

POPULATION DYNAMICS OF THE RED PALM WEEVIL (*RHYNCHOPHORUS FERRUGINEUS* (OLIV.) ON DATE PALM PLANTATIONS IN 6TH OCTOBER GOVERNORATE

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Abstract

The present work aims to study the Population dynamics of RPW *Rhynchophorus ferrugineus* (Oliv.) adults in relation to certain climatic factors using attracting pheromone traps on date palm plantation. Experiments were conducted during two successive years (2009 and 2010) in Wardan and Abu-Ghalep villages, 6th October Governorate. The diurnal flying activity of RPW were also considered. The obtained results showed that adults emerging continually throughout the year. The lowest adults population was recorded during December and January. The population showed four peaks each year. There were four peaks of emergence during 2009 at 2nd week of April, 1st week of June, 1st week of August and 2nd week of November, in 2010, four peaks were also recorded during 4th week of March , 3rd week of June, 3rd week of July and 2nd week of November. Data indicated that there was significant positive correlation between average temperature and adults population abundance of the RPW during the studied two year. While relative humidity had negative effect. The diurnal flying activity of RPW adults was studied during the tested period. The obtained data revealed that the maximum flying activity of RPW adults during day hours was at time 6.00 am followed by the time at 16.00 pm.

INTRODUCTION

The red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (Coleoptera: Curculionidae), is an economically important, tissue-boring pest of date palm in many parts of the world. The insect was first described in India as a serious pest of coconut palm (Lefroy, 1906) and later on date palm (Lal, 1917, Buxton, 1918). The weevil was recorded later in Sri Lanka, Indonesia, Burma, Punjab, and Pakistan (Laskshmanan, 1972). The insect is a major pest of date palm in some of the Arabian Gulf States including Saudi Arabia, United Arab Emirates, Sultanate of Oman, and Egypt (Cox, 1993, Abraham *et. al.* 1998). The agroclimatic conditions prevalent in this region and the unique morphology of the crop, coupled with intensive modern date palm farming, have offered the pest an ideal ecological habitat (Abraham *et. al.*, 1998).

The recent discovery of the male-produced aggregation pheromone [ferrugineol, 4-methyl-5-nonanol] for *R. ferrugineus* (Hallett *et. al.*, 1993) made the

implementation of pheromone-based monitoring and trapping of this weevil possible for the management of this pest. *Rhynchophorus palmarum* is managed in Central and South America without insecticide spray by pheromone trapping and sanitation practices in oil, coconut and palmito palm. It is a strong flyer traps which are normally placed at densities of 3-7 hectare (Chinchilla *et. al.*, 1993). El-Ezaby *et. al.* (1998) reported maximum catches in March and April. Aggregation pheromones have been reported as effective tools for monitoring and trapping RPW in the field (Gunnawardena and Badarage, 1995). The objectives of this study were to study the population dynamics of RPW and Investigate the diurnal flying activity of RPW.

MATERIALS AND METHODS

These experiments were carried out during 2009/2010 in certain date palm plantations, which infested by the Red Palm weevil (RPW). The chosen area are Wardan and Abu Ghaleb Villages, situated in the 6th October Governorate , Egypt.

1- Population dynamics of Red Palm Weevil (RPW) *Rhynchophorus ferrugineus* (Oliv.)

To study the population dynamics of Red palm Weevil (RPW) *R. ferrugineus* (Oliv.), three infested locations at Wardan Village, the 6th October Governorate were taken. The experiment was conducted during 2009 – 2010. Three pheromone traps were distributed in the investigated area. Each trap contained the following materials:

- 1- 250g of dates .

- 2- dispenser of the *R. ferrugineus* male aggregation pheromone (Pheromone lure was manufactured by Chim Tica international S.A. Company, Costa Rica. Trade Name PO28 Ferroluree+, 700mg lure, consists of a mixture of 4-methyl 5 – nonanol and 4-methyl 5-nonanone (9:1part purity of both components □95% release rate 3-10 mg/day).

