USING FREEZING TEMPERATURES AS A CONTROL METHOD AGAINST THE OASIS DATE MOTH, *EPHESTIA CALIDELLA* (GUEN) IN STORED DATE FRUITS

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Abstract

Two degrees of freezing temperatures (-10 and -15°C) was tested as a control method against two stages of *Ephestia calidella* infesting packed tamr inside carton boxes, cellophane and plastic bags. The obtained results could be summarized generally that carton boxes, cellophane and plastic bags at (- 10 °C) for periods from 3.0 –4.5 hours or (– 15°C) for periods from 3.0 – 4.0 hours is sufficient to disinfest date fruits from the insect infestation.

Results indicated generally that the tested insect freezing temperature, consequently, carton boxes required longer exposure periods than cellophane and plastic bags to give a complete control against the tested insect.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is one of the oldest and important cultivated crops in the world. The Middle East is the primary date growing region in the world. It is also the largest consumer of date's especially Arab countries, which consume large quantities during the fasting month of Ramadan. In Egypt, palm plantations represented by more than 13 million trees producing the largest quantity in Arab world, where the annual production reached 1.170.000 thousand tons of fresh, semi - dry and dry fruits each year, nearly 21.5% from this amount is dry date varieties (AECA, 2006). Ali, *et al.* (2001/2002) stated that date fruits pests caused 20-73.3 % loss of tamr annually which consequently shortage production.

On the other hand, the Oasis date moth, *E. calidella* is a major pest of date fruits pre and post harvest, which causes high economical loss. Hussain (1986) showed that the infestation with *C. calidella* (Guen.) appeared in July. infestation in fallen dates was higher than that of date bunches.

For a number of years, the use of extreme temperatures, particularly low temperatures, has been extensively used to control stored product insects. The advantages of physical control methods are that: (1) there are no residues are left on the product after treatment, (2) they are effective against insecticidal resistant strains,

and (3) there are few risks for operators.The aim of this investigation is evaluating freezing temperature as a control method against tested insect in stored date fruits

MATERIALS AND METHODS

1- The tested insect

Oasis date moth was considered a major pest for date fruits (pre and post harvest) namely, *Ephestia calidella* (Guen.) (Lepidoptera: Phycitidae) was used in this study.

2. Tested temperatures and exposure period

Two freezing temperatures were used as control methods against stored dates insect pest. Temperatures used were -10 and -15 °C in deep freezers. The exposure periods were 0.5, 1.5, 3.0, 3.5, 4.0 and 4.5 hrs. Exposure times were chosen to cover the range of lethal times.

3. Tested bags

Three different types of bags were tested for this study, one of them made of small corrugated cardboard (carton box), the second made of cellophane while the third was from plastic (0.5 kg. capacity each).

4. Experiments procedure

The experiments were started by using carton boxes, cellophane and plastic bags as aforementioned. Each carton box and plastic bag contained 250 g. of Frihi date that artificially infested with two stages of tested insect.

A: Infestation by the larval stage, where twenty five larvae (0-1 day old) of *E. calidella* was added to each kind of bags and well closed and kept under lab. Conditions. Each treatment was replicated three times. After twenty five days from the artificial infestation, the bags were exposed to -10 and -15°C. After exposure time, freezing dates of each treatment bags were transferred carefully into glass jars (0.5 kg capacity each) covered with muslin cloth, secured with rubber bands and incubated at 26±0.5°C and 65±5 % R.H. until adult emergence. When adult emergence ceased, percentage of emerged adults was recorded and reduction % was calculated. Three replicates were used for the control.

B: Infestation by the egg stage: hundered eggs (1 day old) of *E. calidella* was added to each bags and replicated three times, then, enclosed well and directly exposed to the same previous low temperature degrees and periods as mentioned before. After 10 days of exposure, cooling dates of each bag were transferred into glass jars (0.5 kg capacity each) covered with muslin and incubated under 26 ± 0.5 and 65 ± 5 % till adult emergence, survival adults were recorded according to Donahaye *et al* (1995).

8. Statistical analysis of the obtained data

The data obtained of the different sets of experiments were statistically analyzed according to Fisher (1950) and Duncan's multiple range test Duncan (1955).

RESULTS AND DISCUSSION

Freezing temperatures as *E. calidella* disinfestations

Two degrees of freezing temperatures (-10 and -15°C) were tested as a control method against two stages of the *Ephestia calidella* infesting tamr packed inside carton boxes, cellophane and plastic bags.

