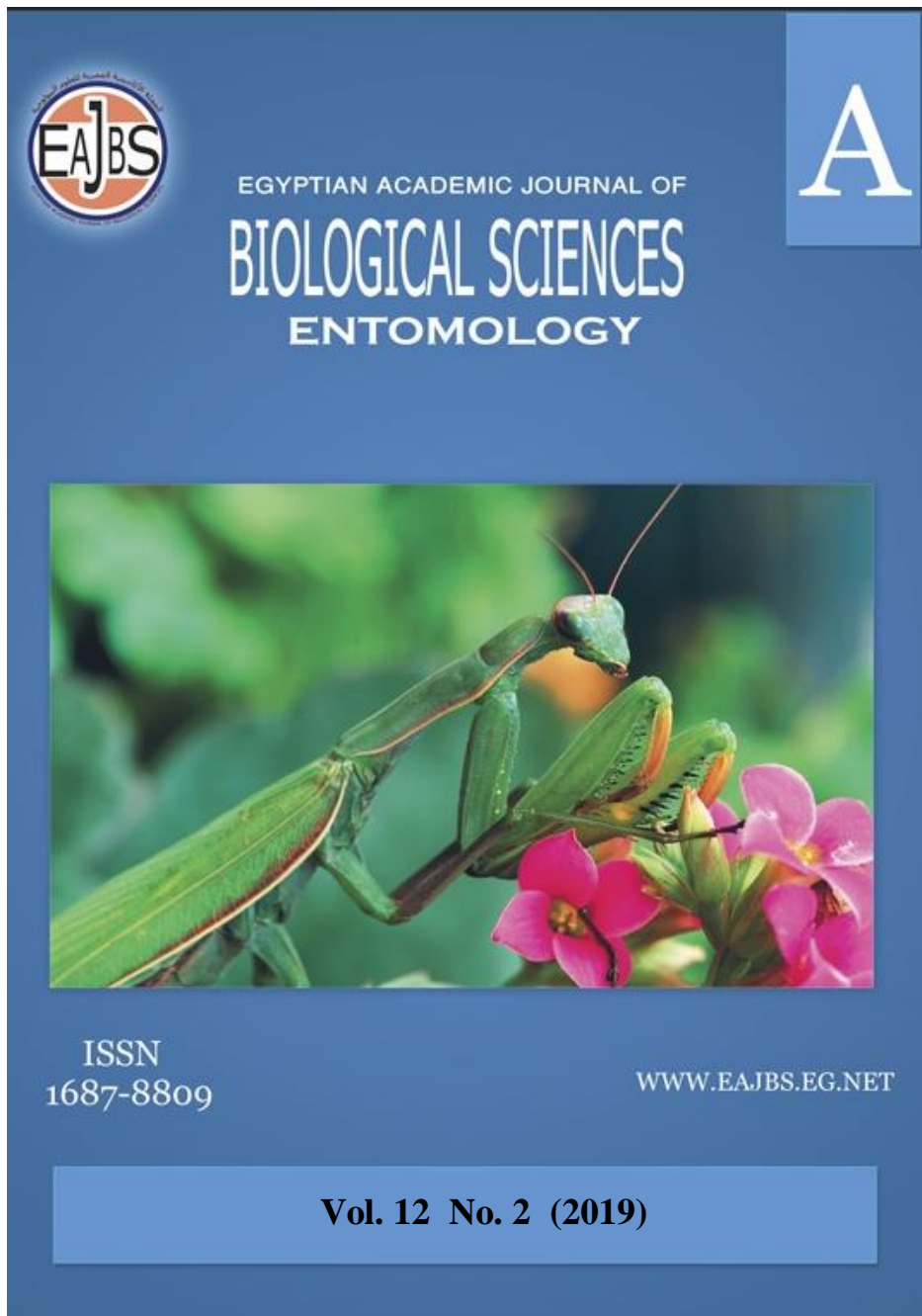
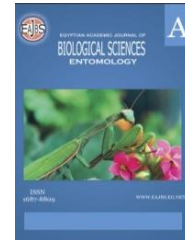


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**The Biological study of the Red Palm Weevil, *Rhynchophorus ferrugineus* through all a year seasons**

