International Journal of Educational Research and Development
www.journalofeducation.in
Online ISSN: 2664-7095, Print ISSN: 2664-7087
Received: 10-08-2021, Accepted: 26-08-2021, Published: 11-09-2021
Volume 3, Issue 3, 2021, Page No. 60-64

Calculate the economic injury level leaf webber & capsule borer to reduce the farmer production cost on sesame crop

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Abstract
A field trial was conducted at the Experimental farm of PC Unit Sesame and Niger (ICAR), at Breeder seed production of groundnut field, College of Agriculture, JNKVV, Jabalpur (Madhya Pradesh) during pre-rabi season, 2018 on TKG-22 variety. The correlation coefficient between the larval population and yield was found highly significant and relationship was found negative during the years. The regression equation showed that the yield of *sesamum* seeds was reduced by 1.16 q/ha for every increase of one larvae/plant during pre-rabi 2018. The economic injury level at 30 days after germination i.e., at pod initiation stage was found 0.74 larvae/plant for *sesamum* during pre-rabi 2018, respectively.

Keywords: economic injury level, *A. catalaunalis*, *sesamum*, larvae/plant, and significant

Introduction

Sesame (*Sesamum indicum* Linnaeus) is an important oilseed crop grown since the beginning of arable cultivation. India ranks first in area, production and export of sesame in the world. Sesame is called the queen of oilseed crops by virtue of oil it produces. In India, at present sesame occupies an area of about 1544.9 (000, ha) with an annual production of 715.7 (000, tones) and an average productivity of 463 kg/ha. (Anonymous 2018) [2]. It feeds on the tender foliage by webbing the top leaves and also bores into the flowers and capsules and cause up to 90 per cent yield loss (Ahuja and Kalyan, 2002) [1]. EIL is the lowest pest population density that will caused economic damage. It is the level at which damage can no longer be tolerated and therefore, at that point or before reaching that level, it is desirable to initiate deliberate control operation. The economic injury level at 40 days after germination *i.e.*, at pod initiation stage was found 0.26 and 0.23 larvae/quadrate for *sesamum* during *kharif* 2012 and 2013, respectively (Wazire and Patel, 2016) [7].

Materials and Methods

To maintain the stock culture of sesame leaf webber and capsule borer, larvae of *A. catalaunalis* were collected from the sesame field and brought to the laboratory for rearing. The larvae were kept in the petri dish for pupation. The larvae were provided with fresh food *viz*., tender leaves and flowers as their diet. The petri dish were clean every day to maintain sanitation and fresh diet was provided daily according to need. After pupation of larvae in silken cocoon, they all were collected and placed in another petri dish. The petri dish was kept inside the wooden rearing cage for the emergence of the adults. Sesame seedling planted in disposable plastic glass were placed inside the cage for oviposition and resting of moths. A swab of cotton dipped in 10 % honey solution was kept in rearing cage as a food for adults. The eggs laid on seedling were collected carefully by moistened camel hair brush and placed in the Petri dishes (7.5 cm x 2.0 cm) for hatching. The larvae thus obtained were used for artificial release to study the economic injury level trials. The sesame was sown in field condition and care was taken to avoid infestation by sucking insects and foliar diseases. The selected plants were covered with mosquito nets (screen cage) with the help of specially designed iron rods. In treatments T_1 to T_7 plants were protected to external damage by insect pests with the help of mosquito nets and known number of 2nd instar larvae were released in each cage according to the treatments. The known number of larval population according to the treatments were maintained till maturity of the crop by releasing fresh 2nd instar larvae and removes the old larvae after pupation. According to treatment, the numbers of larvae were transferred by means of soft camel hair brush. The plants were artificially infested at 20 days after germination. After introducing the larvae, the bottom of the cages were 19 sealed with mud to prevent the entry of other insects. Plants were periodically observed for pre and post infestation of other insect pests. In treatment T8 and T9 plants were grown in open condition, in treatment T8 insects were allowed to feed on the plants while in treatment T9 plants were protected to normal feeding by insect through foliar spray of profenofos 50% EC @ 2ml/l. Total three spraying were done, first at 30 DAS and subsequent sprayings were done at intervals of 15 days. The observations were recorded at vegetative (30 DAS), flowering (45 DAS) and capsule stages (70 DAS) by counting the number of damage and health leaves, flowers and capsule per plant respectively. After maturity the screen nets were removed and plants were harvested separately to record the yield data on per plant basis and converted to quintal/ha by using conversion factor (250000 plants/ha). Finally, the economic

injury level for *sesamum* leaf webber and capsule borer was calculate by fitting regression equation Y = a + bx, between the larval density and reduction in yield.

