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Research Article

EVALUATION OF INSECTICIDE APPLICATION FREQUENCY TO CONTROL SESAME LEAF WEBBER *ANTIGASTRA CATALAUNALIS* (DUPONCHEL) AND MIRID BUG *CREONTIADUS DILUTES*

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Abstract

Sesame (*Sesamum indicum* L.), a member of the Pedaliaceae family, is referred to as the queen of oilseeds. There are numerous barriers to its production and productivity, including a lack of economically feasible and technically adequate manufacturing technology, but insect pests particularly, sesame leaf webber (*Antigastra catalaunalis*) and Mirid Bug (*Creontiadus dilutes)* play a prime role in declining its potential yield. In this study, five treatments, viz. T_1:2-WAE (weeks after emergence), T_2:2,4-WAE, T_3: 2,4,6 WAE, T_4: 2,4,6,8 WEA, T_5: weekly spray after emergence (positive control) and T_6: control (zero application of spray) spray were applied, while T5=weekly spray started one week after emergence, prior to the onset of *A. catalaunalis* infestation on the sesame crop and was continuously applied until the maturity of the crop. A Hand knap sack sprayer was used for the Polytrin C 440EC (Profenophos 400 G/L + Cypermethrin G/L) @500ml/acre application. The results revealed that the incidence of *A. catalaunalis* and *C. dilutes* throughout the season during both years (2022-23) was significantly different ($p < 0.001$) among all treatments. High insecticide application frequency lowers the leaf, flower and capsule damage, which ultimately decreases seed loss and enhances the end product, so it was observed that T_5: weekly spray after emergence (positive control) gave maximum control, followed by four-time spray application (T_4: 2, 4, 6, 8WEA) while maximum infestation was observed in T_6: control (zero application of spray), followed by T_1:2-WAE. Positive control gave the best results. It is suggested that three-time spray application was found to be most suitable for the management of both devastating insects. Based on evaluation, it appears that adjusting the frequency of insecticide application can effectively control sesame leaf Webber and mirid bug populations. However, it's important to balancer pest control with environmental concerns and resistance development.

Keywords: *Sesame leaf Webber, Mirid bug, application frequency, capsule damage, flower damage, pest incidence.*
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1. INTRODUCTION

Sesame (*Sesamum indicum* L.), a member of the Pedaliaceae family, is a historic traditional crop (Fuller, 2003) that is mostly farmed for oil in south Asian countries and African countries (Umar and Okoye., 2010; Bedigian, 2010), and is referred to as the "queen of oilseeds" (Tunde-akintunde and akintunde et al. 2004). Sesame is a valuable cover crop that is planted for food (dry seeds), feed (seed, leaves, and young branches), and other elements of the plant, such as flowers, are also effective in cancer treatment (Pusadkar et al., 2015). Chemically, seeds include 44–57 percent oil, 18–25 percent protein, and 13–14 percent carbohydrates (Borchani et al., 2010; Wei et al., 2022). Sesame may grow in a variety of soil types, but it thrives in well-drained, fertile, medium-textured soils (usually sandy loam) with a neutral pH. (Ashri., 1989; Tafere et al., 2012; Merga, 2021). According to FAO estimations, Honduras and Egypt generate the largest yields, with 1267 and 1063 kg/ha, respectively, but the potential of the varieties was 2000 kg/ha (Pakkisan 2022). There are numerous barriers to its production and productivity, including a lack of economically feasible and technically adequate manufacturing technology, but insect pests play a prime role in declining its potential yield. The insect invasion results in a significant loss of seed yield (between 25 and 90 percent) (Ahuja and Kalyan, 2002).

The leaf webber (*Antigastra catalaunalis*) is known as a major insect pest of sesame because it causes tremendous losses in crop yield every year. It attacks the crop throughout the growing season and feeds on almost all stages of the crop (Thakur and Ghorpade, 2006). The larvae of *A. catalaunalis* entered the tender shoots by webbing and feeding on top leaves. On the latter stages of crops, it bore into the flowers and capsules, so ultimately it deteriorated the seed and oil quality (Narayanan and Nadarajan, 2005, Karuppaiah 2014a). This insect pest results in infestations of leaves (10–70%), flower buds (34–62%), and capsules (10–44%) (Ahirwar et al. 2010) which can cause approximately 90% loss in yield (Egonyu et al 2005; Ahuja and Kalyan, 2002) because it is active throughout the year with about 12 overlapping generations (Cheema and Singh 1987 and Panday et al., 2021). Previously, Mirid bugs were treated as minor insect pests of different crops, including, sesame but climate change and the intense cropping system of sesame developed their status to as major pests of the sesame crop, particularly late sown crops (Jyothi, 2017). The adult mirid bugs look brownish along their semi-transparent brownish wings while the nymphs of mirid bugs are lighter in color with a brown thorax. Both adults and nymphs feed on the tender parts of the plants, including the leaves, tender shoots, flowering stage and pod/capsules ultimately deteriorate the end product.