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**ABSTRACT**

The most dangerous insect to threaten palm trees is the red palm weevil, *Rhynchophorus ferrugineus* (Curculionidae: Coleoptera). This study was aimed to, study the Biology of the red palm weevil on the food circles (date palm, sugar cane, cucumber, banana peel and watermelon peel) under room temperature through one year. The results showed that spring was the most active season for the red palm weevil and decreases during winter. The previous plants showed their effectiveness in the breeding of the red palm weevil and the watermelon peel was nearly as close to the results of date palms (the main host of the red palm weevil), while the lowest on cucumber. The number of eggs on date palms during spring and winter were (392 and 103 eggs/female), respectively. The number of eggs on watermelon peel during spring and winter were (315 and 90 eggs/female), respectively. The number of eggs on cucumber during spring and winter were (151 and 63 eggs/female), respectively. The number of larval instars on date palm during spring and winter were (12 and 8 instars/larva), respectively. The number of larval instars on watermelon peel during spring and winter were (11 and 4 instars/larva), respectively. The number of larval instars on cucumber during spring and winter were (8 and 3 instars/larva), respectively. Pre-egg laying period on date palm and watermelon peel during spring and autumn were 3 and 4 days, respectively. Pre-egg laying period on cucumber during spring and autumn were 4 and 5 days, respectively. Based on these results must protect palms during period activity of the red palm weevil. Take in consideration, watermelon peel as a type of traps to the red palm weevil in palm plantations..

**INTRODUCTION**

The red palm weevil (RPW), *Rhynchophorus ferrugineus* (Oliver) (Curculionidae: Coleoptera), is the most economical pests to date palm, the first record of it in Egypt in 1992 (Saleh, 1992; Cox, 1993 and Abraham et al. 1998). Female throughout its whole life, lays eggs from 200 to 400egg/female, and egg hatch after an incubation period ranging from 2 to 9 days according to the temperature (El -Ezaby, 1997 and Hussein, 1998).

El-Garhy (1996) recorded the adults of red palm weevil were greater during the warmer months than cooler months, and the highest number of adults during March to April but a few numbers of red palm weevil appeared during December and January in Egypt.

Abdel-Latif (2000) recorded four generations of red palm weevil adults per year in Egypt and explained that the weevil flight activity period was during warm months from March until October.

El-Sebay (2003) stated that the red palm weevil had two main seasonal activities annually in Egypt, the first adult brood was during April and the second one was during November.

Mass rearing of the red palm weevil *Rhynchophorus ferrugineus* (Oliver), on sugarcane, banana and date palm for laboratory studies illustration of methodology, Kaakeh et al. (2001) kept the red palm weevil on sugarcane before reared it on different artificial diets, an oat diet (A), an oat diet plus palm and coconut tissue (B) and white bean diet (C). The results showed that diets A and B were preferred by young larvae (1st to 3rd larval instars) while diet B was preferred by older larvae (4th and 5th larval instars).

Salama et al. (2009) studied the biology of the red palm weevil on five diets, banana, sugarcane, squash fruit, apple and palm crown. They found that the duration of generation was the shortest on palm crown, followed by banana and then Squash fruit and apple, but it was longer on sugarcane. Egg production was the highest on palm crown being  $338 \pm 37.24$  eggs/ female followed on the banana, squash fruit, and apple, but the lowest production ( $117 \pm 18.9$  eggs/ female) was obtained on sugarcane. The fertility ranged between 52 and 83% in those eggs deposited by females previously reared on different diet, the development days to red palm weevil was 111-115 on banana slice, 158-162 days on sugarcane lumps, 108-112 days on squash fruits, 124-126 days on apple slice, and 90-93 days on palm crown lumps, also reported 5 instars to larva.

Mahmoud et al. (2015) studied the effect of diets on some biological aspects to the red palm weevil under laboratory conditions (sugar cane slices, semi-artificial diet and palm heart). Larval duration of different instars was significantly affected by different diets except for the 7<sup>th</sup>, 8<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup> larval instars. The larvae fed on sugar cane slices slowly developed to exhibit the longest duration of 179.19 days. Meanwhile, the larvae fed on the other diets showed a gradual shortage in larval periods to give means of 127.24 and 125.98 days with semi-artificial diet and palm heart, successively.

The Aims of the Work, study the Biology of the red palm weevil on the food circles (date palm, sugarcane, cucumber, banana peel and watermelon peel) under room temperature through one year.