- 3 - dispenser of the kairomone containing 45 mL of the active ingredient ethyl acetate in gel, at 95% minimum purity, release rate 200-400 mg/ day colorant added (Kairomone manufactured by ChimTica international S.A. Company, costa Rica. Trade Name PO80A Weevil magnet 45 mL lure)

- 4 - 5 L of water. Traps were fabricated using a 10 L polypropylene bucket .The outer surface of the bucket was rough with plastic net (1-2 mm).Traps were without cover and buried in the ground down to the level of 15 cm to facilitate entrance of *R. ferrugineus* adults. Part-burying of the trap also prevented it from being over-turned by wind or animals or water of flooded irrigation. Each trap was 4 meter away from date palm trees (to avoid that any adult could miss the trap and lay eggs on the palm

tree) in the shade to avoid evaporation. The water was always replenished every two weeks to keep sufficient moisture in each trap for avoid escaping of the adult and it help to kill the insects. Food bait (dates) was renewed every two weeks. Based on the dispensing rates, the pheromone and the kairomone were replaced every 2 months. Trapped weevils were collected, removed, counted, sexed and recorded every two weeks. Correlation coefficient ,and regression values were calculated

2-Diurnal flying activity of RPW

The diurnal activity of RPW in date palm plantation was studied at infested date palm plantations at Abu-Ghalep Village, the 6th October Governorate by recording data of the weevil captures in 5 food baited pheromone traps, during May of two successive seasons, of 2009 & 2010. Two hourly Observations of the number of the trapped weevils were recorded on a daily basis at 6 am, 8 am,10 am,12 am,14 pm,16 pm,18pm and 20 pm. Trapped weevils were removed from the traps and recorded every day.

Statistical analysis

The obtained data were subjected to regular analysis of variance of randomized complete block design (RCBD) , outlined by Gomes and Gomez (1984) .

RESULTS AND DISCUSSION

1. Population dynamics of RPW *Rhynchophorus ferrugineus* (Oliv.)

1.1. Population dynamics of RPW *R. ferrugineus* (Oliv.)on date palm plantation during 2009

Data presented in Table (1) and illustrated in Fig. (1.a&b) showed the adult population abundance of RPW is existed all over the year and there are four peaks all over the year 2009, the mean of total captured adults start with low number in the beginning of January with 5.33 adults / trap and it fluctuated then increased gradually to reach the first peak at the second week of April with 56 adults / trap. Then the mean of total captured adults declined to 21.33 adults / trap at end of April and it stayed stable for while then from the fourth week of May it started to increase drastically to reach the second peak at the second week of June with mean of total captured adults 68.33 adults / trap (highest value) ,then it decreased rapidly until the third week of June with 15 adults / trap and it stay stable for while after it increased gradually to reach the third peak at the first week of August with mean of total captured adults 28.67 adults / trap Then it declined gradually to 2.33 adults / trap at the third week of August then it stayed stable for while until the second week of October it start to increase slowly to reach the fourth peak at the second week of

November with a mean of total captured adults 19 adults / trap then it declined gradually to reach 6.67 adults / trap at the first week of December and it stayed with the same rate until the end of December. The results also indicated that significantly more females were caught by 1.43 times than males during the whole year of 2009. The population fluctuation of the male and female adults of RPW showed the same trend as indicated by the total adults population during 2009. The average mean value of the total adult population, male and female adults populations was 17.79, 7.31, 10.49 respectively.

1.2. Population dynamics of RPW *R. ferrugineus* (Oliv.) on date palm plantation during 2010

Data presented in Table (2) and illustrated in Fig. (2.a&b) showed that the adult population abundance of RPW existed all over the year with four peaks. The mean of total captured adults started with low number in the beginning of January with 4.67 (low value) adults / trap then it increased gradually to 17 adults / trap at the second week of March then it increased sharply to reach the first peak at last week of March with 81.67 total adults / trap (highest value) then the average captured RPW adults declined rapidly to 10 adults / trap at the second week of April. Then the average captured RPW adults increased gradually to reach the second peak at the third week of June with 66.33 adults / trap then it declined to 40.33 at the first week of July and it increased again to reach the third peak at the third week of July with 75.67 adults / trap. Then the average captured RPW adults decreased sharply to 21.67 at the first week of August then it fluctuated to reach 5.67 adults / trap at the fourth week of October then it showed the fourth peak at the second week of November with 30.67 adults / trap then it declined gradually to reach the lowest average captured RPW adults 3 adults / trap (lowest value) at the first week of January. The results also indicated that significantly more females were caught by 1.76 times than males during the whole year of 2010. The population fluctuation of the male and female adults of RPW showed the same trend as indicated by the total adults population during 2010. The average mean value of the total, male and female adults population was 22.81, 8.24, 14.56 respectively. The mean of total adults population during 2010 was slightly higher than mean of total adults population during 2009, which could be due to slight variation in the average of daily temperature during 2010.

