Minufiya J. Agric. Res. Vol.35 No.3:1079-1099(2010) "http://agri.menofia.edu.eg/megla.html"

EFFECT OF INTERCROPPING SYSTEM ON THE ANNUAL VARIATIONS IN POPULATION DENSITY OF THE RED PALM WEEVIL, *RHYNCHOPHORUS FERRUGINEUS* OLIV. IN THE DATE PALM ORCHARDS, IN EL-BEHEIRA GOVERNORATE, EGYPT.

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(Received: Apr. 6 , 2010)

ABSTRACT: ***The present study explain the effect of followed intercropping under the conditions of applied agro-technical practices and prevailling climatic conditions on the existing red palm weevil populations in the investigated date palm orchards. The results showed a delayed flight activity of both adult-sexes throughout most months of the growing season, with three recorded prominant peaks during May, July and October-November, indicating the propable occurrencs of three generations of red palm weevil in EL-Beheira Governorate.***

The rate of emerging adult females was higher and merely twice as that of the emerging adult males, showing a female based sex ratio ranged between 1 male : 2.3 or/and 2.4 females. The delayed flight activity of adult-weevils is greatly related to the resulted interaction of performed interplanting and agropractices with the prevailing higrothermic conditions, which proved the high significant relationship between the number of caught weevils and each of the studied parameters of daily temperature and relative humidity.

The higher or/and lower numbers of captured adult-weevils were detected in case of interplanting citrus and banana trees or/and guava trees and field crops with the growing date palm varieties. Interplanting guava trees decreased the rate of infestation (0.98-1.6 %), versus the increased one in case of interplanting citrus and banana trees (3.9-5.4 %) with date palm varieties in the investigated orchards.

Key words: ***Pheromone trap and population fluctuations.***

INTRODUCTION

The red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) (Col., *Curculionidae*) is an economic serious pest of date palm in many parts of the world, causing considerable damage and often killing the palm tree (Kaakeh *et. al.,* 2001). It was first described in India as a serious pest of coconut palm, and recorded later in Serilanka, Indonesia, Burma, Punjab, and Pakistan (Laskashmanan *et al.* 1972).

Currently, the red palm weevil is a key pest in Asia, Africa and Europe and widly distributed in over 20 countries and attack more than a dozen of palm species of which coconut and date palm are of economic importance. The pest became a major economic dangerous pest of date palm in some of Arabian Gulf states, including Saudi Arabia, United Emirates and Sultanate Oman (Cox, 1993; Abraham *et al.,* 1998 & 2002 and Falerio, 2006). This dangerous pest invaded Egypt and was recorded for the first time by Saleh (1992); since its discovery the weevil has expanded its range westwards very rapidly (Cox , 1993).

The rapid expanstion and wide spatial distribution of the insect pest in the Arabian Gulf states, Middle East and some African countries, in particular, Egypt, is mainly attributed to the agroclimatic conditions prevalent in these regions and the unique morphology of the crop; coupled with intensive modern date palm farming, which offered the pest an ideal and ecological habitat (Abraham *et. al*., 1998 and 2002).

Severe damage to the infested palms is caused by the larval stage (Oehlschlager *et. al.* 1995). The larvae feed within the trunk of palm; this behaviour sequently affects stem and growing points and furtherly kill the tree. Particularly, it is very difficult to detect the red palm weevil in the early stages of infestation, which can be easily detected after the palm has been severely damaged.

Date palm trees provide enough space for intercropping even they are fully grown, as they do not cover much area being very tall trees. Though in EL-Beheira Governorate farmers used to grow date palm trees in mixed orchards; in which palms are either intercropped with other wooden fruit trees or field crops. In this concern, it could be indicated that each of the crop mixture patterns has different physiological characteristics and different advantages (Herrera and Harwood, 1973).

Therefore, the present work was conducted to study the effect of prevalent agroclimatic conditions and intensive intercropping in date palm orchards on the infestation incidence, spatial and distribution pattern of the red palm weevil (RPW) populations in the investigated localities.

MATERIALS AND METHODS

Experimental locality and investigated date palm orchards:

Field experiments were carried out in two commercial date palm orchards at the villages of Kombanyiat Abo-Kir and Kom EL-Tarfaya, Kafr EL-Dawar center, EL-Beheira Governorate throughout two following growing date palms seasons of 2006-2007 and 2007-2008. In these inspected orchards (18-32 fedds), the cultivated date palm area inside each orchard ranged between 8 and 8.5 fedds. the prevailing climatic conditions at the investigated localities, the varied population number of young and old date palms of each

variety and the followed intercropping system in each of these orchards are illustrated and explianed in Tables 1, 2 and 3.

The structure of used aggregation pheromone food baited trap:

The used aggregation pheromone food baited trap (Fig. 1) consists of an eighteen liters inverted plastic bucket , 30 cm in height , with a diameter of 25 cm at its upper opening and 20 cm at the bottom .This inverted plastic bucket is characterized by a manufactured coarse granulated surface from the outside to allow the adult weevils to crawl up easily on the trap to reach the inside through the existing openings of the bucket, i. e., four (2.5 x 7.5 cm) lateral holes made in the upper third of the bucket and three holes with the same diminishes on the cover of the bucket for the entrance of the attracted weevils .

