

**EFFECT OF FOOD HOST TYPE , EXPOSURE TIME IN
RESPONSIBILITY OF DIFFERENT STAGE OF *Trogoderma granarium*
Everts **KHABRA BEETLE FOF MICROWAVE RADIATION UNDER
STORAGE IN BAGS****

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ABSTRACT

The results of food kind exposed to radiation exhibited a different mean mortality on adults reached 52.41 ,58.70 ,50.37 and 52.41% and for percent egg hatch reached 12.96 ,17.78 ,18.33 and 18.33% while the mean mortality in larvae reached 45.56 ,46.48 ,41.30 and 38.15%, and the percentage of pupae transformation to adults reached 47.96 , 46.80 , 45 ,43.52%.Results were positively proportion with increasing the energy levels reached 22.08 , 64.86 , 65.14% for larvae , while the mean percentage of eggs hatchling and the means percentages of pupae transformation to adults decrease with increasing energy levels reached 23.61 , 17.66 and 10.28% for egg hatching , and 58.61 , 40.31 and 29.17% for pupae transformation .The means of adults and larvae mortality increase with increasing the exposure period to radiation reached 31.39 , 58.06 , 72.78 , 75.83 and 76.94% , and 21.67 ,41.39 ,54.72 ,64.44 and 74.17% respectively. Means of eggs hatching percentage and pupae transferred to adults were proportionally decrease with increasing the exposure period. Also the storage of bags affected on mortality of adults Khapra beetle , which reached in bags 5.83%. Compared without bags reached zero, and the mean percentage of eggs hatching in bags treatment decrease reached 31.67% compared without bags reached 100%. While it was no differences in the larvae mortalities of both treatments . Also the pupae transferred to adults were proportionally decrease in bags treatment reached 89.17% compared in controlling without bags reached 100%.

Key Words: Microwave , *Trogoderma granarium* , Sacked grains .

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INTRODUCTION

Stored grains and its products infected by stored insects during storage . The loss in stored grains by insects to attacking plants in the field. Which caused economic damage to store products *Trogoderma granarium* is one khapra beetle of the most serious pest of stored products in warm regions of the worlds. In Iraq it consider a primary pest of grains during storage especially on wheat, barley, cowpea, sesame, rice and the heavy infestation caused a complete damage to the grain because it prefer the germ of the grain and can not used in agriculture (Al-Iraqi 2010).

Many controlling measures were used against the stored products pests especially fumigation gases and insecticides . The adverse effects of chemical

control on environment and public health , as example the recent studies revealed that methyl bromide affect the ozone layer . Therefore the international societies attempt to adopt a plant to stop using methyl bromide and insecticides during beginning of 2005 in addition to that the appearance of resistant to insecticides (Mansor 1997). So it is necessary to look for alternative method to control the stored grains insects with any side effects.

Using microwave measure to control stored grain insects exhibited no adverse effects and control the insects successfully (Ayvas 2008) (Vadivambal 2009). Microwave radiation also kill the insects present in and out of the grains (Halverson, et al. 1999) , a study done by(Ismail 1998) proved that microwave radiation produced a good effect in killing all stages of red flour beetle and khapra beetle and ranged between 0-43.7% at energy levels 250-500 watt. While (Vadivambal, R.; D.S. Jayas and N.D.G. White 2007) found that the all adults of red flour beetle , Rusted grain beetle and grain weevil were kind when exposed for 28 Sec. to energy level 500 watt , (Yousif 2012). Confirmed that microwave radiation killed also the red flour beetle , Saw toothed grain beetle and Khapra beetle when exposed to 100, 300, 600 and 900 watt. Of energy for 10, 30, 60 ,90 and 120 Sec. respectively .

The aim of this study is to find the effect of the sacked host kind and energy level and exposure period an adults and larval mortality , eggs hatching and pupation and adults emerge percentage respectively of Khapra beetle.