The obtained results are in agreement with the findings of Abdallah and Al-Khatri, (2003), who observed that RPW adults emerging continually throughout the year. The minimum number of insects was recorded during December and January. In 1996, there were four peaks of emergence during March, May, July and October,

where as in 1997 the peaks were recorded in April, May and September, In 1998, four peaks were recorded during April, May, August and October . These data insure the previous data obtained by and the same observation was obtained by **Qin *et al*** (2004) who found that, the population monitoring of red palm weevil occurred in four peaks a year in the area of Wenchang, Hainan Province. **On the other hand** El-Sebaey (2003) in Egypt indicated that *R. ferrugineus* had two main active seasons annually. The first adult brood was observed in April and the second one was in November. Female density was higher than male density and it constituted 52.8-57.35% of the total population in the field. In addition, Faleiro (2005) also found that the weevil captures were female dominated and for every male weevil trapped two female Weevils were captured. Furthermore, Al-Saoud,(2007) showed that the adult RPW were present throughout the year, and the number of females was higher than the number of males.

1.3. The effect of weather factors on the population abundance of RPW during 2009 and 2010

Data in Table (3) showed the effect of weather factors (mean daily temperature &RH) on the population abundance of RPW during 2009 and 2010. The simple correlation coefficient (*r*) value indicated significant positive correlation between average temperature and adults population abundance of the RPW during the tested two years of 2009 and 2010, while the means of daily relative humidity had significant negative effect on the population abundance of the RPW adults during the two years. The analysis of variance revealed that the two factors (Temp.+RH.) are responsible for about 22.9% in the variability of the RPW populations during the studied years of 2009 and 2010.

This results is in harmony with the findings of Faleiro (2005) who found that Maximum temperature and rainfall had a significant impact on the weevil activity in India while, the maximum temperature was positively correlated ($r = 0.51$) with weevil captures, rainfall was negatively correlated ($r = -0.61$) with the weevil catch .In this respect. Also, Huang *et. al.*,(2008) in China indicated that the climatic conditions had an obvious influence on the trapping effect of pheromone for RPW. The trapping population was significantly reduced in the conditions of rain and low temperature. In addition, Abdallah and Al-Khatri, (2003), reported that there is an effect of the climatic conditions of maximum and minimum temperature and the Relative Humidity on the population fluctuation of RPW.

Contrarily El-Sebaey (2003) found that there was no relationship between seasonal population fluctuations of RPW and weather factors.

Table 1. Population dynamics of red palm weevil *Rhynchophorus ferrugineus* (Oliv.) on date palm plantation during 2009.

Inspection Date	Average of RPW captured adults/trap			Mean	
	Total	Male	Female	Temperature C°	Humidity (RH)
19-Jan-2009	5.33	2.00	3.33	15.00	55.57
2-Feb-2009	10.00	4.00	6.00	16.93	49.71
16-Feb-2009	20.33	7.00	13.33	17.50	46.21
2-Mar-2009	19.00	4.00	15.00	15.86	45.93
16-Mar-2009	33.00	24.00	9.00	16.73	58.60
30-Mar-2009	34.33	16.00	18.33	17.71	50.64
13-Apr-2009	56.00	24.33	31.67	20.57	51.93
27-Apr-2009	21.33	8.00	13.33	20.86	53.50
11-May-2009	20.67	8.33	12.33	24.29	48.29
25-May-2009	23.67	8.67	15.00	25.07	50.29
8-Jun-2009	68.33	28.33	40.00	26.50	51.29
22-Jun-2009	15.00	5.33	9.67	27.29	52.86
6-Jul-2009	17.33	5.33	12.00	30.14	51.21
20-Jul-2009	14.33	4.33	10.00	28.64	59.14
3-Aug-2009	28.67	10.67	18.00	30.93	56.93
17-Aug-2009	2.33	2.33	0.00	28.07	60.36
31-Aug-2009	3.33	0.67	2.67	29.57	60.00
14-Sep-2009	3.00	1.33	1.67	27.79	61.07
28-Sep-2009	3.33	1.33	2.00	25.79	61.00
12-Oct-2009	2.67	1.33	1.33	25.71	62.00
26-Oct-2009	10.33	2.33	8.00	25.21	62.93
9-Nov-2009	19.00	7.67	11.33	24.43	57.00
23-Nov-2009	14.00	5.67	8.33	19.21	59.00
7-Dec-2009	6.67	3.00	3.67	17.36	59.36
21-Dec-2009	5.67	2.00	3.67	15.64	55.93
4-Jan-2010	5.00	2.00	3.00	14.71	63.21
Total	462.67	190.00	272.67		
Mean ± S.D.	17.79 ± 3.8	7.31 ± 2.2	10.49 ± 2.3	22.60	55.54
L.S.D. at 5%	6.23				

Table 2. Population dynamics of red palm weevil *Rhynchophorus ferrugineus* (Oliv.) on date palm plantation during 2010.