The components and placement of the pheromone food baited trap:

The used aggregation pheromone lure in the performed trials was put in 120 ml plastic bottle and hanged underneath the bucket cover (Fig.1). It is known as ferruginous, (pherocone-RPW 700); the synthetic pheromone lure (4methyl-5nonanol) release its active chemical through a plastic membrane. Attractant food additives or baits (diluted treacle or crushed semi dry date fruits + 3 gm brewers yeast + tap water), are usually put in deep plastic plate (18-20 cm in diameter) placed on the bottom of the bucket. Because of the practically proved result of the high efficiency of the trap located at the ground level , that significantly capture more weevils (Oelschlager *et.al*, 1993), the traps were placed in the ground with the lower two thirds of each trap inserted in the ground between the date palm trees (Photo, 1) .

Spatial pattern of palm weevil populations in the interplanted date palm varieties with other crops plants:

Because the locality of Kafr EL-Dawar center, EL-Beheira Governorate is characterized by plenty of growing date palm orchards which are interplanted with different field and / or horticultural crops, four commercial date palm orchards, at Kombanyiat Abo-Kir and Kom EL-Tarfaya villages were selected for the study during the elapsing period from March 2006- 2007 Feb. 2007-2008. In the inspected farm at Kombanyiat Abo-Kir village the date palms were interplanted in the eastern half of the orchard' s area by fruiting Guava trees , while the growing palms in the area of the western half of the farm were always interplanted by winter and summer field crops. In the selected orchards in Kom EL-Tarfaya village, citrus trees were interplanted between the rows of palm trees besides the consequently planted rows of banana trees on the edges of each dug ditched between three rows of growing palm trees .

In season 2006-2007, two aggregation pheromone food baited traps were used in each of the investigated orchards at Kombanyiat Abo-Kir and Kom EL-Tarfaya villages, whereas one was located at the eastern side of the farm and the other one at the western side, merely in the middle of each orchard. While, in season 2007-2008, at Kom EL-Tarfaya village, seven traps were used in both the investigated farms to evaluate three food baits (crushed semi dry date fruits, treacle, brewers yeast); one attractant chemical (ethyl acetate) with or without the aggregation pheromone.

Table 1: The prevailing climatic conditions of temperature and reltive humidity at the investigated localities in El-Beheira Governorate.

Month	Temperature °C				Relative Humidity %			
	Max. °C	Min. °C	Mean °C	Thermic amplitude °C	Max. %	Min. %	Mean %	Rate of monthly higro-variation
Mar. 2006	23.2	11.3	17.3	11.1	86	35	61	52
Apr.	25.0	13.0	19.0	12.7	96	36	66	55
May	30.3	16.9	23.6	13.8	96	33	65	62
Jun.	33.5	20.8	27.2	11.9	96	35	66	55
Jul.	33.7	22.8	28.2	9.8	96	44	70	43
Aug.	33.4	23.0	28.2	11.6	97	49	73	42
Sep.	31.3	20.6	26.0	11.6	98	45	72	47
Oct.	30.4	18.1	24.3	11.5	96	41	68	52
Nov.	26.3	14.6	20.5	10.5	96	43	69	48
Dec.	20.1	12.0	16.0	9.6	92	48	70	44
Jan. 2007	18.6	9.2	13.9	9.8	91	47	69	42
Feb.	20.3	9.7	15	9.5**	88	42	65	45
Mar.	23.0	12.0	17.5	12.0	89	39	64	50
Apr.	27.1	14.3	20.7	12.4	91	33	62	58
May	30.7	16.7	23.7	14.4	92	28	60	63
Jun.	33.0	21.2	27.1	12.6	89	34	62	62
Jul.	32.4	22.8	27.6	11.0	88	45	66	52
Aug.	33.4	23.2	28.3	10.4	88	45	66	47
Sep.	32.9	20.7	26.8	10.7	87	40	64	52
Oct.	30.1	18.5	24.3	12.3	87	35	61	55
Nov.	24.2	13.7	19.0	11.7	89	41	65	52
Dec.	20.4	10.8	15.6	9.4	89	45	67	43
Jan. 2008	17.7	8.5	13.1	16.0	96	50	73	72
Feb.	19.6	8.8	10.8	16.0	98	48	73	75

*** Growing season 2006 – 2007.** **** Growing season 2007 – 2008.**

Table 2: A list of growing date palm varieties in the inspected orchards at Kombanyiat Abo – Kir and Kom El-Tarfaya villages, Kafr El-Dawar, El-Beheira Governorate , (March 2006 – Feb. 2008) .

Date Palm Variety	Young trees (< 10 years old)	Old trees (> 10 years old)	Total
Kombanyiat Abo – Kir * (Mar. 2006 – Feb. 2007)			
Zaghloul	-------	210	210
Hayane	-------	110	110
Samany	15	145	160
Bent - Aesha	10	20	30
The total	25	485	510
Kom El-Tarfaya ** (Mar. 2006 – Feb. 2007)			
Zaghloul	------	200	200
Hayane	------	177	177
Samany	------	150	150
Hellawe	------	08	08
The total	------	535	535

Kom El-Tarfaya village **(Mar. 2007 – Feb. 2008)

Orchard (a) **			
Zaghloul	-------	200	200
Hayane	-------	177	177
Samany	------	150	150
Hellawe	------	08	08
The total	------	535	535
Orchard (b) **			
Zaghloul	11	179	190
Hayane	------	160	160
Samany	17	123	140
Bent-Aesha	------	10	10
The total	28	472	500

*** Date palm trees in the eastern half of the orchard, were intercropped by Guava trees between the rows of growing palms; the western half of the orchard, is usually cultivated with winter or / and summer field crops between the rows of palms.**

**** Date palm trees are intercropped by citrus trees between palms rows, besides planted rows of banana trees on the edges of ditches of the orchard at a rate of a ditch between each 3 rows of growing palms.**

Table, (3): Numbers of monthly attracted adults of red palm weevil *Rhynchophorous ferrugineus* oliv to aggregation pheromone/ food baited traps in orchard of intercropped palms with guava trees, winter or/and summer field crops, at Kombanyiat Abo Kir village, Kafr EL-Dawar, El-Beheira Governorate, in Mar. 2006 – Feb. 2007.