MATERIAL & METHODS

In this study we used two kinds of wheat (Hard and Soft wheat) and two kinds of barley (Black and White barley) and Khapra beetles were reared on each host for more than one generation to obtain stages of insect used in experiment. And exposed to microwave radiation using microwave oven (Cookworks) using three levels of energy (200, 500 and 800 watt) for five intervals (15, 30 , 45, 60 and 90 Sec.).

Exposure to Radiation :

- 1- **Exposure of Adults:** Fifty grams from each host mixed with 25 adults of Khapra beetle and put in bags made from fabric and measure 7x15 cm. three replicates were used for each host with control treatment . After exposure the samples were transported to incubator under $27\pm 2^{\circ}\text{C}$ and 70% relative humidity and the result will take mortality percentage of adults after 24h.
- 2- **Exposure of eggs:** In this study prepared 1Kg. from each varieties and add 100 pairs of insect adults after 72 hours to ensure the egg-laying insects were lifted from the grain , Fifty grams from each host put in bags made from fabric and measure 7x15 cm. three replicates were used for each host and control treatment . after exposure the samples were transported to incubator under $27\pm 2^{\circ}\text{C}$ and 70% R.H. and after 5 days eggs hatching been calculate for all treatments .
- 3- **Exposure of Larvae :** Taken Fifty grams from each host mixed with 25 third instars larvae of Khapra beetle and put in bags made from fabric and measure 7x15 cm. three replicates were used for each host and control treatment. After exposure the samples were transported to incubator under

27±2°C and 70% R.H. and the result will take mortality percentage of larvae after 24h.

- 4- **Exposure of pupae:** Taken Fifty grams from each host mixed with 25 pupae and put in the same bags mentioned previously. three replicates were used for each host and control treatment. After exposure the samples were transported to incubator under 27±2°C and 70% R.H. and the result will taken pupae transferred to adults after exit all living adults.

The results were analyzed statistically using (C.R.D.) and using Duncan's test used to test the significant between means depending on (SAS). The values of correlation and equation of regression between mortality percentage , energy levels and exposure time were calculated (SAS. 2002).

RESULTS AND DISCUSSION

Infected sacked host kinds by *Trogoderma granarium* exposed to microwave showed a significant difference between the means of adults mortality percentages according to host kinds and reached the highest value 58.70% on soft wheat var. Semeto (Table 1). The previous table also showed that the means of adults mortality percentages were increased as increasing energy level (200, 500, 800 watt) and reached 22.08 , 64.85 and 73.47% respectively . from table (1) also we found a significant difference between the means of adults mortality percentage as increasing the exposure period to microwave radiation in comparison with control and from the interference between the sacked host kinds and energy level we found that the highs adults mortality percentage occurred on soft wheat var. Semeto and reached 78.89% , while the lowest mean of adult motility percentage found on white barley at energy level 200 watt and reached 15.56%. From the same table the results of the study showed that the storage of bags affected the killing of adults Khapra beetle , As the means of mortality in bags control var. reached 0, 6.67, 13.33 and 3.33% respectively compared treatment without bags reached zero.

Table (2) illustrate that the infected sacked host kinds energy level and time exposure to microwave radiation produced a different effects on the mean percentage of eggs hatching of khapra beetles the statistical analysis showed no significant different between the means of eggs hatching percentages according to sacked host kinds . From table (2) the mean of eggs hatching increased as increasing energy level and reached 23.61 , 17.66 and 10.28% respectively . the results of statistical analysis also revealed that there is a significant difference between the means of eggs hatching and energy levels and the mean eggs hatching percentage decreased with increasing the exposure period. In comparison with control .The interference results between the a lower mean of eggs hatching percentage and reached 7.78% at 800 watt energy on hard wheat var. Tamose 2 while the highest eggs hatching percentage and reached 26.67% on black barley at 200 watt energy . From the same table showed the mean percentage of eggs hatching in bags control var. decrease reached 30, 40, 26.67 and 30% respectively compared without bags reached 100%.

Table (1) Effect of food host type and period of exposure in response adult Khabra beetle to microwave radiation under storage in bags.