## MATERIALS AND METHODS

The stages of the red palm weevil, *Rhynchophorus ferrugineus*, adults- larvae and pupae were collected from the infested date palm trees in Adayasat, Armant, El-Wapourat, and El-Habil in Luxor and South Valley University Farm in Qena.

The pupae were preserved in plastic boxes with perforated cover at room temperature. The samples of the adults and larvae were preserved in a glass basin with a wire cover under room temperature. Prepared small pieces 100 gram of food groups (parts of trunk palm, sugarcane, watermelon peel, banana peel, cucumber, corn scaly, lettuce core, cabbage core, cauliflower cone, orange and tangerine). The

adults and larvae were fed with various food groups mentioned above under room temperature separately. Saw which food groups were suitable food to the red palm weevil (adults and larvae) and then started the experiment by using suitable food groups for insect growth.

A new pair of male and female was put together in a glass jar to feed it on each food groups under room temperature separately ( $\pm 100$  gram of each food), during all periods( spring, summer, autumn and winter) separately.

The food was changed every day by new fresh ones. The food was inspected daily to record the date of laying of the first egg, the number of eggs deposit and determine female pre-oviposition periods during a year (spring, summer, autumn and winter).The new larva fed on the same food to record the number of larval instars and the number of days to each instar during a year (spring, summer, autumn and winter).

**RESULTS**

The red palm weevils (RPW) were feed on Part of trunk palm, sugarcane, watermelon peel, Banana peel and cucumber to give acceptable results, however, fed the red palm weevil (RPW) on corn scaly, lettuce core, cabbage core, cauliflower core, orange and tangerine the results were Unsatisfactory, the RPW refused to feed on these types of food.

The red palm weevils (RPW) were reared on different food groups through four seasons.

**1- Rearing the Red Palm Weevil During Spring:**

Table (1) explained the cultivation of red palm weevils on watermelon peel, banana peel, cucumber, sugarcane and date palm during spring at room temperature. It is found that the greatest number of eggs to the red palm weevil was  $\pm 392$ eggs/female on date palm with 12 instars to larva and the first egg lay after 3 days.

The red palm weevil laid  $\pm 315$  eggs/female on watermelon peel with 11 instars to larva and the first egg lay after 3 days. While on cucumber female laid  $\pm 151$  eggs, larva recorded 8 instars and the first egg lay after 4 days.

**Table (1):** The red palm weevil reared on different media in spring at room temperature.

Feeding type	Laying egg after (days)	No. of eggs	Period before hatching (days)	No. of instars
Watermelon peel	3	315	3 to 5	11
Banana peel	4	197	4 to 5	7
Cucumber	4	151	4 to 5	8
Sugarcane	3	235	3 to 5	10
Date palm	3	392	3 to 5	12

**Table (2):** The number of days to larva instars of the red palm weevil on the different food during spring.

Type of food	Number of days to instar $\pm$											
	1	2	3	4	5	6	7	8	9	10	11	12
Watermelon peel	2	4	4	7	9	12	15	22	21	18	16	
Banana peel	5	6	7	9	7	8	8					
Cucumber	4	5	7	7	11	10	10	11				
Sugarcane	3	8	10	11	11	19	23	22	20	18		
Date palm	2	5	7	9	10	18	20	23	21	19	20	18

Table (2) explained the number of days to larva instars on the different food during spring, found the high number days to larva instars were  $\pm 23$  days in 8<sup>th</sup> instar on date palm and in 7<sup>th</sup> instar on sugarcane, however the low number days to larva instars were  $\pm 2$  and  $\pm 3$  days in the first instar on date palm and sugarcane respectively.

Watermelon peel gave results approach to date palm, the high number days to larva instars were 22 days in 8<sup>th</sup> instar while the low number days to larva instars were  $\pm 2$  days in the first instar.

### 2-Rearing the Red Palm Weevil During Summer:

Table (3) explained the cultivation of red palm weevils on watermelon peel, banana peel, cucumber, sugar cane and date palm during summer at room temperature. It is found that the greatest number of eggs to the red palm weevil was  $\pm 209$  eggs/female on date palm with 11 instars to larva and the first egg lay after 3 days. The red palm weevil laid  $\pm 189$  eggs/female on watermelon peel with 10 instars to larva and the first egg lay after 3 days. While on cucumber female laid  $\pm 98$  eggs, larva recorded 7 instars and the first egg lay after 4 days.