Yield loss in respective treatment = (Yield in completely protected treatment) - (Yield in respective treatment)

The EIL was computed based on the procedure given by Stone and Pedigo (1972) [6] and modified by Ongulana and Pedigo (1974) [5] using the following formula.

$$EIL = \frac{\text{Grain threshold}}{\text{Yield reduction per larvae}}$$

$$\text{Gain threshold} = \frac{\text{Management cost (Rs/ha)}}{\text{Market value of grain (Rs/q)}}$$

$$\% \text{ yield loss} = \frac{\text{Yield loss in respective treatment}}{\text{Yield in completely protected treatment}} \times 100$$

Result and Discussion

The experiment was conducted by adopting RBD with nine treatments including control having three replications. In treatments T1 to T7 plants were protected to external damage by insect pests with the help of mosquito nets and known number of 2nd instar larvae were released in each cage according to the treatments. The known number of larval population inside the cage was maintained till maturity of the crop. The larval population was maintained by releasing fresh larvae and removes the old larvae after pupation. In treatment T8 and T9 plants were grown in open condition, in treatment T8 insects were allowed to feed on the plants while in treatment T9 plants were protected to normal feeding by insect through foliar spray of profenofos 50% EC @ 2ml/l at 30, 45 and 60 days after sowing. During experiment it was observed that at vegetative stage the larvae of leaf webber and capsule borer thrived on the new shoots and in the reproductive stage on the flowers and young pods. The results obtained in the investigation are presented below.

Table 1: Percent leaf damage due to leaf webber and capsule borer at vegetative stage (30DAS).

Treatments	Larval Density	(%) Leaf damage at 30 DAS			Mean
		R1	R2	R3	
T1	1 larva/plant	12.14	11.9	12.5	12.18
		-20.39	-20.18	-20.7	
T2	2 larvae/plant	25.83	26.67	27.92	26.81
		-30.55	-31.09	-31.9	
T3	3 larvae/plant	36.67	37.86	37.09	37.2
		-37.27	-37.97	-37.52	
T4	4 larvae/plant	46.55	48.33	48.08	47.65
		-43.02	-44.04	-43.9	
T5	5 larvae/plant	59.82	60	59.34	59.72
		-50.66	-50.77	-50.38	
T6	6 larvae/plant	73.33	72.12	73.46	72.97
		-58.91	-58.13	-58.99	
T7	Control (No larvae)	0	0	0	0
		-4.05	-4.05	-4.05	
T8	Natural population no cage	30.95	30.36	30	30.44
		-33.8	-33.43	-33.21	
T9	Completely Protected (Spray)	4.42	5.83	4.36	4.87
		-12.14	-13.98	-12.05	
SEm ±		17.72			
C. D. (P = 0.05)		53.14			
CV (%)		10.5			

Table 2: Percent flower damage due to leaf webber and capsule borer at flowering stage (45 DAS).

Treatments	Larval Density	(%) Flower damage at 45 DAS			Mean
		R1	R2	R3	
T1	1 larva/plant	10.00 (18.43)	10.00 (18.43)	12.50 (20.70)	10.83
T2	2 larvae/plant	22.50 (28.32)	20.83 (27.16)	23.61 (29.07)	22.31
T3	3 larvae/plant	38.75 (38.50)	35.00 (36.27)	37.50 (37.76)	37.08
T4	4 larvae/plant	50.00 (45.00)	56.25 (48.59)	50.00 (45.00)	52.08
T5	5 larvae/plant	66.67 (54.74)	66.67 (54.74)	72.92 (58.64)	68.75
T6	6 larvae/plant	81.25 (64.34)	81.25 (64.34)	87.50 (69.30)	83.33
T7	Control (No larvae)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00
T8	Natural population no cage	33.04 (35.08)	35.42 (36.52)	37.50 (37.76)	35.32
T9	Completely Protected (Spray)	6.25 (14.48)	5.00 (12.92)	5.00 (12.92)	5.42
SEm ±		20.17			
C. D. (P = 0.05)		60.48			
CV (%)		11.38			

Table 3: Percent capsule damage due to leaf webber and capsule borer at maturity stage (70 DAS).

Treatments	Larval Density	(%) Capsule damage at 70 DAS			Mean
		R1	R2	R3	
T1	1 larva/plant	7.92 (16.34)	8.10 (16.53)	7.67 (16.08)	7.89
T2	2 larvae/plant	16.62 (24.06)	15.70 (23.34)	17.02 (24.37)	16.45
T3	3 larvae/plant	29.17 (32.69)	30.36 (33.43)	30.95 (33.80)	30.16
T4	4 larvae/plant	42.26 (40.55)	45.24 (42.27)	45.00 (42.13)	44.17
T5	5 larvae/plant	59.03 (50.20)	59.82 (50.66)	62.50 (52.24)	60.45
T6	6 larvae/plant	80.00 (63.43)	80.36 (63.69)	81.67 (64.65)	80.67
T7	Control (No larvae)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00
T8	Natural population no cage	19.29 (26.06)	21.79 (27.82)	23.61 (29.07)	21.56
T9	Completely Protected (Spray)	5.42 (13.47)	4.99 (12.90)	6.25 (14.48)	5.55
SEm ±		19.81			
C. D. (P = 0.05)		59.39			
CV (%)		12.64			

Table 4: Effect of larval population of leaf webber and capsule borer on seed yield of sesame (g/plant).