Host Type Food	Energy level / watt	Mean of adults mortality%						General mean effect		
		Exposure period \ sec.						Inter. Between Varieties & energy level	Host Type Food	Energy level
		Control	15	30	45	60	90			
Hard Wheat Tamuz 2	200	0.00 n	0.00 n	33.33 f-k	16.67 j-n	23.33 i-n	46.67 efg	20.00 f		
	500	0.00 n	33.33 f-k	50.00 d-g	100 a	96.67 a	100 a	63.33d		
	800	0.00 n	53.33 def	93.33 a	96.67 a	100 a	100 a	73.89 ab		
Soft Wheat Semito	200	6.67 lmn	23.33 i-n	26.67 h-m	43.33 f-i	43.33 f-i	50 d-g	32.22 e		
	500	6.67 lmn	43.33 f-i	50 d-g	90.00 ab	100 a	100 a	65.00 cd		
	800	6.67 lmn	70.00 bcd	96.67 a	100 a	100 a	100 a	78.89 a		
Wheat Barly	200	13.33 k-n	6.67 lmn	16.67 j-n	23.33 i-n	16.67 j-n	16.67 j-n	15.56 f		
	500	13.33 k-n	23.33 i-n	66.67 cde	90.00 ab	93.33 a	90.00 ab	62.78d		
	800	13.33 k-n	40.00 f-j	83.33 abc	100 a	100 a	100 a	72.78 abc		
Black Barly	200	3.33 mn	16.67 j-n	16.67 j-n	30.00 h-l	36.67 f-k	20.00 j-n	20.56 f		
	500	3.33 mn	36.67 f-k	86.67 abc	83.33 abc	100 a	100 a	68.33 bcd		
	800	3.33 mn	30.00 g-l	76.67 abc	100 a	100 a	100 a	68.33 bcd		
General mean effect	Inter. Between Host Type & Exposure Times	H. W. Tamuz 2	0.00 k	28.89 g	58.89 def	71.11 a-d	73.33 abc	82.22 ab		52.41 b
		S. W. Semito	6.67 jk	45.56 g	57.78 ef	77.78 abc	81.11abc	83.33 a		58.70 a
		Wheat Barly	13.33 ij	23.33 hi	55.56 fg	71.11 a-d	70.00 bcd	68.89 cde		50.37 b
		Black Barly	3.33 jk	27.78 h	60.00 def	71.11 a-d	78.89 abc	73.33 abc		52.41 b
	Inter. Between Energy Level & Exposure Times	200	5.83 g	11.67 g	23.33 f	28.33 ef	30.00 ef	33.33 ef		22.08 c
		500	5.83 g	34.17 e	63.33 c	90.83 ab	97.50 ab	97.50 ab		64.86 b
		800	5.83 g	48.33 cd	87.50 b	99.17 a	100 a	100 a		73.47 a
Exposure times \ sec.		5.83 d	31.39 c	58.06 b	72.78 a	75.83 a	76.94 a			

Means with different letters in the same sectors showed a significant different at p= 5%
% Mortality control without bags = zero

Table (2) Effect of food host type and period of exposure Khabra beetle to microwave radiation on percentage of hatching eggs under storage in bags.