A. catalaunalis and mirid bugs are getting more and more severe in the growing areas of Pakistan, attacking sesame from two weeks after emergence until threshing. Previous research were undertaken on pesticide efficacy either on mirid buds or leaf webber while Few studies have been undertaken on the insecticide application frequency and date of sowing of sesame to combat leaf webber infestation in different climatic conditions but both pests were not studied concurrently. In order to control both *A. catalaunalis* and mirid bug, farmers are spraying chemicals on their infected fields as much as 5-9 times, which raises the total production. But ultimately the end profit declines. Hence, the current study was designed to evaluate the pesticide application schedule (time and frequency of application) to retain the population of *A. catalaunalis* and *C. dilutes* below the ETL level. This is attributed to a knowledge gap on the time and frequency of application of the chemical.

2. MATERIALS AND METHODS

The sesame crop was sown at the research area of the Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad (31.4049,73.0504), during 2022–23. All recommended practices were used for crop growth.

2.1. Experimental Design

The experiment was conducted under natural conditions and RCBD (Randomized complete block design) designs with three replications were used. Each replication had a plot size of 10 by 10 meters. The paths between the two replications were 2 meters. The sesame seeds were planted at 40-50 cm inter-row spacing and 10cm inter-plant spacing (Lakew et al., 2018)

2.2. Treatments

When the larvae were first detected almost after 2 WAE (weeks after emergence), a broad-spectrum insecticide, Polytrin C 440EC (Profenophos 400G/L + Cypermethrin G/L) was applied at a dose rate of 500 ml/acre. The five treatments, viz., T1:2-WAE, T2:2,4-WAE, T3: 2,4,6 WAE, T4: 2,4,6,8 WEA, T5: weekly spray after emergence (positive control) and T6: control (zero application of spray) was applied while T5:weekly spray started one week after emergence, prior to the onset of *A. catalaunalis* and *C. dilutes* infestations on the sesame crop and continuously applied until the maturity of the crop. A hand knap sack sprayer was used for the Polytrin C 440EC application.

2.3. Data recording

- **Percentage pest incidence**: The data regarding insect incidence was recorded by counting the total number of infested parts (leaves, flowers and pods) of plant from randomly selected 25 plants from each replication on a fortnightly basis. The pest percentage incidence was calculated by using the following equation.

  *Percentage Pest incidence= (total number of infested plants/25)*100*
- **Percentage leaf damage:** The data regarding percentage leaf damage was counted by total number of damaged and healthy leaves from randomly selected five plants on a fortnightly basis. The leaves showed any attack by leaf webber and mirid bug i.e holed, borred or webbed leaves were considered damaged leaves.

  *Percentage leaf damage= (total number of damage leaves/total number of healthy leaves)*100*
- **Percentage flower damage:** It was calculated by counting the total number of damaged and healthy flowers from five randomly selected plants. Any damage to flower done by mirid bug, i.e borred/holed flower was considered as damaged flower.

  *Percentage flower damage= (total number of damage flower/total number of healthy flower)*100*
- **Percentage capsule/pod damage:** The percentage capsule or pod damage was calculated by counting the total number of damage/infested capsules/pods and healthy pods/capsules. Any damage to capsule caused by leaf webber i.e borred/holed capsule/pods were considered as damaged capsule or pods.

  *Percentage capsule/pod damage= (total number of damage pod/capsules/total number of healthy pods/capsules)*100*

2.4. Data analysis

The data was analysed using the computer software statistix 8.1. For post-ANOVA mean separation, for a parameter, the Tuckey test at 5% probability level was used (Steel *et al*., 1997).