Inspection Date	Average of RPW captured adults/trap			Mean	
	Total	Male	Female	Temperature C°	Humidity (RH)
18-Jan-2010	4.67	2.00	2.67	11.93	65.50
1-Feb-2010	8.67	3.00	5.67	11.86	64.57
15-Feb-2010	11.33	4.67	6.67	14.00	62.93
1-Mar-2010	14.33	5.33	9.00	13.80	64.20
15-Mar-2010	17.00	7.33	9.67	18.64	55.86
29-Mar-2010	81.67	31.00	50.67	22.86	42.93
12-Apr-2010	10.00	3.67	6.33	19.36	50.14
26-Apr-2010	12.33	4.00	8.33	25.07	46.86
10-May-2010	17.33	5.33	12.00	22.29	49.00
24-May-2010	22.67	5.33	17.33	25.43	45.64
7-Jun-2010	51.00	16.33	34.67	27.14	48.93
21-Jun-2010	66.33	21.33	45.00	28.14	48.71
5-Jul-2010	40.33	14.00	26.33	29.64	51.57
19-Jul-2010	75.67	32.00	43.67	29.43	59.07
2-Aug-2010	21.67	6.00	15.67	28.93	58.00
16-Aug-2010	22.33	8.67	13.67	29.50	59.43
30-Aug-2010	11.33	4.33	7.00	30.50	58.29
13-Sep-2010	13.00	6.33	6.67	28.57	61.79
27-Sep-2010	10.33	4.00	6.33	29.36	51.86
11-Oct-2010	10.67	3.67	7.00	26.29	55.86
25-Oct-2010	5.67	1.33	4.33	23.43	61.38
8-Nov-2010	30.67	12.33	18.33	21.64	63.50
22-Nov-2010	12.00	4.67	7.33	20.36	62.79
6-Dec-2010	11.00	3.33	7.67	20.14	51.07
20-Dec-2010	8.00	3.33	4.67	18.00	56.36
3-Jan-2011	3.00	1.00	2.00	14.50	63.64
Total	593.00	214.33	378.67		
Mean ± S.D.	22.81 ±4.8	8.24 ±2.6	14.56 ± 4.3	22.72	56.15
L.S.D. at 5%	7.77				

Table 3. The effect of weather factors on the population fluctuations of RPW.

Factors	r	b	R ²	S.E.	Prediction equation
Mean of daily Temperature P	0.252	0.872	6.3%	0.270	$\hat{y} = a + b x$ x= Temperature degree \hat{y} =Number of RPW adults at this degree
	0.001	0.002			
Mean of daily RH P	- 0.444	- 1.451	19.2%	0.236	$\hat{y} = a + (-)b x$ x= RH \hat{y} =Number of RPW adults at this degree
	0.000	0.000			
Temp. & RH	- 0.168		22.9%		$\hat{y} = a + b_1 x_1 + b_2 x_2$