Host Type Food	Energy level / watt	Mean of percent eggs hatch %						General mean effect		
		Exposure period \ sec.						Inter. Between Varieties & energy level	Host Type Food	Energy level
		Control	15	30	45	60	90			
Hard Wheat Tamuz 2	200	30.00abc	26.67 abc	13.33 abc	13.33 abc	10.00 abc	10.00 abc	17.22 abc		
	500	30.00abc	13.33 abc	20.00 abc	10.00 abc	6.67 abc	3.33 bc	13.89 abc		
	800	30.00abc	13.33 abc	0.00 c	0.00 c	0.00 c	3.33 bc	7.78 c		
Soft Wheat Semito	200	40.00 a	23.33 abc	16.76 abc	36.67 ab	16.67 abc	13.33 abc	24.44 ab		
	500	40.00 a	13.33 abc	23.33 abc	6.67 abc	10.00 abc	6.67 abc	16.67 abc		
	800	40.00 a	26.67 abc	6.67 abc	0.00 c	0.00 c	0.00 c	12.22 bc		
Wheat Barly	200	26.67abc	26.67 abc	26.67 abc	26.67 abc	33.33 abc	16.67 abc	26.11 a		
	500	26.67abc	20.00 abc	33.33 abc	6.67 abc	13.33 abc	16.67 abc	19.44 abc		
	800	26.67abc	20.00 abc	6.67 abc	0.00 c	0.00 c	3.33 bc	9.44 c		
Black Barly	200	30.00abc	30.00 abc	30.00 abc	30.00 abc	13.33 abc	26.67 abc	26.67 a		
	500	30.00abc	20.00 abc	30.00 abc	3.33 abc	10.00 abc	6.67 abc	16.67 abc		
	800	30.00abc	33.33 abc	0.00 c	0.00 c	6.67 c	0.00 c	11.67 bc		
General mean effect	Inter. Between Host Type & Exposure Times	H. W. Tamuz 2	30.00 ab	17.78 b-e	11.11 b-e	7.78 de	5.56 e	5.56 e	12.96 a	
		S. W. Semito	40.00 a	21.11 b-e	15.56 b-e	14.44 b-e	8.89 cde	6.67 e	17.78 a	
		Wheat Barly	26.67a-d	22.22 a-e	22.22 a-e	11.11 b-e	15.56 b-e	12.22 b-e	18.33 a	
		Black Barly	30.00 ab	27.78 abc	20.00 b-e	11.11 b-e	10.00 cde	11.11 b-e	18.33 a	
	Inter. Between Energy Level & Exposure Times	200	31.67 a	26.67 a	21.67 abc	26.67 a	18.33 a-d	16.67 a-e	23.61 a	
		500	31.67 a	16.67 a-e	26.67 a	6.67 c-f	10.00 b-e	8.33 b-f	17.66 b	
		800	31.67 a	23.33 ab	3.33 def	0.00 f	1.67 ef	1.67 ef	10.28 c	
Exposure times \ sec.		31.67 a	22.22 b	17.22 bc	11.11 c	10.00 c	8.89 c			

Means with different letters in the same sectors showed a significant different at p= 5%

% Mortality control without bags = 100

The results of table (3) showed that there is no significant effect of sacked host kind on the mean mortality percentage of khapra larvae , the results of table (3) showed that increasing energy levels (200, 500, 800 watt) increased the larvae mortality percentages and reached 23.06 , 40.42 , 65.14% respectively. The means mortality of larvae increased as increasing the time of exposure to radiation and reached 21.67 , 41.30 , 54.72 , 64.44 and 74.17% at 15 , 30 , 45 , 60 and 90 Sec. respectively in comparison with control treatment which reached 0.83% . The results of statistical analysis revealed a significant difference between the means of larvae mortality percentages and time of exposure to radiation and control. The interaction results between sacked host kind and energy level showed that the highest mean of larvae mortality noticed on hard and soft wheat at energy level 800 watt reached 68.89 , 68.33% respectively , while the lowest mean of larvae mortality percentage found on black barley at 200 watt an reached 7.22% (Table 3). From the same table there was no effect of the bags in means mortality Khapra beetle larvae between comparison bags and non bags .

The results of table (4) showed that the sacked host kind exhibit no significant effect on mean percentage of transforming pupae to adults . the results of the same table showed that the mean percentage of pupae transformation to adults were decreased as increasing the energy level (200, 500 ,800 watt) and reached 58.61 , 49.31 , 29.17% respectively . The statistical analyses confirmed a significant difference between the means of the pupae transformation percentages to adults and energy levels. The mean transformation of pupae reduced as increasing the exposure period 15, 30 , 45, 60 and 90 Sec. reached 63.78 , 45.60 , 35.83 , 25.56 and 15.28% respectively in comparison with 89.17% for control. At the same time were a significant different between the means of pupae transformation and exposure time and control . the results of interaction between sacked host kinds and energy levels showed that the lowest pupae transformation to adults occurred on white barley at 800 watt energy and reached 27.22%, while the highest mean of pupae transformation occurred on soft wheat var. Semeto at energy level 200 watt and reached 60%. showed pupae transferred to adults were proportionally decrease in controlling bags reached 89.17% compared in controlling without bags reached 100% (Table 4). This results agreed with (AL-Ebady and Marwa 2018) were found that the means of mortality percentages of all stages of *Callosobruchus maculatus* increased as increasing the level of energy and time of exposure, and agreed with (AL-Ebady and Mohammed 2018) were found that the lethal dose of energy reduce the percentage of transformation of larvae to pupae and pupae to adults .