Treatments	Larval Density	Seed yield (g/plant)			Mean	Yield loss (g/plant)	Yield loss (%)
		R1	R2	R3			
T1	1 larva/plant	4.20	4.80	3.48	4.16	2.84	40.57
T2	2 larvae/plant	2.70	2.46	2.04	2.40	4.60	65.71
T3	3 larvae/plant	1.74	1.62	1.20	1.52	5.48	78.29
T4	4 larvae/plant	0.90	0.66	0.72	0.76	6.24	89.14
T5	5 larvae/plant	0.36	0.34	0.32	0.34	6.66	95.14
T6	6 larvae/plant	0.10	0.16	0.10	0.12	6.88	98.29
T7	Control (No larvae)	6.90	7.00	7.10	7.00	0.00	0.00
T8	Natural population no cage	2.28	2.82	1.56	2.22	4.78	68.29
T9	Completely Protected (Spray)	6.24	7.14	6.54	6.64	0.36	5.14
SEm ±		0.72					
C. D. (P = 0.05)		2.15					
CV (%)		8.19					

Table 5: Effect of larval population of leaf webber/capsule borer on seed yield of sesame (q/ha.).

Treatments	Larval Density	Seed yield (q/ha)			Mean	Yield loss (q/ha)	Yield loss (%)
		R1	R2	R3			
T1	1 larva/plant	10.50	12.00	8.70	10.40	7.10	40.57
T2	2 larvae/plant	6.75	6.15	5.10	6.00	11.50	65.71
T3	3 larvae/plant	4.35	4.05	3.00	3.80	13.70	78.29
T4	4 larvae/plant	2.25	1.65	1.80	1.90	15.60	89.14
T5	5 larvae/plant	0.90	0.85	0.80	0.85	16.65	95.14
T6	6 larvae/plant	0.25	0.40	0.25	0.30	17.20	98.29
T7	0.00 Control (No larvae)	17.25	17.50	17.75	17.50	0.00	0.00
T8	2.38 larvae/plant (natural population no cage)	5.70	7.05	3.90	5.55	11.95	68.29
T9	0.45 larvae/plant (completely Protected by three foliar spray of profenofos 50% EC)	15.60	17.85	16.35	16.60	0.90	5.14
SEm ±		1.22					
C. D. (P = 0.05)		3.65					
CV (%)		9.44					

Table 6: Larval population of *Antigastra* under protected condition (3 spraying of insecticides).

S. No.	Days after sowing	Days after sowing	Larval Population/plant			
			R1	R2	R3	Mean
1.	Crop saving spray	10 DAS	0.20	0.30	0.20	0.23
2.	-	20 DAS	0.40	0.50	0.40	0.43
3.	I st Spray	30 DAS	0.60	0.80	0.60	0.67
4.	2nd spray 45 DAS	40 DAS	0.70	0.80	0.90	0.80
5.	-	50 DAS	0.20	0.10	0.40	0.23
6.	3rd Spray	60 DAS	0.40	0.60	0.50	0.50
7.	-	70 DAS	0.30	0.20	0.40	0.30
Average population/plant			0.40	0.47	0.49	0.45

Table 7: Larval population of *Antigastra* under natural infestation condition (Open condition).

S. No.	Days after sowing	Larval Population/plant			
		R1	R2	R3	Mean
1.	10 DAS	1.40	1.20	1.30	1.30
2.	20 DAS	2.40	2.90	2.40	2.57
3.	30 DAS	3.20	2.70	2.90	2.93
4.	40 DAS	3.50	3.70	3.80	3.67
5.	50 DAS	3.30	3.50	3.60	3.47
6.	60 DAS	1.80	1.90	1.70	1.80
7.	70 DAS	0.80	1.10	0.90	0.93
Average population/plant		2.34	2.43	2.37	2.38

Table 8: Effect of larval population of leaf webber and capsule borer on percent leaf, flower and capsule damage and seed yield.