Date of inspection	(a) Kombanyiat Abo Kir village			(b) Kom El-Tarfaya avillage		
	No of captured insects			No of captured insects		
	Male	Female	Total	Male	Female	Total
Mar-2006	21^{bc}	39^{abc}	60^{ab}	47^{ab}	89^{ab}	136^{a}
Apr-2006	29^{bc}	65^{c}	94^{ab}	62^{ab}	134^{ab}	196^{a}
May-2006	55^{d}	116^{d}	171^{b}	111^{b}	248^{bc}	359^{d}
Jun-2006	27^{bc}	52^{b}	79^{ab}	53^{ab}	111^{ab}	164^{b}
Jul-2006	27^{bc}	55^{c}	82^{ab}	60^{ab}	120^{ab}	180^{a}
Aug-2006	13^{ab}	32^{abc}	45^{ab}	32^{ab}	69^{a}	101^{a}
Sep-2006	26^{bc}	51^{bc}	77^{ab}	50^{ab}	110^{ab}	160^{a}
Oct-2006	34^{c}	98^{d}	132^{ab}	101^{ab}	283^{c}	384^{b}
Nov-2006	32^{c}	97^{d}	129^{b}	70^{ab}	183^{ab}	253^{ab}
Dec-2006	15^{ab}	42^{abc}	57^{ab}	30^{ab}	85^{ab}	115^{a}
Jan-2007	7^{a}	18^{ab}	25^{a}	27^{ab}	71^{a}	98^{a}
Feb.-2007	2^{a}	10^{a}	12^{a}	7^{a}	29^{a}	36^{a}
L.S.D.	9.932	22.23	78.33	28.716	39.799	81.466
$F_{cal.}$	19.99	21.52	14.24	28.88	40.11	11.206

$F_{tab.} = 2.11$
significant at 0.05

Figure, 1 – Schematic draw of the structure of tested plastic bucket trap:

Photomicrograph (1). Show trap placement with its inserted lower two thirds in the ground.

Traps were placed on the ground as previously described above. The used aggregation pheromone lure was replaced with new one every 50 days; while the added food baits were replaced fortnightly with new ones. Traps were weekly inspected, the numbers of captured adult weevils were consequently recorded from the beginning of February the 17th 2006 and/or the 23ed 2007 up to February the 16th 2007 or/and 2008.The collected adults were identified, sexed and counted.

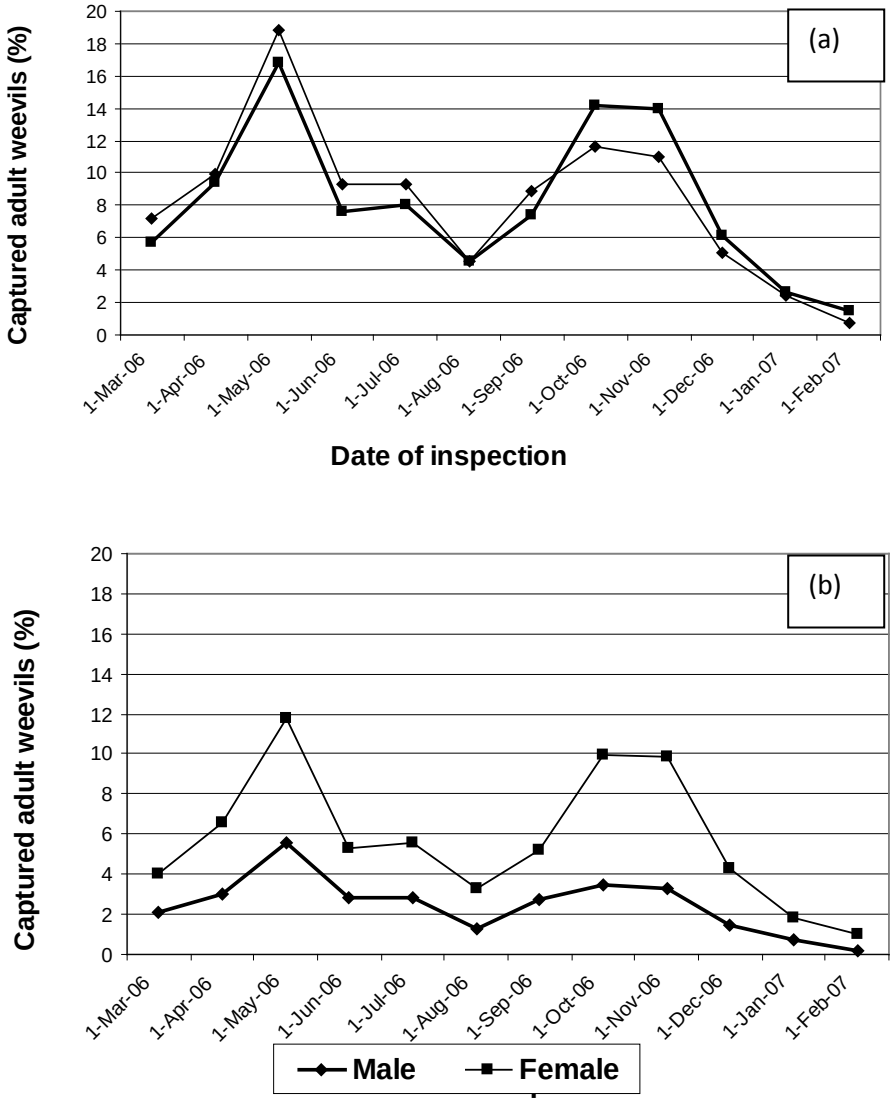
The numbers of weekly captured and, recorded male and female adult weevils were calculated in monthly cumulative numbers and proportioned to the counts of their yearly totals, to estimate and extract the possible resulting effects of followed intercropping system, agrotechincal practices and prevailing climatic conditions on the dynamical fluctuation of red palm weevil populations in each of inspected orchards throughout the growing season on date palm trees.

