

Original Research Article

<https://doi.org/10.20546/ijcmas.2017.607.364>

The Effect of Non-ionic Infrared (IR) on Some Stages of Fig Moth, *Ephestia cautella* (Walk) Lepidoptera: Pyralidae

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A B S T R A C T

This study was carried out to determine non-ionic infrared waves effect to control important stored insects as an alternative technique which reduces the chemical pesticide usage. The insect *Ephestia cautella* was used as a sample of store insects. Eggs, larvae, pupa and adults were exposed to different time (15, 30 and 60second) at 40 °C. Results also showed that infrared waves (IR) had ability to kill different stages of *E. cautella*. And this effect increased by increasing of exposure period. The highest percentage mortality at 60 second exposing period reached 44, 38, 27.1 and 48% for egg, second larval instars', pupa and adult, respectively as compared with 3.3, 1.3, 0 and 0% in the control treatments respectively, and decline percentage mortality to 24, 22,17 and 22% at 30 second % for egg, second larval instars', pupa and adult, respectively. The results of this study demonstrated the importance of further studies to assess the efficiency of infrared waves to control other insect.

Keywords

Non-ionic
infrared, Fig moth,
Ephestia cautella.

Article Info

Accepted:
26 June 2017
Available Online:
10 July 2017

Introduction

Ephestia cautella (Walk) (Lepidoptera: Pyralidae) is considered one of the most important pests of dates; as it is attacking many crops including walnuts, almonds, raisins, figs and grapes, that causes economic losses as cause damage (Al Hussain and Jafar.1968). The risk occur due tendency of larvae to feed into the crop (Al-Taweel, *et al.*, 1990). The store insects are often controlling by using the chemical pesticides, but this methods, which have many problems, such as pest resistance against pesticides (Kabbashi, *et al.*, 2012). So, researchers found other alternative methods by which store insects can be controlled, like gamma irradiation (Boshra. 2007). One of the promised alternative methods is the non-ionic infrared

(IR), this method, which is depended on the application of electromagnetic radiation (0.78 up to 1000 nm) (Ramaswamy, *et al.*, 2012). It is a band of energy in the complete electromagnetic spectrum and it is longer than visible light and shorter than microwaves (Penner, 1998).

The flameless catalytic infrared radiation it has been effectively used for protection stored control three insect, *Rhyzopertha dominica*, *Sitophilus oryzae* and *Tribolium castaneum* (Khamis, 2009) The research was aimed to determine the effects of non-ionic infrared waves (IR) on biological aspect of *Ephestia cautella* was used as a sample of store insects.

Materials and Methods

Ephestia cautella was obtained from University of Baghdad/ college of Agriculture/ plant protection / Entomology Lab, and the culture was created by putting adults on wheat seeds in 11 cm X 25 cm plastic containers.

5 grams of dry bread yeast were added and then the culture was covered with a fine cloth. The cover was fitted with a rubber band to prevent the adults from leaving it. The culture was incubated at $28 \pm 2^{\circ}\text{C}$ and $60 \pm 2\%$ relative humidity and kept until the experiment time.

Infrared (IR)

Infrared was generated by locally device with Halogen lamp hard glass 250 W, double reflector system and tungsten heat radiator in quartz tubes (Commercially name as InfraPhil infrared lamp, made by PHILIPS - Korea). This device can generate Infrared energy (up to 1400 nm). The system was provided with a cooler and thermometer to watch the temperature as specific in Technical Data

Infrared impact on *E. cautella* 24 hour old eggs

10 eggs with three replicates were used in the experiment; put in Petri dishes and then the dishes were put in infrared device for different exposure times (15, 30 and 60 seconds) at 40°C . Dishes were moved to incubator at $28 \pm 2^{\circ}\text{C}$ and $60 \pm 2\%$ relative humidity; mortality ratio and hatching period were recorded.

Effect of infrared on 2nd instars' larvae of *E. cautella*

The second instars' larvae were got by separating the eggs and following up their

progress instars until reaching the second instar larvae's. and using 10 larvae's with three replicates ; put in Petri dishes and then the dishes were put in infrared device for different exposure times (15, 30 and 60 seconds) at 40°C .

Dishes were moved to a at $28 \pm 2^{\circ}\text{C}$ and $60 \pm 2\%$ relative humidity, mortality ratio and larval stage period were recorded.