Treatments	Larval population/plant	Leaf damage (%)	Flower damage (%)	Capsule damage (%)	Seed yield		Losses in yield (%)
					(g/plant)	(q/ha)	
Larval population/plant	1						
Leaf damage (%)	0.99**	1					
Flower damage (%)	0.99**	0.99**	1				
Capsule damage (%)	0.99**	0.98**	0.99**	1			
Seed yield /plant (g/plant)	-0.92**	-0.93**	-0.90**	-0.85**	1		
Seed Yield (q/ha)	-0.92**	-0.93**	-0.90**	-0.85**	1	1	
Losses in yield (%)	0.92**	0.93**	0.90**	0.85**	-1.00	-1	1

Calculation of Economic Injury Level for *A. catalaunalis*

Spraying cost (Insecticide cost (3 spraying) Profenofos 50 EC (2 ml/l) + labour cost) = Rs.5142/ha

Market price of the produce is fixed 6000/q

Total cost was = 5142

$$\text{Gain threshold (GT)} = \frac{\text{Cost of plant protection measures (Rs/ha)}}{\text{Market price of the produce (Rs/q)}}$$

$$\text{Gain threshold (GT)} = \frac{5142}{6000} = 0.86$$

$$\text{Economic Injury Level (EIL)} = \frac{\text{Gain Threshold (GT)}}{\text{Regression coefficient}}$$

$$\text{Economic Injury Level (EIL)} = \frac{0.86}{1.16}$$

= 0.74 larvae/plant

Therefore, the Economic Injury Level (EIL) of leaf roller and capsule borer for sesame was 0.74 larvae per plant.

The method suggested by Stone and Pedigo (1972) [6] mainly depends on the market price of the produce and cost of plant protection; as a result EIL varies from time to time, crop to crop and locality to locality. This indicated that the EIL was directly related to the cost of control measures and inversely related to the market price of sesame. Present findings are supported by the findings of Manisegaran *et al.* (2002) [4] they reported that for increase in 1 larvae/m_2 the yield loss was 18 to 200 kg/ha during vegetative and reproductive stage of the crop. Wazire and Patel (2016) [7] they also reported that the the yield of *sesamum* seeds was reduced by 0.57 and 0.43 q/ha for every increase of one larvae/plant. The economic injury level of *Antigastra catalaunalis* was worked out to be 0.74 larvae per plant for TKG-22 variety of sesame. This means chemical control measures are to be imposed before *Antigastra catalaunalis* population reaching 0.74 larvae per plant so as to realize a profitable sesame crop production. So it is evident from the present studies that the management strategies should be imposed in the initial buildup of *Antigastra catalaunalis* larval population. The present findings are inconformity with the findings of Bhadoria (1997) [3] who reported the economic injury level of 1.01 and 1.18 larvae/quadrate of *A. catalaunalis* in *sesamum* at 40 days after germination *i.e.,* at pod initiation stage obtained with monocrotophos 0.04 per cent during *kharif* 1995 and 1996, respectively.

Table 9: Relationship between larval population of leaf webber and capsule borer versus sesame seed yield.

Treatments	Larval Density	Larval population of leaf webber andcapsule borer/plant (X)	Seed yield (q/ha) (Y)	XY	X^2
T1	1 larva/plant	1	10.4	10.4	1
T2	2 larvae/plant	2	6	12	4
T3	3 larvae/plant	3	3.8	11.4	9
T4	4 larvae/plant	4	1.9	7.6	16
T5	5 larvae/plant	5	0.85	4.25	25
T6	6 larvae/plant	6	0.3	1.8	36
T7	Control (0.00 larvae/plant)	0	17.5	0	0
T8	Natural population no cage (2.38 larvae/plant)	2.38	5.55	13.21	5.66
T9	Completely Protected through foliar spray of insecticide (0.45 larvae/plant)	0.45	16.6	7.47	0.2
		∑X=23.8	∑Y=62.90	∑XY=68.1	$\sum X^2$=96.87

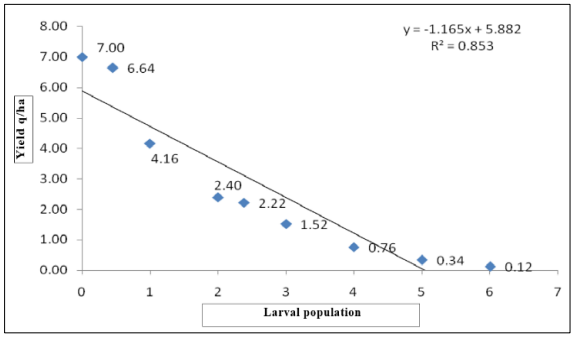

Fig 1: Relationship between larval population of leaf webber and capsule borer versus sesame seed yield.

Acknowledgement

The authors are grateful to Dr. A. K. Panday, Scientist/Assistant Professor, PC Unit Sesame and Niger, College of Agriculture, JNKVV, Jabalpur (M.P.) for providing the necessary laboratory and field facilities.

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