RESULTS AND DISCUSSION

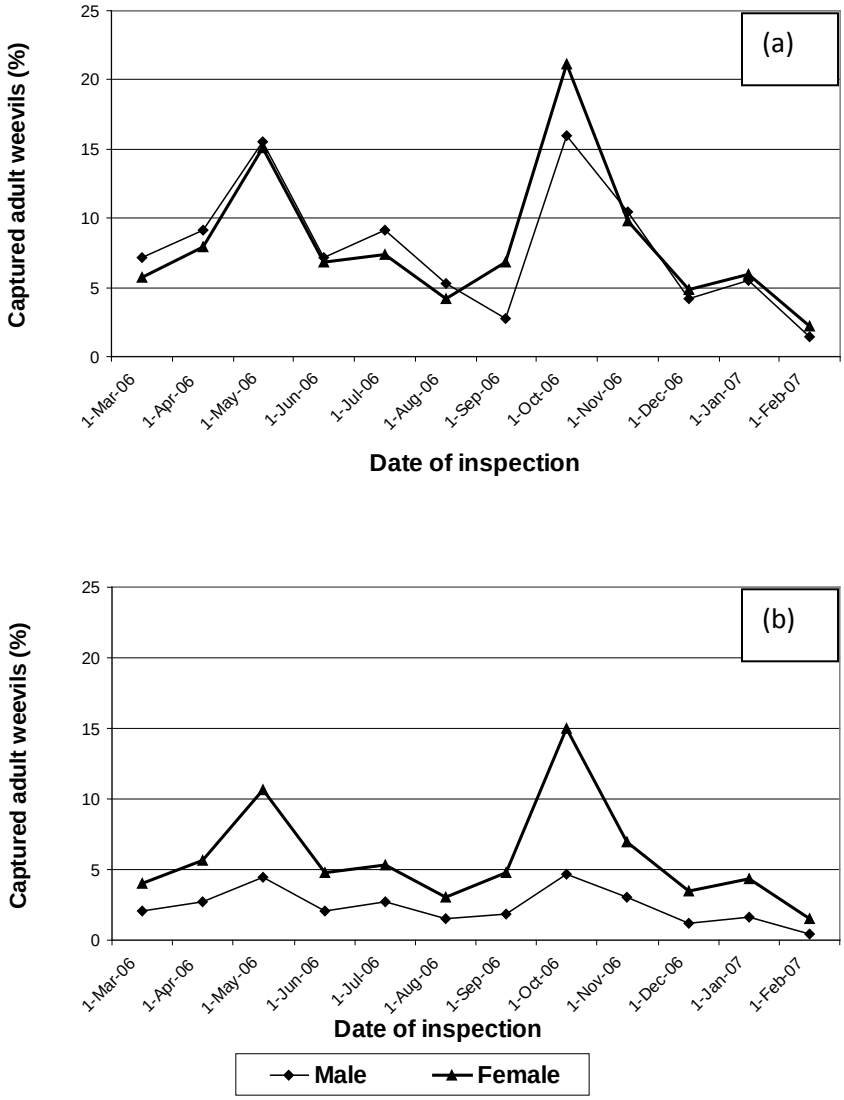
The included data in Table 3 and Figures 2 and 3 show the calculated monthly commulative numbers of weekly attracted adults of red palm weevil, *Rhynchophorus ferrugineus* Oliv. to aggregation pheromone –food baited traps; the seasonal variation in calculated percentages of the monthly captured adults in proportion to the total captured males or females; and the grand total of both sexes throughout the growing season of Mar. 2006-Feb.2007,to determine the possible resulting effects of followed intercropping system under the conditions of applied agro-technical practices and prevailing climatic conditions on the existing red palm weevil populations in the investigated orchards. Whereas, in the inspected orchard at Kombanyiat Abo-Kir village, the date palm trees were intercropped with guava trees, besides some winter and / or summer field crops.In the other inspected one, at Kom EL-Tarfaya village, date palm trees were interplanted by citrus and banana trees.

In general, the emergence of adult weevils, represented by more or less higher monthly cumulative numbers of captured weevils, indicated that the flight activity of this insect-pest, essentially occurs in most months of the growing season; extended with comparatively lower number in the 2nd half of February 2006; more or less increased until December-2006; then decreased again in lower numbers till the end of February in the next year of 2007. (Table 3).

The same trend of delayed adult emergence was detected in the fluctuating calculated percentages of attracted adult- males or- females of red palm weevil when proportionate to the totals of captured males or females ,or / and the grand total of both sexes during the growing season (Figs. 2 and 3).