The values of coefficient factor and the regression equation between mortality percentage of the all stages of Khapra beetle and energy level and time of exposure were listed in table (5) and showed that larvae and pupae were more affected by exposure to microwave radiation on studied host in comparison with adults and eggs . The highest value of coefficient factor for pupae transformation occurred on soft wheat var. Smeto reached 91.5 . the linear regression equation revealed that increasing energy levels and exposure

Table (3) Effect of food host type and exposure period in response Larvae Khabra beetle to microwave radiation under storage in bags.

Host Type Food	Energy level / watt	Mean of mortality%						General mean effect		
		Exposure period \ sec.						Inter. Between Varieties & energy level	Host Type Food	Energy level
		Control	15	30	45	60	90			
Hard Wheat Tamuz 2	200	3.33 ij	6.67 hij	13.33 f-j	43.33 a-j	40.00 a-j	56.67 a-j	27.22 cde		
	500	3.33 ij	36.67 a-j	40.00a-j	46.67 a-j	53.33 a-j	66.67 a-i	41.11 bcd		
	800	3.33 ij	20.00 d-j	86.67 abc	100 a	100 a	100 a	68.33 a		
Soft Wheat Semito	200	0.00 j	16.67 e-j	13.33 f-j	43.33 a-j	46.67 a-j	53.33 a-j	28.89 cde		
	500	0.00 j	36.67 g-j	36.67 a-j	46.67 a-j	56.67 a-j	73.33 a-g	41.67 bcd		
	800	0.00 j	43.33 a-j	83.33 a-d	90.00 ab	100 a	96.67 a	68.89 a		
Wheat Barly	200	0.00 j	3.33 ij	6.67 hij	13.33 f-j	36.67 a-j	53.33 a-j	18.89 de		
	500	0.00 j	40.00 a-j	40.00 a-j	53.33 a-j	60.00 a-j	76.67 a-f	45.00 bc		
	800	0.00 j	16.67 e-j	66.67 a-i	80.00 a-e	96.67 ab	100 a	60.00 ab		
Black Barly	200	0.00 j	6.67 hij	10.00 g-j	10.00 g-j	33.33 c-j	43.33 a-j	17.22 e		
	500	0.00 j	16.67e-j	23.33 c-j	36.67 a-j	56.67 a-j	70.00 a-j	33.89 cde		
	800	0.00 j	16.67 e-j	76.67 a-f	93.33 ab	93.33 ab	100 a	63.33 ab		
General mean effect	Inter. Between Host Type & Exposure Times	H. W. Tamuz 2	3.33 f	21.11 def	46.67 a-e	63.33 abc	64.44 abc	74.44 a	45.56 a	
		S. W. Semito	0.00 f	32.22 cde	44.44 a-e	60.00 abc	67.78 ab	74.44 a	46.48 a	
		Wheat Barly	0.00 f	20.00 def	37.78 b-e	48.89 abcd	64.44 abc	76.67 a	41.30 a	
		Black Barly	0.00 f	13.33 ef	36.67 b-e	46.67 a-e	61.11 abc	71.11 ab	38.15 a	
	Inter. Between Energy Level & Exposure Times	200	0.83 h	8.33 gh	10.83 fgh	27.50 e-h	39.17 def	51.17 b-e	23.06 c	
		500	0.83 h	32.50 d-g	35.00 d-g	45.83 cde	56.67 bcd	71.67 abc	40.42 b	
		800	0.83 h	24.17 e-g	78.33 ab	90.83 a	97.50 a	99.17 a	65.14 a	
Exposure times \ sec.		0.83 h	21.67 d	41.39 c	54.72 bc	64.44 ab	74.17 a			

Means with different letters in the same sectors showed a significant different at p= 5%

%Mortality control without bags = zero

Table (4) Effect of food host type and exposure Khabra beetle to microwave radiation on percentage of transforming pupae to adults under storage in bags.