**Table (3):** the red palm weevil reared on different media during summer at room temperature

Feeding type	Laying egg after (days)	No. of eggs	Period before hatching (days)	No. of instars
Watermelon peel	3	189	3 to 5	10
Banana peel	4	110	3 to 5	6
Cucumber	4	98	4 to 5	7
Sugarcane	3	176	3 to 5	9
Date palm	3	209	3 to 5	11

**Table (4):** The number of days to larva instars of the red palm weevil on the different food during summer.

Type of food	Number of days to instar $\pm$											
	1	2	3	4	5	6	7	8	9	10	11	12
Watermelon peel	2	3	4	6	7	10	20	23	15	18		
Banana peel	4	5	7	8	6	6						
Cucumber	4	4	6	7	9	8	8					
Sugarcane	3	5	7	10	11	19	23	22	20			
Date palm	2	4	5	9	10	17	19	20	18	16	15	

Table (4) explained the number of days to larva instars on the different food during summer; found the high number days to larva instars on sugarcane and watermelon peels were  $\pm 23$  days in 7<sup>th</sup> instar and 8<sup>th</sup> instar respectively. While on date palm the 8<sup>th</sup> instar had 20 days, however the low number days to larva instars were  $\pm 2$  days in the first instar on date palm and watermelon peel, while the first instar to larva on sugarcane completed in 3 days.

### 3- Rearing the Red Palm Weevil During Autumn:

Table (5) explained the cultivation of red palm weevils on watermelon peel, banana peel, cucumber, sugarcane and date palm during autumn at room temperature. It is found that the greatest number of eggs to the red palm weevil was  $\pm 307$  eggs/female on date palm with 10 instars to larva and the first egg lay after 3 days. The red palm weevil laid  $\pm 210$  eggs/female on watermelon peel with 9 instars to larva and the first egg lay after 3 days. While on cucumber female laid  $\pm 113$  eggs, larva recorded 5 instars and the first egg lay after 4 days.

**Table (5):** The red palm weevil reared on different media during autumn at room temperature.

Feeding type	Laying egg after (days)	No. of eggs	Period before hatching (days)	No. of instars
Watermelon peel	3	210	3 to 5	9
Banana peel	4	148	4 to 5	4
Cucumber	4	113	4 to 5	5
Sugarcane	3	205	3 to 5	8
Date palm	3	307	3 to 5	10

**Table (6):** The number of days to larva instars of the red palm weevil about different food during autumn.

Type of food	Number of days to instar ±											
	1	2	3	4	5	6	7	8	9	10	11	12
Watermelon peel	2	4	4	7	9	12	20	21	18			
Banana peel	5	6	7	6	-	-	-	-	-	-		
Cucumber	4	5	7	8	6	-	-	-	-	-	-	-
Sugarcane	3	6	9	10	12	18	21	20	-	-	-	-
Date palm	2	5	7	8	9	15	19	22	20	19	-	-

Table (6) explained the number of days to larva instars on the different food during autumn; found the high number days to larva instars in 8<sup>th</sup> instar on date palm and watermelon peels were ± 22 days and 21 days respectively. On sugarcane 21 days recorded in 7<sup>th</sup> instar, however, the low number days to larva instars were ±2 days in the first instar on date palm and watermelon peel, while the first instar to larva on sugarcane completed in 3 days.

**4- Rearing the Red Palm Weevil During Winter:**

Table (7) explained the cultivation of red palm weevils on watermelon peel, banana peel, cucumber, sugarcane and date palm during winter at room temperature. It is found that the greatest number of eggs to the red palm weevil was ± 103eggs/female on date palm with 8 instars to larva and the first egg lay after 4 days.

The red palm weevil laid ±90 eggs/female on watermelon peel with 4 instars to larva and the first egg lay after 4 days. While on cucumber female laid ±63 eggs, larva recorded 3 instars and the first egg lay after 5 days.