Figure, (2): Dynamical fluctuation of calculated percentages of monthly captured males or/and females of the red palm weevil *Rhynchophorus ferrugineus* oliv. in proportion to (a) the total captured males or/and females ; (b) the grand total of captured males and females per year in the inspected date palm orchard, at Kombanyiat Abo Kir village Kafr EL-Dawar, El-Beheira Governorate, in March 2006-Feb. 2007.



Figure, (3): Dynamical fluctuation of calculated percentages of monthly captured males or/and females of the red palm weevil *Rhynchophorus ferrugineus* oliv .in proportion to (a) the total captured males or/and females; (b) the grand total of captured males and females per year in the inspected date palm orchard at kom EL-Tarfaya village, Kafr EL- Dawar, El-Beheira Governorate, in March 2006 - Feb. 2007.

That delayed flight activity of red palm weevil adults all over the growing season could be explained by the mentioned results in the works of many researchers. Menon and Pandalai (1960) stated that the complete life cycle of the weevil from egg to adult emergence, takes an average 82 days. After emergence from pupal case, the adult weevil remains inside the cocoon for 4-17 days (average 8 days). At Sharkia and Ismailia governorates, Egypt, Abbas *et al*. (2000) explained that the flight activity of red palm weevil *R. ferrugineus*, occupied essentially most year and lasted from the end of February until the end of December; declined in low numbers during January and first half of February of the next year, then started to reincrease again up to the end of the year. Salama *et. al*. (2002) used the calculated thermal constant of pupal stage of *R. ferrugineus* to determine the dates and numbers of weevil emergence cycles in Ismailia during 1999-2000. It was revealed that the thermal threshold was (-2.3˚C) while the thermal constant was (423 degree days), and around 20.7 cycles of weevil emergence per year have been predicted in Egypt. Also, our results are in agreement with those arrived at by Hagley (1963), Morales and Chinchilla (1990) and Weissling *et al.* (1994) who reported on the high seasonal variation in the flight activity of *Rhynchophorus spp.* adult weevils.

Moreover, three prominat peaks of male and/or female weevil captures were recorded in the investigated date palm orchards at Kombanyat Abo-Kir and Kom EL-Tarfya villages at Kafr EL-Dawar center (Figs. 2 and 3). These peaks occurred during the months of May, July and October - November. Where, the relatively higher recorded numbers of captured adults during these months comprised 55, 116 & 171; 27, 55 & 82; and 34, 98 & 132 and 32, 97 & 129 for males, females and their totals, respectively in the interplanted date palm orchard with guava trees and some winter and summer field crops at Kombanyiat Abo-Kir village (Table 3); 111, 248 & 359; 60, 120 & 180; and 101, 283 & 384 and 70, 183 & 253, in respect, in the interplanted date palm orchard with citrus and banana trees, at Kom EL-Tarfaya village (Table 3).

From the above mentioned results, these peaks of weevils captures may be considered as indicator to the number of existing red palm weevil generations in EL-Beheira Governorate.

In this concern, EL-Ezaby (1997) reported that the red palm weevil has three generations per year. The shortest generation (the first) of 100.5 days, and the longest (the third) of 127.8 days. He also showed that the upper temperature threshold of egg was 40˚C. EL-Garhy (1996) showed that many more adults of red palm weevil were captured during the warmer summer months than during the cooler winter months. The threshold for red palm weevil was found to be in the range of 12-14˚C with very low number of weevils being captured in December and January, the only months in which the average daily temperature fell below 14˚C. While, captures rates were highest in the months of April, May and June which correspond to the onset

of warmer weather in Egypt. He also explained that the higher capture rates during the warmer period may propably due to the emergence of broods whose development was prolonged by the condition of cooler winter months. Also, EL-Sebaey (2003) studied the seasonal abundance and seasonal activity of *R. ferrugineus* during 1996-2001, in Egypt; and showed that this insect-pest had two main active seasons annually. The first – adult brood was observed in April; the second one was in November.

Irrespective to the followed intereropping system in inspected date palm farms, the obtained results of the calculated percentages of captured female or male weevils (monthly or weekly) indicated that the fluctuating densities of emerging adult-females were, to more extent, higher than that of the emerging adult-males throughout the whole growing season. That fact was ascertained by the included data in Table, 4. Where, the estimated rates of captured adults-males or females- were significant and merely equal in the inspected date palm orchards in the villages of Kombanayat Abo-Kir and Kom EL-Tarfaya, at Kafr EL-Dawar center. The higher numbers of captured females were nerely twice as that of captured males; and the female based sex ratio ranged between 1 male: 2.3 females and 1 male: 2.4 females.

Table, (4): Sex ratio of captured red palm weevil adults *Rhynchophorous ferrugineus* oliv in the aggregation pheromone/ food baited traps in date palm orchards, at different localities of El Beheira governorate, in Mar. 2006- Feb. 2007.

Rate Females / Males		
Kombanyiat Abo-Kir village		
Adult sex	Ratio	
Male	45.68[a]	1:2.3
Female	105.26[b]	
L.S.D$_{0.05}$	13.048	
F $_{cal.}$	96.625	

F $_{tab}$ =2.21
**significant at 0.05

Kom El-tarfaya village		
Male	55.52[a]	1 : 2.4
Female	134.44[b]	
L.S.D$_{0.05}$	41.088	
F $_{cal.}$	117.59	

F $_{tab}$ =2.21
**significant at 0.05

Similar findings were mentioned by EL-Garhy (1996) who showed that twice as many female as male weevils were caught during the period of investigation. Abbas *et al.* (2000) reported that the numbers of females attracted were generally, twice as that of males and no sharp change was observed from season to another. EL-Sebaey (2003) determined that female density was higher than male density and constituted 52.8- 57.8 % of the total population in the field. Also, Soroker *et al* (2005) stated that the sex ratio of trapped adults during three years of study in Jordan was significantly female-based (2.5:1). Therefore, mass trapping might have played a significant role in the suppression of red palm weevil populations in date palm plantations.