Effect of infrared on 24 hour old pupa of *E. cautella*

24 hour old pupa were collected by flowing up larva until reaching pupa stages, and using 10 pupas with three replicates ; put in Petri dishes and then the dishes were put in infrared device for different exposure times (15, 30 and 60 seconds) at 40°C . Dishes were transport to a at $28 \pm 2^{\circ}\text{C}$ and $60 \pm 2\%$ relative humidity, mortality ratio and pupal period were recorded.

Effect of infrared on 24 hour adults of *E. cautella*

24-hours old adults, were collected by flowing up pupa until development to adults put into in 8.5 X 2.5 cm test tube and put into IR device for three different exposure period (15, 30 and 60 sec) at 40°C with three replicates for each treatment in addition the control treatment.

Mortality of adults was recorded after exposure to IR.

Statistical analysis

The Statistical Analysis System- SAS (2012) program was applied to find effect of difference factors in study parameters. Least significant difference –LSD test was used to significant comparative between means in this research.

Results and Discussion

Effect of the infrared on 24 hour old eggs of *E. cautella*

The results showed (Table 1) a significant effect of IR on the eggs mortality. The highest percentage killing of eggs was 44% at 60 seconds exposure and decline to 24%, 7% at 30, 15 exposure time respectively. As for the hatching period no significant differences between all treatments, Through the results noted increased kill of eggs by increasing of exposure time, Similar results were obtained by Khamis *et al.*, (2010) When exposed flameless catalytic infrared radiation on *R. dominica*.

Effect of the infrared on 2nd instar larvae of *E. cautella*

The results showed that there was a positive relationship between the increasing time exposure and the percentage of second larval mortality. The percentage killing was 38%, 22% and 3.5% at (15, 30 and 60second) exposure time, respectively, the longest larval stage period was 6.5 for 60 seconds while it was the 30-second exposure which showed 5 days and decline to 4.3 days at 15 seconds. The control treatment recorded mortality rate 1.3% and 4.1 days period larval stage (Table 2). That results agreement with Duangkhamchan, 2017 when using Infrared Heating against *Sitophilus oryzae*.

Table.1 Effect of the infrared on 24 hour old Eggs of *E. cautella*

Tempters	Exposure time	Mortality rates %	Hatching period (days)
40	15	7 c	4.5 b
	30	24 b	5.0 ab
	60	44 a	5.8 a
	Control	1.3 d	4.5 b
LSD value		4.092 *	1.025 *
* (P<0.05).			

Table.2 Effect of the infrared on 2nd Instar larvae of *E. cautella*

Tempters	Exposure time	Mortality rates %	Larval stage period (Days)
40	15	3.5 c	4.3 b
	30	22 b	5.0 b
	60	38 a	6.5 a
	Control	1.3 c	4.1 b
LSD value		5.016 *	1.284 *
* (P<0.05).			

Table.3 Effect of infrared on 24 hour old pupa of *E. cautella*

Tempters	Exposure time	Mortality rates %	Papal stage period (Days)
40	15	0 c	5.3 a
	30	17 b	5.5 a
	60	27.1 a	6.1 a
	Control	0 c	5.0 a
LSD value		4.673 *	1.266 NS
* (P<0.05).			

Table.4 Effect of infrared on 24 hour adults of *E. cautella*

Exposure time	Mortality rates %
15	7.1 c
30	22 b
60	48 a
Control	0 d
LSD value	5.228 *

Effect of infrared on 24 hour old pupa of *E. cautella*

Data presented in table 3 shows that percentage of pupa mortality was 27.1% at 60 seconds exposure period and decline to 17 % at 30 seconds while don't recorded mortality ratio at 15 exposure time and control treatment, and pupal stage period not significantly increase from control at all treatments.

Effect of infrared on 24 hour adults of *E. cautella*

The results of experiment showed (Table 4) a significant effect of Infrared on the adult at 60 seconds, the kill ratio was 48% as compared with control treatment. While it was 22, 7.1 % at 30, 15 seconds respectively, and control treatment not recorded any mortality ratio on adults. Results agreed with (Abd Elghffar, et al., 2012) when used gamma radiation on the *Ephestia cautella* he founded mortality rates increased when increase exposure time. It can be concluded from all results that there is a positive relationship between exposure time and mortality ratio, when exposure time is raised than mortality ratio become high.

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How to cite this article:

Sarah Ibrahim Mahmood. 2017. The Effect of Non-ionic Infrared (IR) on Some Stages of Fig Moth, *Ephestia cautella* (Walk) Lepidoptera: Pyralidae. *Int.J.Curr.Microbiol.App.Sci.* 6(7): 2581-2585. doi: <https://doi.org/10.20546/ijcmas.2017.607.364>