**Table (7):** The red palm weevil rearing on the different media during winter at room temperature.

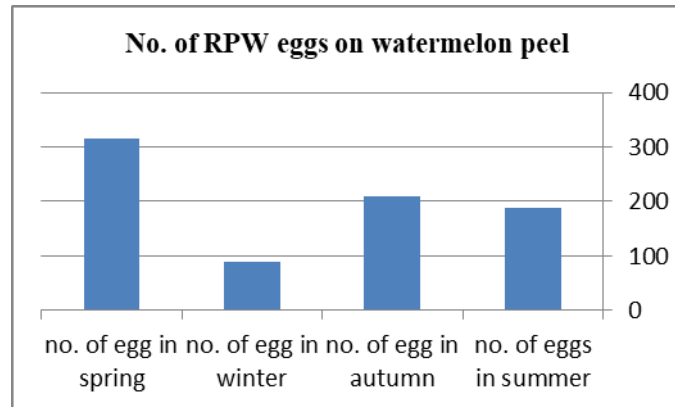
Feeding type	Laying egg after (days)	No. of eggs	Period before hatching (days)	No. of instars
Watermelon peel	4	90	3 to 5	4
Banana peel	5	70	4 to 5	3
Cucumber	5	63	4 to 5	3
Sugarcane	4	96	3 to 5	6
Date palm	4	103	3 to 5	8

**Table (8):** The number of days to larva instars of the red palm weevil on the different food during winter.

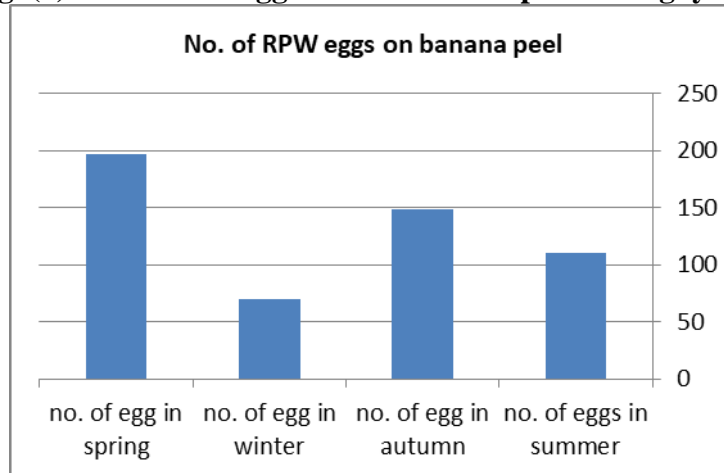
Type of food	Number of days to instar ±											
	1	2	3	4	5	6	7	8	9	10	11	12
Watermelon peel	6	7	10	11	-	-	-	-	-	-	-	-
Banana peel	7	10	14	-	-	-	-	-	-	-	-	-
Cucumber	8	9	16	-	-	-	-	-	-	-	-	-
Sugarcane	5	9	12	19	22	20	-	-	-	-	-	-
Date palm	4	7	9	12	17	24	19	19	-	-	-	-

Table (8) explained the number of days to larval instars on the different food during winter; found that the high number days to larval instars were 24 days in 6<sup>th</sup> instar on date palm, however, 5<sup>th</sup> larval instar were recorded  $\pm 22$  days on sugarcane. On watermelon peel, the high number days to larval instars appeared in 4<sup>th</sup> instar with 11 days.

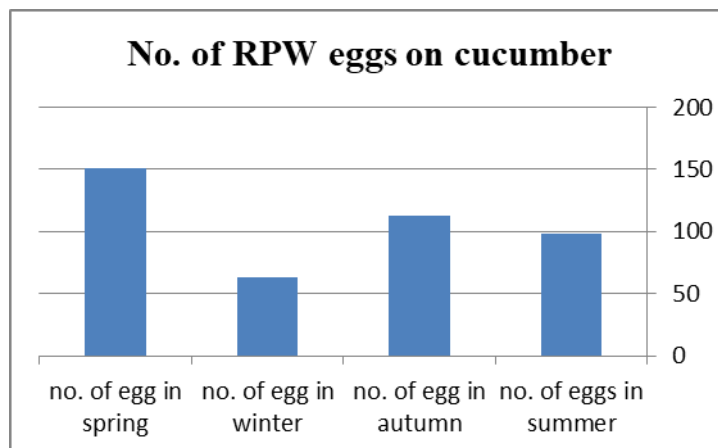
The larvae were recorded the low number of days to its instars in the first instar on date palm and sugarcane ( $\pm 4$ ,  $\pm 5$  days) respectively. While the first instar to larva on watermelon peel completed in 6 days.