In addition to the above cited results, it was noticed that most of the weekly calculated higher minor peaks of captured adult-males or females in proportion to the total captured adults per year comparatively occurred during May, July and October – November months at the inspected localities. Consequently, that may ascertain the propable occurrence of three generations of red palm weevil per year in these locations of EL-Beheira Governorate. Moreover, the recorded variation in the delayed flight activity of the weekly and/or monthly captured adults could be also greatly attributed to the resulting interaction of followed agropractices and intercropping system with the prevailing climatic conditions in each of the investigated date palm orchards. Where, the calculated correlation coefficient (r) values between the correlated numbers of attracted red palm weevils to pheromone traps and estimated parameters of temperature and relative humidity indicated a highly significant relationship between the counted numbers of captured adults and higrothermic conditions of maximum temperature and mean daily relative humidity in the inspected locations (Table, 5).

Remarkedly, the followed practical performance of interplanting some other fruit trees within the rows of date palm trees in the investigated farms revealed interaction effects that, to a more or a less, extent reflected on the level of occurring infestation by red palm weevils.

The demonstrated results in Table 6, declear the effects of interplanted fruits trees between the growing rows of date palms on the detected rates of infested Zaghloul and/or sammany date palm varieties with the red palm weevils.

In general, the previously shown higher rates of counted numbers of attracted red palm weevil adults to aggregation pheromone/food baited traps in the intercropped date palm farm with citrus and banana trees at Kom EL-Tarfaya village, compared to those lower recorded rates in the farm of intercropped date palms with guava trees; winter and or summer crops, at Kombanyat Abo-Kir village, throughout most months of the growing season (Table, 4), in some extent, correspondend to a high or lower estimated levels of infested date palm varieties during the period of delayed flight activity of the emerging weevils.

Table (5). The calculated correlation coefficient (r) values between the prevailing parameters of temperature and relative humidity and number of attracted red palm weevil adults to pheromone traps in the date palm orchards of investigated localities at El-Beheira Governorate; in Feb. 2006- Jan. 2007.

Physical parameter \ Locality		Kambaniyat Abo kir			Kom El-Tarfaya			Kafr El-Dawar		
		M*	F**	M+F	M	F	M+F	M	F	M+F
Temperature C^0	Max. Temp C^0	0.30	0.78**	0.56*	0.60	0.81**	0.73	0.63*	0.82**	0.77**
	Min. Temp C^0	0.11	0.21	0.17	0.18	0.31	0.27	0.18	0.25	0.21
	Mean C^0	0.21	0.42	0.36	0.20	0.35	0.29	0.22	0.36	0.30
	Thermic amplitude C^0	0.24	0.33	0.37	0.29	0.40	0.44	0.31	0.43	0.49
%Relative humidity	Max. RH	0.32	0.43	0.51	0.42	0.56	0.61*	0.43	0.58	0.62*
	Min. RH	0.21	0.23	0.20	0.14	0.29	0.32	0.24	0.21	0.35
	Mean. RH	0.99**	0.83**	0.88**	0.93**	0.86**	0.88**	0.62*	0.84**	0.87**

M* = Males
F = Females**

The measured level of red palm weevil infestation of each inspected date palm variety in these orchards is dependent to the density of emerged adult's population (Table, 6). Whereas, interplanting guava trees between the rows of Zaghloul and /or Sammany date palm varieties, to more extent decreased the rate of infestation by red palm weevil up to 0.98 and 2.4 and 1.6% and 7.3% in proportion to the total growing palms and/or the total inspected palms of each variety in respect; compared to a more increased rate of infestation ranged between 3.6-3.9 and 9.5 – 10.5 % and/or 4.4 – 5.4 and 15.7 – 19.3 % in case of interplanting citrus and banana trees between the rows of Zagloul and/or Sammany date palm varieties, respectively.

From our view point the resulting physiological interaction effects between the interplanted fruit trees or field crops and the varieties of growing date palm trees in the inspected orchards; may be in a more or a less extent

reflect on the occurring infestation level by the existing population of red palm weevil adults. In this concept numerous research workers pointed to the effect of different experimented intercropping systems using various interpalnted field and/or horticultural crops on the occurred pests infestations; yield quality and losses of the interpalnted crops, in particular, the cover crop.

Table, (6): The estimated rates of red palm weevil infestation of grown rate palm varieties at the inspected farms in EL-Beheira governorate during the following growing season of 2006 – 2007 & 2007 – 2008.

Growing season	Orchard No./Locality	Total - palms	No. of inspected date trees		Infested Palms No./%			
			Zaghloul Palms	Samany Palms	Zaghloul		Samany	
					(a)	(b)	(a)	(b)
2006/ 2007	Kombanyia Abo-Kir*	510	210	145	5		8	
					0.98	2.4	1.6	7.3
	Kom EL-Tarfaya**	535	200	150	21		29	
					3.9	10.5	5.4	19.3
2007/ 2008	Kom EL-Tarfaya**	535	200	150	21		29	
					3.9	10.5	5.4	19.3
	Kom EL-Tarfaya**	500	190	140	18		22	
					3.6	9.5	4.4	15.7

(a) Proportion to total palms in the orchard.
(b) Proportion to total Zaghloul or/and Samany date palm trees.
(*) Guava trees interplant with date palm trees.
(**) Citrus & Banana trees interplant with date palm trees

Hall *et. al.* (2005) indicated that in Viet Nam interplanting citrus with guava negated infestations of Asian citrus psyllid and consequently huanglongbing, a serious disease caused by a bacterium vectored by the psyllid. Young citrus interplanted with guava remained disease-free for a year. Whereas a similar plot of citrus by itself showed signs of the disease within four months of planting and reached over 30% trees infected within a year. Observations supporting the guava effect were made in other Vietnamese groves where citrus and guava were intercropped.