Host Type Food	Energy level / watt	Mean of percent of pupae transformed to adult%						General mean effect		
		Exposure period \ sec.						Inter. Between Varieties & energy level	Host Type Food	Energy level
		Control	15	30	45	60	90			
Hard Wheat Tamuz 2	200	93.33 a	73.33 a-e	56.67 a-h	56.67 a-h	36.67 d-i	40.00 d-i	59.44 a		
	500	93.33 a	73.33 a-e	53.33 a-h	56.67 a-h	36.67 d-i	20.00 ghi	55.56 a		
	800	93.33 a	43.33 c-g	23.33 ghi	13.33 hi	0.00 i	0.00 i	28.89 c		
Soft Wheat Semito	200	90.00 ab	76.67 a-d	56.67 a-h	56.67 a-h	50.00 b-h	30.00 f-i	60.00 a		
	500	90.00 ab	63.33 a-g	46.67 c-h	36.67 d-i	30.00 f-i	16.67 hi	47.22 ab		
	800	90.00 ab	50.50 a-h	33.33 f-i	16.67 hi	0.00 i	0.00 i	31.67 bc		
Wheat Barly	200	90.00 ab	66.67 a-f	63.33 a-g	60.00 a-g	43.33 c-h	23.33 ghi	57.78 a		
	500	90.00 ab	73.33 a-e	53.33 a-h	26.67 f-i	36.67 d-i	20.00 ghi	50.00 a		
	800	90.00 ab	33.33 e-i	26.67 f-i	13.33 hi	0.00 i	0.00 i	27.22 c		
Black Barly	200	83.33 abc	76.67 a-d	63.33 a-g	53.33 a-h	46.67 c-h	20.00 ghi	57.22 a		
	500	83.33 abc	66.67 a-f	50.00 b-h	26.67 f-i	26.67 f-i	13.33 hi	44.44 ab		
	800	83.33 abc	56.67 a-h	20.00 ghi	13.33 hi	0.00 i	0.00 i	28.89 c		
General mean effect	Inter. Between Host Type & Exposure Times	H. W. Tamuz 2	93.33 a	63.33 bcd	44.44 c-f	42.22 d-g	24.44 f-i	20.00 ghi		47.96 a
		S. W. Semito	90.00 a	63.33 bcd	45.56 c-f	36.67 e-h	26.67 f-i	15.56 hi		46.80 a
		Wheat Barly	90.00 a	57.78 cde	47.78 c-f	33.33 f-i	26.67 f-i	14.44 hi		45.00 a
		Black Barly	83.33 ab	66.67 bc	44.44 c-f	31.11 f-i	24.44 f-i	11.11 i		43.52 a
	Inter. Between Energy Level & Exposure Times	200	89.17 a	73.33 abc	60.00 bcd	56.67 bcd	44.17 d-g	28.33 fgh		58.61 a
		500	89.17 a	69.17 bc	50.83 cde	36.67 efg	32.50 e-h	17.50 hi		49.31 b
		800	89.17 a	45.83 de	25.83 gh	14.17 hi	0.00 i	0.00 i		29.17 c
Exposure times \ sec.		89.17 a	63.78 b	45.60 c	35.83 c	25.56 d	15.28 e			

Means with different letters in the same sectors showed a significant different at p= 5%
% Mortality control without bags = 100

Table (5) Regressions equation and effect rate of the relation mortality Khabra beetle and microwave energy level and exposure time.

