaf roller/ capsule borer, *Antigastra catalaunalis* (Dupochel). *Adv. Bioresour.* 1(2): 90-104.

Balaji K and V Selvanarayanan (2009) Evaluation of resistance in sesame germplasm against shoot webber and capsule borer. *Indian J. Plant Prot*. 37(1): 35-38.

Choudhary R, KM Singh and RN Singh (1986) Pest complex and succession of insect-pests in *Sesamum indicum* Linn. *Indian J. Ento*. 48: 428-438.

Karuppaiah V and L Nadarajan (2013) Host plant resistance against sesame leaf webber and capsule borer, *Antigastra catalaunalis* Duponchel (Pyraustidae: Lepidoptera). *African J. Agric. Res.* 8(37): 4674-80.

Mamta Devi Choudhary, KC Kumawat, MK Yadav and RG Samota (2018) Host plant resistance in sesame genotypes to *Antigastra catalaunalis* Dup. *J. Ento. Zool. Stud*. 6(1): 1012-15.

Mishra MK, SR Takhur, MP Gupta and Y Singh (2016) Field Screening of sesame accessions against leaf roller and capsule borer (*Antigastra catalaunalis* Dup.). *Indian J. Plant Genet. Resour.* 29(1): 8.

Narayanan US and L Nadarajan (2005) Evidence for a male-produced sex pheromone in sesame leaf webber*, Antigastra catalaunalis* (Duponchel) (Pyraustidae: Lepidoptera). *J. Curr. Science*. 88(4): 631-634.

Panday AK, Rajinibisen, Rajupanse and ARG Ranganatha (2014) Screening of different germplasm lines of sesame against capsule borer (*Antigastra catalaunalis* Dup.). *J. Environ. Empo. Econ.* 1: 25-29.

Prem Kishore (2001) Current status of host plant resistance in sorghum in Indian *J. Ento. Res*. 25(1): 1-20.

Sridhar PR and M Gopalan (2002) Studies on screening and mechanism of resistant against the *Antigastra catalaunalis. Entom*. 27: 365-375.

Srivastava (1993) *A textbook of Applied Entomology* Vol 2. Kalyani Publishers, India, pp 55-109.