1. Using carton boxes

Results in Table (1) and illustrated in Fig. (1, 2) showed latent exposure effect of freezing temperatures against *E. calidella* eggs (1day old) and larvae (25 days old) inside carton boxes containing tamr. This effect expressed as emerged adult mean and reduction % compared with untreated carton boxes. It was clear that there were negative correlation between the length of the exposure time and emerged adults %. The obtained results showed that the emerged adult percentages were 31.0 and 49.33 % (with 8.81 and 9.77 % reduction) for eggs and larvae, respectively at -10 °C freezing temperature after 0.5 hours exposure. Significantly and gradually decreasing of emerged adults was recorded by increasing exposure period to reach 0.0 % (100 % reduction) after 4 and 4.5 hours for eggs and larvae respectively. At the freezing temperature (-15 °C) the emerged adult percentages significantly decreased by increasing exposure time up to 0.0 % (100 % reduction) after 3.5 and 4.0 hours for eggs and larval stages, resp. Egg stage was more sensitive than larval stage to both freezing degrees.

2. Using cellophane bags

The obtained results in Table (2) and illustrated in Fig. (1, 2) reported that at freezing temperature (-10°C) after 0.5 hour the emerged adult percentages were 25.0 and 40.0 % (with 24.24 and 21.06 % reduction) for eggs and larval stages, resp., significant decrease of emerged adult % was recorded with increasing exposure times up to 0.0 % (100 % reduction) recorded after 3.5 hours for the two stages. At freezing temperature (-15°C), no emerged adults (100 % reduction) were observed after 3.0 hours for both stages. From the results of the two freezing degrees, it seemed clearly that the two stages (eggs and larvae) were more susceptible to freezing temperatures in cellophane bags than those in carton boxes. Also, it was observed from the data of both freezing degrees that there was significant difference between the percentage of resulting emerged adults from both of the exposed larvae and eggs.

3. Using plastic bags

The results of Table (3) and illustrated in Fig. (1, 2) revealed that a similar trend was observed as mentioned in case of cellophane bags at both freezing degrees (-10 and -15 °C). At freezing temperature (-10°C), the emerged adult percentages were 20.0 and 34.67 % (with 9.09 and 23.52 % reduction) for egg and larval stages, resp. after 0.5 hours. After 3.5 hours, the reduction % reached 100 % for the two stages. Regarding freezing temperature (-15°C), it was noticed that the time required to attain complete suppression of emerged adult (100 % reduction) was 3.0 hours for the two stages.

These results are in agreement with those obtained by Gharib and El-Lakwah (2007) who reported that reduction of eggs hatchability and adult survival percentages were obviously increased by rising exposure periods at 0.0, -5.0 and -10.0 °C. Eggs of *E. cautella* were more sensitive to cold storage than *P. interpunctella*. Exposing eggs of both species for three days at -5.0 and -10.0 °C, affected its embryonic development and stopped its development. Storing home amounts of dates at -5.0 and -10.0 °C for at least 3 days was sufficient to protect dates from early moth infestation.

These results also, agreed with that obtained by Mullen and Arbogast (1979) who stated that exposure of 9 hrs at -10°C was sufficient to kill 95 % of *E. cautella* eggs. Similar findings were reported by.Burges (1956) who found that large larvae of *E. cautella* were more resistant to cold than smaller larvae or eggs. The shortest exposures necessary prevent large larvae becoming adults were about one day at -1°C., five days at 0°C., 32 days at 5°C and 83 days at 10°C.

In general, these results indicated that *Ephestia calidella* may be easily controlled by the freezing temperatures available in commercial freezers by keeping packed tamr (0.5 kg) in carton, cellophane and plastic bags in freezers (-10 and -15 °C) for 3.0-4.5 hours to protect tamr from the insect infestation.

Also, these results indicated generally that *Ephestia calidella* in carton boxes were more tolerant than those in the other bags to freezing temperature, consequently, carton boxes required longer exposure periods than cellophane and plastic bags to give a complete control against tested insect.

It concluded that there are many factors, such as freezing degree, exposure period and insect stage in addition to bag materials can be required to determine the time needed to kill all individuals.