r = simple correlation coefficient value

b = simple regression coefficient value

R² = relative contribution

S.E= standard error

P = probability

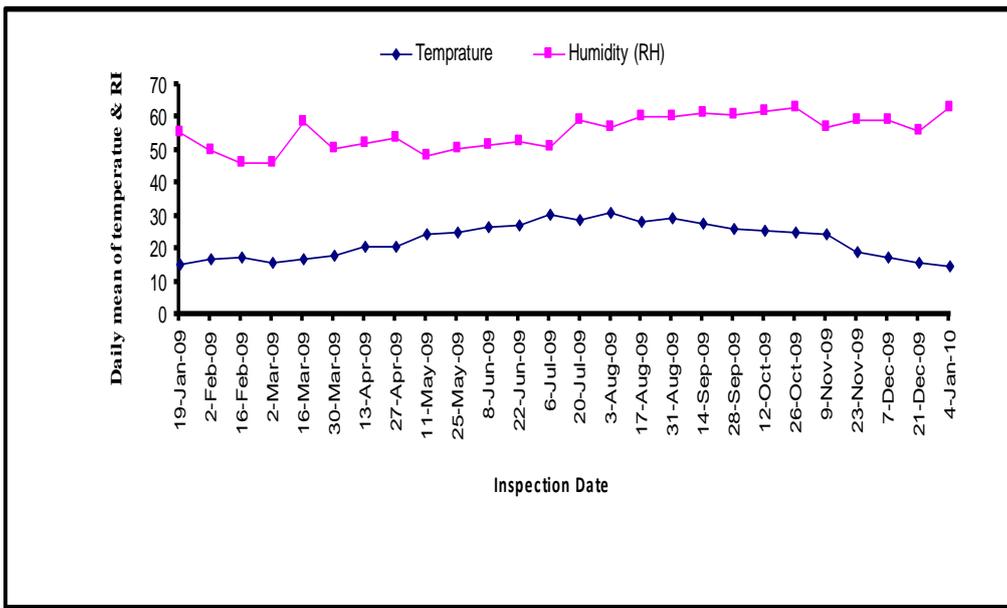


Fig. 1.a. Mean daily temperature and relative humidity during 2009.

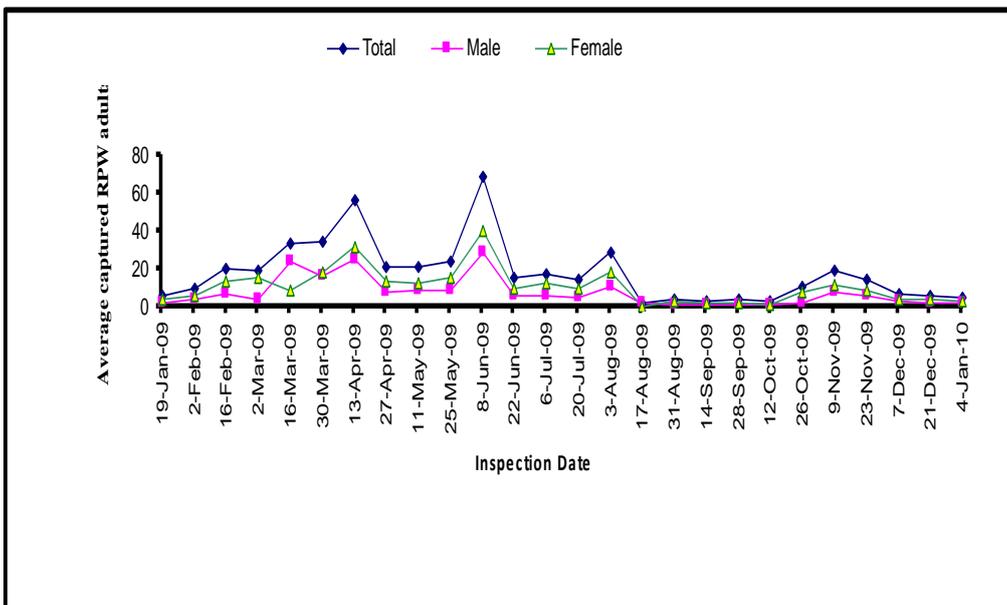


Fig. 1.b. Population dynamics of RPW *Rhynchophorus ferrugineus*(Oliv.) on date palm plantation during 2009.