**Fig. (1):** Number of eggs on watermelon peel during year.



**Fig. (2):** Number of eggs on a banana peel during year.



**Fig. (3):** Number of eggs on cucumber during year

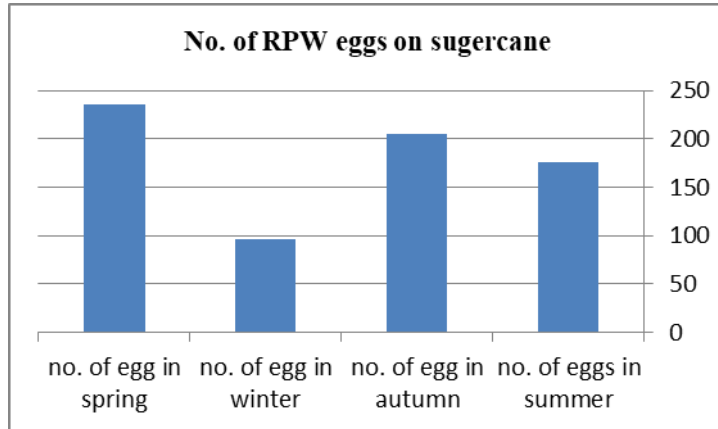


Fig. (4): Number of eggs on sugarcane during year.

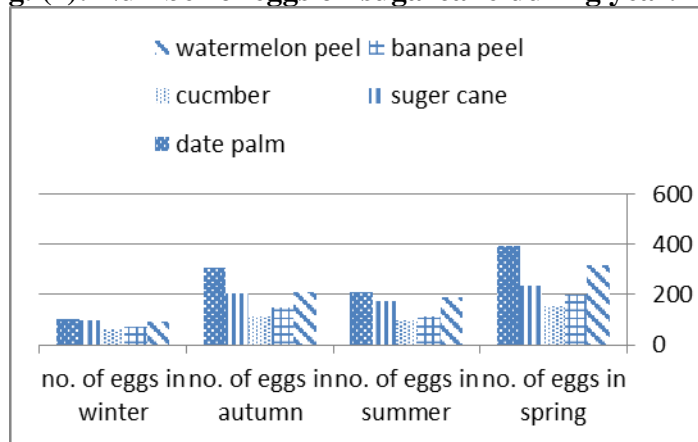


Fig. (5) Number of eggs to RPW on different food groups for one year

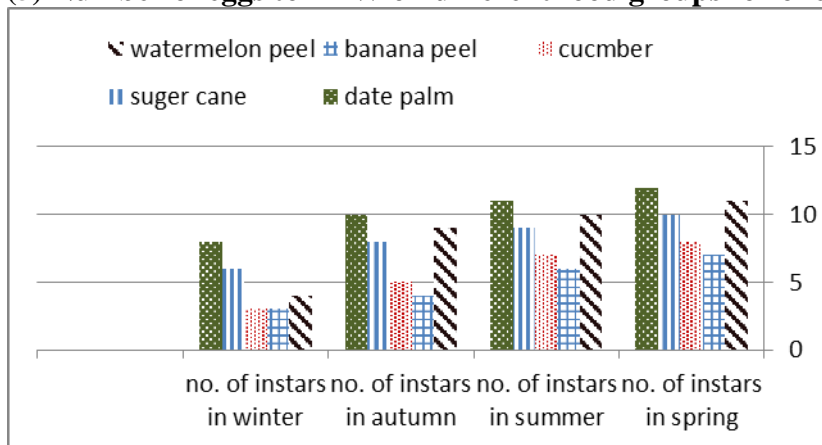


Fig. (6): Number of larva instars for one year.

## DISCUSSION

Feeding the red palm weevil on date palm, watermelon peel, sugarcane, cucumber and banana peel during a year, showed the pre-oviposition periods of the female weevils were ( $\pm 3$  to  $\pm 5$ ) days, on all food groups. These results agreed with Huston (1933), Nirula (1956) who found that, the red palm female began to lay their first egg after 3-5 days, and with Hussein (1998) and Kaakeh et al. (2001) who reported that there were no significant changes between females in the pre-oviposition periods when feed on different host.



When feeding the red palm weevil on date palm, the highest numbers of eggs were 392 eggs/female in the most active periods of the insect during spring and recorded 12 instars to larva. These results agreed with Hussein (1998) reported that, female throughout its whole life, lays eggs from 200 to 400 and 300 in average and recorded 9-13 instars to larva, Muralidharan *et al.* (2000) recorded 206 eggs to female, Marten-Molina and Cabello, T. (2004) reported 8-15 instars to red palm weevil on palm lumps, while Dembilio *et al.* (2012) reported 16 instars to larva with 35-129 development days.