Host type food	Adults		percent of hatching eggs		Larvae		ratio of the conversion of pupae to adults	
	Effect rate	Regressions equation	Effect rate	Regressions equation	Effect rate	Regressions equation	Effect rate	Regressions equation
Hard Wheatt Tamuz 2	73.4	$Y=18.84+1.0797X-0.00472X^2$	66.8	$Y=23.08+0.2529X$	81.2	$Y=13.556+0.80007X$	83.8	$Y=78.9-0.7735X$
Soft Wheat Semito	75.5	$Y=26.75+0.7990X$	63.3	$Y=33.67-0.69123X$	89.6	$Y=3.5913+1.6265X-0.009405X^2$	91.5	$Y=73.16-0.7132X$
Whaet Barly	61.6	$Y=22.63+0.7408X$	60	$Y=24.957+0.089X-0.006870X^2$	87.2	$Y=7.093+0.8548X$	87.2	$Y=79.816-1.0665X+0.00317X^2$
Black Barly	77.83	$Y=17.374+1.054X$	54.9	$Y=31.87-0.4687X+0.007801X^2+0.0000645X^3$	88.43	$Y=5.5016+0.80516X+0.000528X^2$	89.7	$Y=75.853-0.8085X$

Y: Mortality Khabra beetle
X₁: Microwave energy level
X₂: Exposure time

period increase mortality percentage of insect stages on sacked soft wheat . the lowest value of coefficient factor for eggs hatching percentage found on black barley and reached 54.9.

تأثير نوع العائل الغذائي ومدة التعريض في استجابة الأطوار المختلفة لخنفساء الحبوب الشعرية
(الخابرا) *Trogoderma granarium* للأشعة المايكروية تحت ظروف الخزن المكيسة

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الخلاصة

أظهرت نتائج الدراسة تباين تأثير نوع العائل الغذائي للأشعة المعرضة اذ بلغت نسبة القتل 52.41 و 58.70 و 50.37 و 52.41% للكاملات و 12.96 و 17.78 و 18.33 و 18.33% لفقس البيض و 45.56 و 46.48 و 41.30 و 38.15% لليرقات و 47.96 و 46.80 و 45 و 43.52% لنسبة تطور العذارى الى كاملات فيما بينت النتائج تناسب متوسطات نسب قتل الكاملات واليرقات تناسباً طردياً مع زيادة مستويات الطاقة اذ بلغت 22.08 و 64.86 و 73.47% للكاملات و 23.06 و 40.42 و 65.14% لليرقات فيما تناسب متوسطات نسب قتل فقس البيض ونسبة تطور العذارى الى كاملات تناسباً عكسياً مع زيادة مستويات الطاقة اذ بلغت 23.61 و 17.66 و 10.28% لفقس البيض و 58.61 و 49.31 و 29.17% لنسبة تحول العذارى الى كاملات ، وأظهرت نتائج البحث تناسب متوسطات قتل الكاملات واليرقات تناسباً طردياً مع زيادة مدة التعريض اذ بلغت 31.39 و 58.06 و 72.78 و 75.83 و 76.94% للكاملات و 21.67 و 41.39 و 54.72 و 64.44 و 74.17% لليرقات فيما تناسبت متوسطات فقس البيض ونسبة تطور العذارى الى كاملات تناسباً عكسياً مع زيادة مدة التعريض .وأظهرت نتائج الدراسة ان للخزن بالاكياس اثر في قتل كاملات الخابرا اذ بلغ متوسط نسب القتل في المقارنة المكيسة 5.83% مقارنة بمعاملة المقارنة بدون اكياس والتي بلغت صفر ، كما كان لها اثر واضح في خفض متوسط نسبة فقس البيض اذ بلغ في المعاملة المكيسة 31.67% مقارنة بمعاملة المقارنة بدون اكياس والتي بلغت 100% ، فيما لم يكن للاكياس اثر واضح في متوسط قتل اليرقات في معاملة المقارنة المكيسة وبدون اكياس ، الا انه ظهر للخزن بالاكياس فرق واضح في متوسط تحول العذارى الى كاملات في معاملة المقارنة المكيسة اذ بلغ 89.17% مقارنة بمعاملة المقارنة بدون اكياس وبلغت 100%.

الكلمات الدالة: الأشعة المايكروية، *Trogoderma granarium* ، حبوب مكيسة .

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