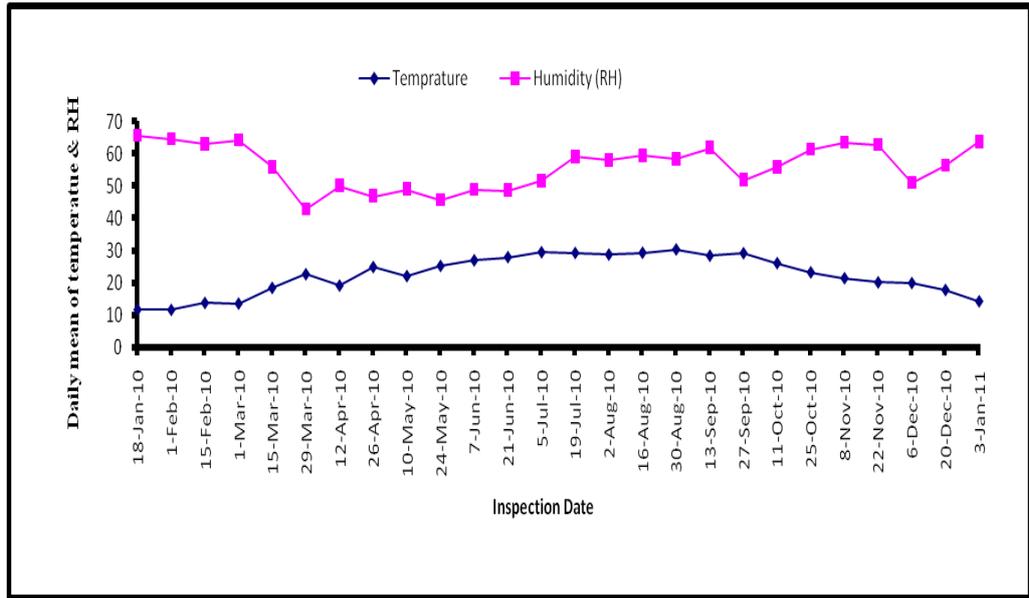


Fig. 2.a. Mean daily temperature and relative humidity during 2010.

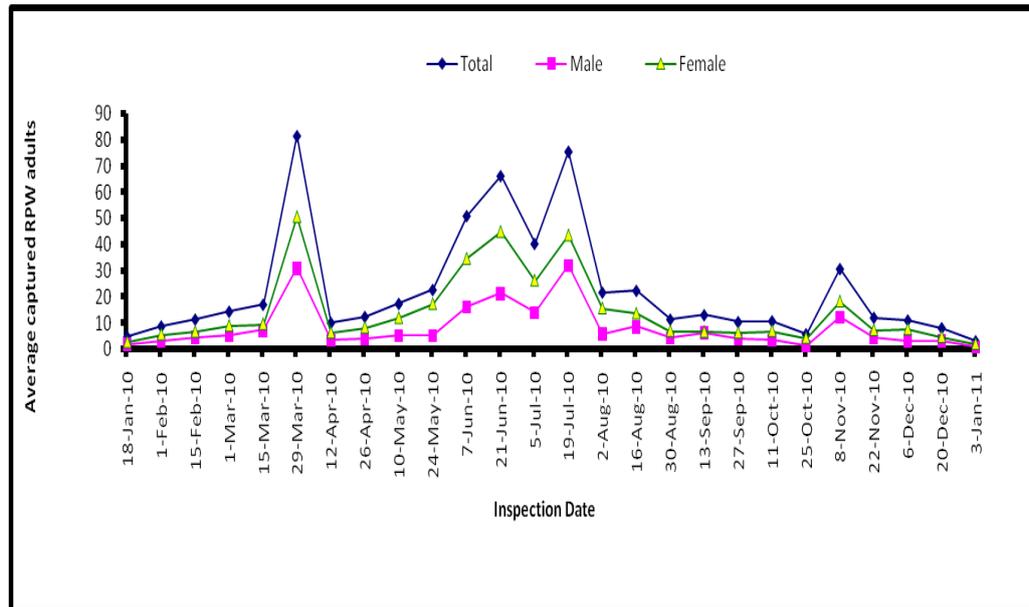


Fig. 2.b. Population dynamics of RPW *Rhynchophorus ferrugineus*(Oliv.) on date palm plantation during 2010.

2. Diurnal flying activity of RPW.

The diurnal flying activity of RPW adults was studied during the tested period of (May 2009 and May 2010). The obtained data given in Table (4) and illustrated in Fig.(4&5) revealed that the maximum flying activity of RPW adults during the day hours was at 6.00 am with an average captured RPW adults of (7.20 ,6.80 per trap) in the two seasons of 2009 and 2010, respectively, followed by the time at 16.00 pm with an average of (5 , 4.40 per trap) for the two seasons respectively. Otherwise, the flying activity of RPW adults were lower showing fluctuation in the average captured values and could be arranged in descending order as follows : (3.20,3.20), (3.00,2.60), (2.00,1.60),(2.00,1.60),(1.60,1.20)at 14.00,12.00,10.00,18.00,20.00 hours during the two seasons respectively .The lowest flying activity of the insect during the day was at 8.00 am with an average of 0.2 adults /trap and zero adults /trap during 2009 and 2010, respectively . Data showed also that there were no significant difference between the flying activity of the insect during the day hours at 12.00 and 1400 hours. The data also showed that there were no significant differences between the RPW flying activity at day hours at 10.00, 18.00, 20.00 hours depending on the average captured adults.