The numbers of larvae instars when fed the red palm weevil on sugarcane were ranged from 6 to 10 instars, this result agreed with Jaya *et al.* (2000) recorded 7 instars to larva in laboratory, Marten-Molina and Cabello, T. (2004) reported 11-17 instars on sugarcane lumps in 116 days, Salama *et al.* (2009) recorded 5 instars to larva, and Shahina *et al.* (2009) recorded 9 instars.

Banana peel was successful as the food to the red palm weevil, this result agreed with Hussein (1998), Salama *et al.* (2009) who reared the red palm weevil on banana stems.

Watermelon peel and cucumber were successful as the food to the red palm weevil; the high results appeared on watermelon peel has had an effect on insect reproduction and its development relative to date palms.

The reproduction of the red palm weevil insect was high on watermelon peel such as on date palm approximately, when cucumber came in the last one of the food groups. All results above approved that the population density affected by the temperature, the population density of the red palm weevil increased on temperate zone during spring and autumn and decreased on higher, cooler temperatures during summer and winter, In fact many researchers have reported that the high number of population density of red palm weevil on the end of wet season during March to May and decreased during summer and winter. Weissling *et al.* (1992), El-Garhy (1996), Abdel-Latif (2000), Hanounik *et al.* (2002), El-Sebay (2003), Ju Ruiting *et al.* (2010) and Saleh *et al.* (2012).

From the above-mentioned data, we can be sprayed the palm during the growing period of RPW to reduce the density of RPW and prevented palms. Watermelons can be added to the pheromone traps to increase their effectiveness in palm plantations, or plants watermelons around date palm plantations.

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## ARABIC SUMMARY

دراسة بيولوجية سوسة النخيل الحمراء، رينكوفورس فيروجينس خلال كل مواسم السنة

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2- قسم وقاية النبات- كلية الزراعة- جامعة بني سويف.

أخطر حشرة لتهديد أشجار النخيل هي سوسة النخيل الحمراء، رينكوفورس فيروجينس (غمدية الأجنحة: سوسيات). هدفت هذه الدراسة إلى دراسة بيولوجيا سوسة النخيل الحمراء على الدوائر الغذائية (نخيل التمر وقصب السكر والخيار وقشر الموز وقشور البطيخ) تحت درجة حرارة الغرفة خلال سنة واحدة. وأظهرت النتائج أن الربيع هو أكثر موسم نشط لسوسة النخيل الحمراء وينخفض خلال فصل الشتاء. أظهرت النباتات السابقة فعاليتها في تكاثر سوسة النخيل الحمراء وقشور البطيخ كانت قريبة تقريبا من نتائج نخيل التمر (المضيف الرئيسي لسوسة النخيل الحمراء)، بينما أقلها على الخيار. بلغ عدد البيض في نخيل التمر خلال فصلي الربيع والشتاء (103 & 392 بيضة/أنثى) على التوالي. كان عدد البيض على قشور البطيخ خلال الربيع والشتاء (90 & 315 بيضة / أنثى)، على التوالي. كان عدد البيض على الخيار خلال الربيع والشتاء (151 & 63 بيضة/أنثى)، على التوالي. كان عدد الأوعية اليرقية على نخيل التمر خلال الربيع والشتاء (12 & 8 انسلاخ/ يرقة)، على التوالي. كان عدد الأوعية اليرقية على قشور البطيخ خلال الربيع والشتاء (11 & 4 انسلاخ/ يرقة)، على التوالي. كان عدد اليرقات على الخيار خلال الربيع والشتاء (8 & 3 انسلاخ/ يرقة)، على التوالي. كانت فترة وضع البيض على نخيل البلح وقشور البطيخ خلال الربيع والخريف 3 & 4 أيام على التوالي. فترة ما قبل البيض على الخيار خلال الربيع والخريف كانت 4 & 5 أيام، على التوالي. على أساس هذه النتائج يجب حماية النخيل خلال نشاط فترة سوسة النخيل الحمراء. كما يمكن الأخذ في الاعتبار، البطيخ كنوع من المصايد لسوسة النخيل الحمراء في مزارع النخيل.

الكلمات المفتاحية: سوسة النخيل الحمراء، نخيل التمر، قشر البطيخ، الخيار.