The intercropping of banana trees with other crops was refered by Scot *et al.* (2006), who explained that growing of Musa species require space and light; and co-exist well with a wide range of plants and trees in the pacific.

They also pointed to the benefits of inter-planting banana trees with other plant species, in particular, wind protection; disease and pest control. And their reverse potential drawbacks when intercropped with other horticultural crops; mainly; root competition and drastic drain of water and nutrients, disease transmission from alternative hosts; attracting and harbouring some injurios insect-pests.

Kalleshwaraswamy *et al.* (2006) tested food baits, like cut pieces of pine-apple and sugarcane, hand crushed grapes, pieces of coconut petiole and peeled banana for their efficacy in inhancing the attraction of red palm weevil adults by synthetic aggregation pheromone lure. It was revealed that highest weevils capture could be obtained if pine apple and sugarcane followed by banana and coconut petiole were used as food bait with lure.

In regard to many conducted research works to asses the resulted physiological interaction effects of intercropping different field or horticultural crops with the cover crop, Bakheit *et. al.* (2001) showed the effect of different intercropping packing with faba on the infestation of *Orobanche.* Intercropping faba bean with each of lupine fenugreek and Egyptian clover markedly reduces the *Orobanche crenata* Forsk, infestation of faba bean. Also, number of branches, height of the first pod, number of pods, seed yield and number and dry weight of *Orobanche* spikes were significantly affected by intercropping packages. They concluded that intercropping faba bean with each of lupine, fenugreek and Egyptian clover increased faba bean seed yield, consequently the economic return was also increased.

Jones and Gillett (2005) stateed that the presence of sunflower rows included in a polyculture system increased the occurrence and abundance of beneficial insects in cropped fields. Sunflower plantings within rows of vegetable crops may indeed be an effective way to attract beneficial insects into cropped fields. Also, Jones and Sieving (2006) reported that cropped areas with sunflower treatments of one or two rows per 0.4 ha exhibited significantly greater mean abundance of insectivorous birds than did control plots, across a variety, of organic vegetable crop types. The addition of sunflower intercrops proved to be an effective habitat modification for augmenting avian insectivore numbers and insect-foraging time in organic vegetables.

Scott and Liburd (2005) reported that in organic systems, cover crops have been shown to reduce insect pest populations in subsequent cash crops. Results of the conducted experiments to track insect pests and natural enemies from cover crops to broccoli and squash, proved that plots treated with graminaceous cover crops had significantly fewer aphids and whiteflies compared with leguminous cover crops. Cover crop mixtures also had significantly fewer pests compared with single cover crops.

Ibeawuchi, (2007) decleared that intercropping as a system of cropping two or more crops suppresses weeds, reduces pest disease infestation,

gives yield advantage and there is stable yield over time. Intercropping encourages high nutrient uptake than in sole cropping and water use efficiency is high because of intercoopertive interaction between the intercrops. . Intercropping is done with crop rotation to break weed, diseases and pests' cycles and also provides complementary fertilization to crops in sequence with each other. He also showed that another major advantage of intercropping is pest management whereas; intercropping can play a significant role in integrated pest management.

There are many cases where pests and especially weeds are suppressed by certain crop combinations like maize/soybean, maize/black grain, maize/velvet bean. Chaud and Sharma (1977) reported that in all the crop combinations there were pest (stem borer) reduction in all intercropping involving maize and another crop when compared to maize grown sole.

According to Moreno (1979) intercropping cassava and maize significantly delayed the onset of the cassava scab (*Spaceloma* spp.) epidemic. Also, when cassava is planted in association with maize and common bean, there is less rust (*Uromyces manihotis)* on cassava.

REFERENCES

Abbas, M.S.T.; S.B., Hanounik; S.A., Mousa and S.H. Bagham (2000). Soil application of entomopathogenic nematodes as a new approach for controlling *Rhynchophorus ferrugineus* on date palm. International Journal of Nematology, 10(2): 215-218.

Abraham. V.A., M.A. AL-Shuaibi, J.R. Faleiro and R.A. Abozuhairah (1998). An Integrated management approach for red palm weevil *Rhynchophorus ferrugineus*. Oliv. A key pest of date palm in the Middle East. Sultan Qaboos University Journal for Scientific Research Agricultural Sciences, 3: 77-83.

Abraham. V.A., J.R. Faleiro; C.P.R. Nair and S.S. Nair (2002). Present management technologies for red palm weevil *Rhynchophorus ferrugineus*. Oliv. (Coleoptera: *Curculionidae*). In palms and future thrusts. Pest Management in Horticultural, Ecosystems, 8(2): 69-82.

Bakheit Bahy R., A.Y. Allam and Anaam H. Galal (2001). Intercropping Faba Bean with some Legume Crops for Control of *Orobanche Crenata.* No. 225 Assiut J. of Agric, Sci., Vol. 32, No.3

Chaud, P. and N.N. Sharma (1977). Influence of crop association in insect pest incidence. Proceedings, Indian National Science Academy 43 (Part 3).