In this respect, Faleiro (2005) in India studied the diurnal activity of RPW in Coconut by recording during May2002. Six hourly Observations on the number of weevil trapped were recorded on a daily basis at 6 am, 12 pm, 6 pm and 12 am. The maximum number of weevils trapped was at 6 am, while no weevils were observed at 12 am. This indicates that RPW was most active between 12 am (mid night) to 6 am (morning). The highest mean cumulative catch per trap was between 12 am and 6 am while, the least cumulative catch per trap was between 6 pm to 12 am .The findings of this study therefore indicate that RPW adults prefer to fly in the coconut plantations of Goa between 12 at mid night and 6 in the morning .Also, Gunawardena and Bandarage(1995) in Sri Lanka reported that the daily activity of RPW adults were between 6:00-8:00am and 6:00-8:00pm.In Sultanate of Oman, Abdallah and Al-Khatri, (2003) found that the daily activity of RPW in date palm plantation (was maximum Number of weevils trapped) were between 6.00 -9.00Am which the population percentage was 39.4% followed by the time between 6.00 -9.00pm which the population percentage was 33.3% while no weevils were observed in the time between 9.00am to 3.00 pm and 12 am -3 00am ,and the population percentage at the time 3:00-6:00 am , 3:00-6:00 pm were 1.9% and 15.2% respectively. In addition,

Table 4. Diurnal flying activity of RPW during 2009 and 2010.

Average captured RPW adults during day hours per trap									
	Day hours								
Years	6 am	8 am	10 am	12 am	14 pm	16 pm	18 pm	20 pm	LSD at 0.05
2009	7.20 a	0.20 e	2.00 d	3.00 c	3.20 c	5.00 b	2.00 d	1.60 d	0.948
2010	6.80 a	0.00 e	1.60 d	2.60 c	3.20 c	4.40 b	1.60 d	1.20 d	0.795

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ديناميكية التعداد لحشرة سوسة النخيل الحمراء على نخيل البلح بمحافظة 6 أكتوبر

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١ . قسم وقاية النبات - كلية الزراعة بمشهور - جامعة بنها - مصر .

٢ . معمل بحوث النخيل-مركز البحوث الزراعية - الجيزة - مصر .

أجريت هذه الدراسة خلال عامى 2009 و 2010 فى قرى وردان وابو غالب بمحافظة 6 أكتوبر- بهدف دراسة تعداد سوسة النخيل الحمراء بمزارع النخيل وتأثير العوامل الجوية (حرارة ورطوبة نسبية)على التغير فى غزارة تعدادالحشرة.

- وقد اظهرت نتائج هذه الدراسة ان الحشرة تتواجد طوال العام وان تعدادها يتذبذب خلال السنة حيث تبين وجود اربع قمم للتعداد خلال العام . وقد ظهرت القمة الاولى للتعداد خلال عام2009 فى الاسبوع الثانى من ابريل والقمة الثانية فى الاسبوع الاول من يونيه والقمة الثالثة فى الاسبوع الاول من اغسطس والقمة الرابعة فى الاسبوع الثانى من نوفمبروبالنسبة لعام 2010 فقد تبين كذلك ان لتعداد الحشرة اربع قمم ظهرت الاولى فى الاسبوع الاخير من مارس والثانية فى الاسبوع الثالث من يونيه والثالثة فى الاسبوع الثالث من يوليو والقمة الرابعة فى الاسبوع الثانى من نوفمبر.وكانت النسبة الجنسية للحشرات للاناث ضعف اعداد الذكور تقريبا .ووجد ان للعوامل الجوية تأثير معنوى على غزارة التعداد حيث أعطى عامل الحرارة تأثيرا معنويا موجبا بينما كان للرطوبة النسبية تأثيرا معنويا سالبا على التعداد.

- وبالنسبة للنشاط اليومي للحشرات فقد وجد ان اعلى نسبة للحشرات المصطادة كانت عند الساعة السادسة صباحا تليها الساعة الرابعة مساء ثم تساوت اعداد الحشرات المصطادة فى الساعة الثانية مساء والثانية عشرة ظهرا وفى الساعات العاشرة صباحا والسادسة والثامنة مساء فقد انخفض عدد الحشرات بوضوح بينما انعدمت تماما اعدد الحشرات فى الساعة الثامنة صباحا.