Table 1. Effect of freezing temperatures at different exposure times against two stages of *E.calidella* existed in carton boxes

Freezing degrees	Exposure times (hrs)	Eggs		Larvae	
		Means of emerged adults	Reduction %	Means of emerged adults %	Reduction %
-10	0.5	31.0±2.65a	8.81	49.33±4.8ab	9.77
	1.0	25.33±1.0b	25.5	42.0±1.15bc	23.18
	1.5	19.0±2.65c	44.12	34.67±3.5c	36.58
	3.0	5.67±1.45d	83.32	14.67±2.6d	73.17
	3.5	2.0±0.58de	94.12	10.67±1.3d	80.48
	4.0	0.0e	100	6.67±2.67de	87.80
	4.5	0.0e	100	0.0e	100
Control		34.0±2.31 a	-	54.67±3.5a	-
F. test		**	-	**	-
LSD 0.05		5.08	-	8.57	-
-15	0.5	30.33±1.4a	10.79	45.33±1.3b	17.08
	1.0	22.67±0.3b	33.32	34.67±2.4c	36.58
	1.5	15.0±2.08c	55.88	24.0±4.00d	56.10
	3.0	2.67±0.88d	92.15	9.33±1.33e	82.93
	3.5	0.0d	100	5.33±1.33ef	90.25
	4.0	0.0d	100	0.0f	100
	4.5	0.0d	100	0.0f	100
Control		34.0±2.31a	-	54.67±3.5a	-
F. test		**	-	**	-
LSD 0.05		3.77	-	6.67	-

Means in each columns followed by different letters are significantly different from each other at $P < 0.05$ (Duncan's test)

Table 2. Effect of freezing temperatures at different exposure times against two stages of *E. calidella* existed in Cellophane bags

Freezing degrees	Exposure times (hrs)	Eggs		Larvae	
		Means of emerged adults	Reduction %	Means of emerged adults	Reduction %
-10	0.5	25.0 ±1.15b	24.24	40.00±4.62ab	21.06
	1.0	19.67±1.64c	40.39	36.0±5.03b	28.95
	1.5	14.33±2.19d	56.58	32.0±6.11b	36.85
	3.0	2.00 ±0.58	93.94	9.33±1.33 c	81.56
	3.5	0.0e	100	0.0c	100
	4.0	0.0e	100	0.0c	100
	4.5	0.0e	100	0.0c	100
Control		33.00±1.53a	-	50.67±5.33a	-
F. test		**	-	**	-
LSD 0.05		3.59	-	11.33	-
-15	0.5	23.00±1.53b	30.30	36.0±4.00b	28.95
	1.0	14.67±1.09c	55.55	30.00±3.05bc	40.79
	1.5	9.00±2.08d	72.73	24.00±3.31c	52.63
	3.0	0.0e	100	0.0d	100
	3.5	0.0e	100	0.0d	100
	4.0	0.0e	100	0.0d	100
	4.5	0.0e	100	0.0d	100
Control		33.00±1.53a	-	50.67±5.33a	-
F. test		**	-	**	-
LSD 0.05		3.38	-	8.15	-

Means in each columns followed by different letters are significantly different from each other at $P < 0.05$ (Duncan's test)

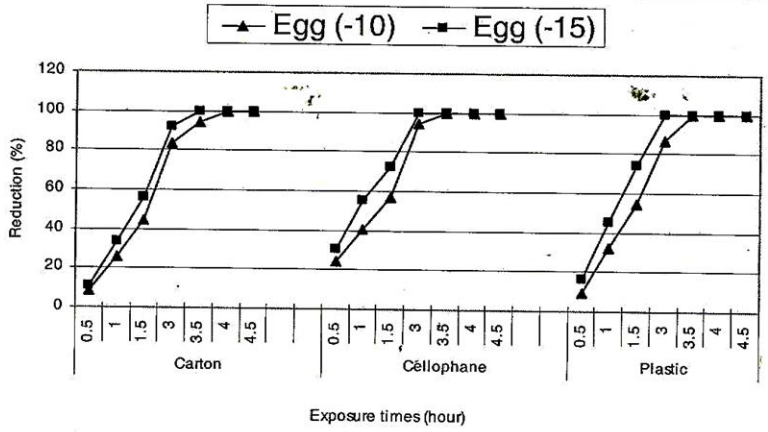

Fig. 1. Reduction percentage of emerged adult from *E. calidella* eggs (1 day old) existed in different bags exposed to freezing temperatures with different exposure periods