3. Results and Discussion

The incidence of *A. catalaunalis* throughout the season during both years (2022-23) was significantly different ($p < 0.001$) among all treatments. The results revealed that high insecticide application frequency lowers leaf and capsule damage, which ultimately decreases seed loss and enhances the end product. Although the insect and its incidence could not be completely eliminated. Minimum leaf damage (4.60% and 5.05%) was observed in the case of positive control (weekly spray after emergence), followed by four applications (T4: 2,4,6,8 Weeks after emergence) (6.97% and 6.88%) while maximum damage was observed in control treatment (T6: control (zero application of spray) (30.52% and 29.57%) respectively during 2022-23 (Table 1&2). Similarly, in the case of pod/capsule damage, maximum percentage damage was observed in control treatment (T6: zero application of spray) (38.51% and 37.29%), followed by one time spray application (T1:2-WAE) (24.01% and 22.96%) while minimum capsule/pod damage was observed in positive control (weekly spray after emergence) (3.18% and 4.24%) followed by four applications T4: 2,4,6,8 WAE) (7.07% and 9.00%) (Table 1&2).

Table 01: Effect of insecticide application on seasonal percentage damage caused by Sesame Leaf Webber during year 2022.

Treatments	**% LD**	**% PD**
T_1:2-WAE (Weeks after emergence)	18.02B	24.01B
T_2:2,4-WAE (Weeks after emergence)	12.94C	18.01C
T_3: 2,4,6 WAE (Weeks after emergence)	10.06 D	12.90D
T_4: 2,4,6,8 WEA (Weeks after emergence)	6.97E	7.07 E
T_5: weekly Spray After emergence	4.60E	3.18 E
T_6 : Control (zero application of spray)	30.52A	38.51 A
CV	6.77	9.99
F Value	302.58	164.96
S.E %	0.7655	1.4088

***%LD= Percentage leaf damage, *%PD= Percentage Pod damage.**

Table 02: Effect of insecticide application on seasonal percentage damage caused by sesame. Leaf Webber during year 2023.

	% LD	**% PD**
T_1:2-WAE (Weeks after emergence)	18.57 B	22.96 B
T_2:2,4-WAE (Weeks after emergence)	13.44 C	17.69 BC
T_3: 2,4,6 WAE (Weeks after emergence)	11.00 C	13.72 CD
T_4: 2,4,6,8 WEA (Weeks after emergence)	6.88 D	9.00 DE
T_5: weekly Spray After emergence	5.05 D	4.24 E
T_6 : Control (zero application of spray)	29.57 A	37.29 A
CV	8.3	11.92
F Value	174.27	94.38
S.E %	0.9622	1.7024

***%LD= Percentage leaf damage, *%PD= Percentage Pod damage**

Similar results were observed by Reddy in 1996, who described that weekly spraying and twice at 2 and 4-WAE spraying might potentially reduce the bug's incidence to 26 and 56% respectively. In order to effectively control *A. catalaunalis*, endosulfan 0.07% application was found to be most effective at 30 and 45 days after sowing of crop. The studies of Gebregergis et al., 2018, Wazire and Patel, 2015 and Karuppaiah et al., 2014b also had similar conclusion that As soon as the rains begin, sesame crop should be sown for less attack of insect pest complex particularly *A. catalaunalis* while Two insecticide application treatments (2,4 WAE) should be applied to retain the insect below ETL level for successful management of *A. catalaunalis*. Sasikumar, et al 2015 also described the results in the row that four application of insecticide gave the lowest leaf damage (4.0%) as compared to the check plot (11%). Similar studies on insecticide spray application on sesame by Akinyemi et al., 2015 revealed that with high application of lambda-cyhalothrin sprayed plot lowed the leaf and capsule damage (2 % each), as compared to the unsprayed plots. Nayak et al., 2015 and Asikumar and Kumar, 2015 also determined the similar results and revealed that capsule borer affect the leaf, flower and capsule stage and declined the net profit but these results are partially co relate with current studies.

Similar trends of incidence throughout the season were observed in the case of sesame mirid bug (*Creontiadus dilutes*). All the treatments were significantly different ($p < 0.001$) during both years of study. Similarly, the mirid bug was not completely eradicated from treated fields but may be managed below the ETL level to enhance the quality and quantity of the end product.

treatment (T6: control (zero application of spray) (6.21% and 5.95%) respectively,

Table 03: Effect of insecticide application on seasonal percentage damage caused by sesame Mirid bug during year 2022.

Treatments	**% LD**	**% FD**	**% PD**
T_1:2-WAE (Weeks after emergence)	4.38 B	5.46 B	3.14 B
T_2:2,4-WAE (Weeks after emergence)	3.88 BC	4.55 C	2.97 B
T_3:2,4,6WAE (Weeks after emergence)	3.43 CD	3.80 CD	2.82 B
T_4: 2,4,6,8 WEA (Weeks after emergence)	2.81 D	3.28 D	1.62 C
T_5: weekly Spray After emergence	1.33 E	1.95 E	0.86 C
T_6 : Control (zero application of spray)	6.21 A	6.83 A	5.78 A
CV	7.71	7.31	9.51
F Value	99.35	87.94	114.40
S.E %	0.2313	0.2576	0.2225

***%LD= Percentage leaf damage, *%FD=Percentage flower damage *%PD= Percentage Pod damage**

Table 04: Effect of insecticide application on seasonal percentage damage caused by sesame Mirid bug during year 2023.

Treatments	**% LD**	**% FD**	**% PD**
T_1:2-WAE (Weeks after emergence)	4.64 B	5.94 A	3.34 B
T_2:2,4-WAE (Weeks after emergence)	3.65 C	4.47 B	3.25 B
T_3: 2,4,6 WAE (Weeks after emergence)	3.44 C	4.22 B	2.83 BC
T_4: 2,4,6,8 WEA (Weeks after emergence)	2.64 D	3.08 BC	1.47 CD
T_5: weekly Spray After emergence	1.65 E	2.27 C	0.71 D
T_6 : Control (zero application of spray)	5.95 A	7.16 A	5.98 A
CV	6.23	11.45	16.96
F Value	130.46	36.17	40.35
S.E %	0.1864	0.4235	0.4064

***%LD= Percentage leaf damage, *%FD=percentage flower damage *%PD= Percentage Pod damage**

Minimum damage percentage at leaf stage due to *C. dilutes* (1.33% and 1.65%) was observed in the case of positive control (weekly spray after emergence), followed by four applications (T4:2, 4, 6, 8 Weeks after emergence) (2.81% and 2.64%) while maximum damage was observed in control during 2022-23 (Table 3&4). In the case of percentage damage at the flowering stage, similarly, minimum percentage damage was observed in positive control (weekly spray) (1.95% and 2.27%) followed by T4:2, 4, 6 ,8 weeks after emergence (3.28% and 3.08%), while maximum damage was observed in T6: control (zero application of spray) (6.83% and 7.16%), similarly, in the case of pod/capsule percentage damage, maximum percentage damage was observed in the control treatment (T6: zero application of spray) (5.78% and 5.98%), followed by one-time spray application (T1:2-WAE) (0.86% and 0.71%), while minimum capsule/pod damage was observed in the positive control (weekly spray after emergence) (1.62% and 4.24%), followed by four application T4: 2, 4, 6, 8WAE) (7.07% and 1.47%) respectively, during year 2022-23 (Table 3&4). Moïse et al., 2014 conducted studies on efficacy and time of spray of different insecticides on different doses to control mirid bug and concluded that an insecticide application consists of two distinct treatments spaced one month apart. The purpose of the second treatment is to eradicate grubs that emerge from eggs that withstood the first treatment. To control 90% or more of mirids, 0.150 L/ha, or 30 g.ma/ha, is the suggested dose. The research work of Moise is partially correlated with the present studies because he has worked on different crop, "cocoa." Devaiah et al., 2020 executed experiment to evaluate the nine insecticides to control the sesame mirid bug and recommended that seed treatment along with foliar sprays of imidacloprid 60 FS and thiamethoxam 25 WG @ 0.3 g/l found to be effective to control the mirid bug, followed by flonicamid 50 WG @ 0.4 g/l. Our studies are partially correlated because the objective of the study was to evaluate the insecticide frequency to control the mirid bug and leaf webber at a time but Devaiah et al., 2020 focused only on the bio-efficacy of insecticides on mirid bug.

4. Conclusion

This study concluded that positive control (weekly spray application) gave the best results, but three-time spray application was found to be most suitable for the management of both devastating insets to retain under the ETL level. Based on evaluation, it appears that adjusting the frequency of insecticide application can effectively control sesame leaf Webber and mirid bug populations. However, it's important to balancer pest control with environmental concerns and resistance development.

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