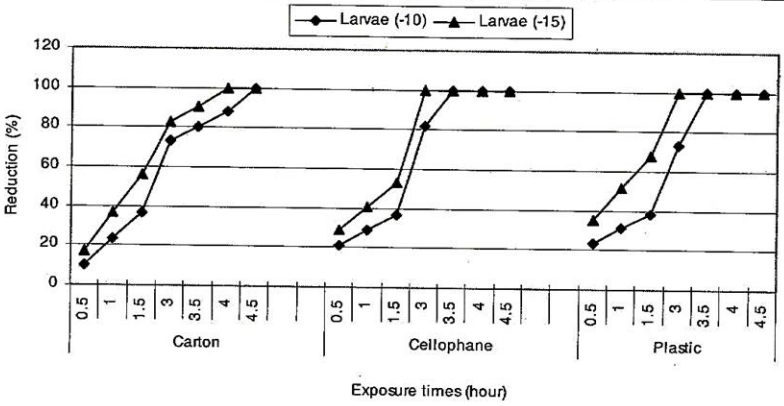

Fig. 2. Reduction percentage of emerged adult from *E. calidella* larvae (25 days old) existed in different bags exposed to freezing temperatures with different exposure periods

Table 3. Effect of freezing temperatures at different exposure times against two stages of *E.calidella* existed in Plastic bags

Freezing degrees	Exposure times (hrs)	Eggs		Larvae	
		Means of emerged adults	Reduction %	Means of emerged adults	Reduction %
-10	0.5	20.00±0.58a	9.09	34.67±3.53b	23.52
	1.0	15.00±1.0b	31.82	31.33±2.91b	30.88
	1.5	10.00±1.15c	54.55	28.00±2.31b	38.23
	3.0	3.00±1.15d	86.36	12.00±2.31c	73.53
	3.5	0.0e	100	0.0d	100
	4.0	0.0e	100	0.0d	100
	4.5	0.0e	100	0.0d	100
Control		22.00±1.15a	-	45.33±3.53a	-
F. test		**	-	**	-
LSD 0.05		2.45	-	7.03	-
-15	0.5	18.33±0.88b	16.68	29.33±1.33b	35.29
	1.0	12..00±1.15c	45.45	22.00±1.15c	51.47
	1.5	5.67±1.20d	74.23	14.67±1.33d	67.64
	3.0	0.0e	100	0.0e	100
	3.5	0.0e	100	0.0e	100
	4.0	0.0e	100	0.0e	100
	4.5	0.0e	100	0.0e	100
Control		22.00±1.15a	-	45.33±3.53a	-
F. test		**	-	**	-
LSD 0.05		2.34	-	4.41	-

Means in each columns followed by different letters are significantly different from each other at $P < 0.05$ (Duncan's test)

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استخدام درجات التجمد كوسيلة مكافحة ضد فراشة بلح الواحات في التمور المخزونة

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في هذه الدراسة تم استخدام ثلاثة عبوات (الكراتين ، الأكياس البلاستيك ، السيلوفان) تم وضع ٢٥٠ جرام من بلح الغريحي في كل عبوة وتم عمل عدوي صناعية لها بطورين من الحشرات المختبرة ، وهما البيض ، اليرقات بعد ذلك تركت في الحضان علي درجة حرارة ٢٦ ± ٠,٥ ، ٦٥ ± ٥ ٪ رطوبة نسبية لمدة ٢٥ يوم ثم عرضت لدرجتين حرارة هما -١٠ ، - ١٥م لفترات تعريض مختلفة وأوضحت النتائج المتحصل عليها ما يلي :

تأثير الحرارة المنخفضة علي فراشة بلح الواحات : فان الفترة اللازمة للحصول علي ١٠٠٪ انخفاض في نسبة الخروج داخل العبوات الكرتونية كانت بعد ٤ ، ٤,٥ ساعة تعريض للبيض واليرقات عند درجة حرارة -١٠ م ، بينما كانت هذه الفترة ٣,٥ ، ٤ ساعة تعريض للبيض واليرقات عند درجة حرارة -١٥ م. أما في حالة عبوات السيلوفان والبلاستيك فان الفترة اللازمة للحصول علي ١٠٠٪ انخفاض في نسبة الخروج كانت تقريبا ٣,٥ ساعة تعريض لكلا الطورين عند -١٠ م٥ ، أما عند درجة – ١٥ م فان الفترة اللازمة للحصول علي ١٠٠٪ انخفاض في نسبة خروج كانت ٣ ساعات ساعة تعريض لكلا الطورين .