Cox, M.L. (1993). Red palm weevil *Rhynchophorus ferrugineus* in Egypt. FAO Plant Protection Bulletin, 41(1): 30-31.

EL-Ezaby, F.A. (1997). A biological in-vitro study on the Red Indian palm weevil. Arab Journal of Plant Protection, 15(2): 84-87.

EL-Garhy, M.E. (1996). Field Evaluation of the aggregation pheromone of the red palm weevil *Rhynchophorus ferrugineus* in Egypt. Brighton Crop Protection Conference, Pests and diseases, Volume 3: 1059-1064.

EL-Sebaey, Y. (2003). Ecological studies on the red palm weevils *Rhynchophorus ferrugineus* Oliv. (*Coleoptera: Curculionidae)* in Egypt Egyptian Journal of Agricultural Researches, 81(2): 523-529.

Faleiro, J.R. (2006). A review of the issues and management of the red palm weevil, *Rhynchophorus ferrugineus* (*Coleoptera: Rhynchophorinae)* in coconut date palm during the last one hundred years. International Journal of Tropical Insect Science, 26(3): 135-154.

Hagley, E.A.C. (1963) the role of the palm weevil, *Rhynchophorus ferrugineus* palmarum as vector of red ring disease of coconut. I. Results of preliminary investigations. Journal of Economic Entomology, 56, 375-380.

Hall, D. G., T. R. Gottwald, N. M. Chau, K. Ichinose, L. Q. Dien and G.A.C. Beattie (2005). Intercropping of citrus and guava trees for management of Huanglongbing. Florida Entomological Society, Vol. 88, issue 1 page 91-96.

Herrera, W.A.T. and R.R. Harwood (1973). Crop interrelation-ships in intensive cropping systems. Saturday seminar, International Rice Research Institute, Los Banos, Philipines. 26 pp.

Ibeawuchi, I. I. (2007). Intercropping - A Food Production Strategy for the Resource Poor farmers Nature and Science, 5(1)

Jones Gregory A. and Jennifer L. Gillet (2005). Intercropping for Beneficial Insects 91Intercropping with sunflowers to attract insect's iorganic agriculture. Florida Entomological Society 2007 Annual Meeting Abstracts.

Jones, Gregory A. and Kathryn E. Sieving (2006). Intercropping sunflower in organic vegetables to agument bird predators of Arthropod. Agriculture, Ecosystems & Enivronment, Vol. 117, issues 2-3, November 2006, pages 171-177.

Kaakeh, W.; F. El-Ezaby; M.M., Abou-Nour and A.A. khamis (2001). Management of the red palm weevil, (*Rhynchophorus ferrugineus* Oliv.) by a pheromone/ food-based trapping system. 2nd International Conference on date palm, Al-Ain, UAE.

Kalleshwaraswamy, C. M.; P. S. Jagadish and Puttaswamy (2006). Standardization of food bait, hight and colour of the trap for attracting red palm weevil, *Rhynchophorus ferrugineus* (*Olivier*) by synthetic pheromone lure. Annals of Palm Protection Sciences, 14(1): 17-21.

Lakashmanan, P.L.; P.V. Subba-Rao and T.R. Subramaniam (1972). A note on the control of the coconut red palm weevil on coconut. Madras Agricultural Journal, 59(11/12): 638-639.

Menon, K.P.V. and K.M. Pandalai (1960) Pests In The Coconut Palm A Monograph, pp. 261-265, *Inrankulam*, South India Central Committee.

Morales, J. and C.M. Chinchilla (1990). Studies Poblacionales *Rhynchophorus* palmarum (L.) relacion conla enfermeded de anillo rojo, hoja pequena en palma aceitera en costarica Turrialb 40:478-485.

Moreno, R.A. (1979). Crop protection implications of cassava intercropping In: Weber E., Nestel B. and Campbell N. (Eds.) Intercropping with cassava. Proceedings, International workshop IDRC Ottawa pp 113-127.

Oehlschlager, A.C.; C.M. Chinchilla; L.M. Gonzalez, L.F. Jiron; R.G. Mexzon and B. Morgan (1993) Development of a pheromone, based trapping system for *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae). J. Econ. Entomol. 24: 1005-1012.

Oehlschlager, A.C.; R.N.B. Prior; A.L. Perez; R. Gries; H.D. Jr-Pierce and S. Laup (1995). Structure, chirality, and field testing of a male produced aggregation pheromone of Asian palm weevil *Rhynchophorus bilineatus* (Montr.) (*Coleoptera: Curcul*ionidae). Journal of Chemical Ecology, 21(10): 1619-1629.

Salama H.S.; M.K. Hamdy and M.M. El-Din (2002). The thermal constant for timing the emergence of the red palm weevil, *Rhynchophorus ferrugineus* (Olivier) *(Coleoptera: Curculionidae*), Anzeiger Fur Schadlingsk unde, 75(1): 26-29.

Saleh, M.R.A. (1992). Red Palm Weevil *Rhynchophorus ferrugiueus* (Oliver) in the first record for Egypt and indeed the African continut list No. 10634 Africa collection No. 22563 International Institute of Entomology 56 Queen 5 Gate. London. SW 75 JR. UK.

Scot. C.N.; R.C. Ploetz and A.K. Kepler (2006). Musa species (banana and plantaion). Species profiles for Pacific Island, Agroforestry. www.traditional tree.org

Scott, C.A. and O.E. Liburd (2005). tracking insect populations within organic vega table systems to determine how residual population from cover crops affect vegetable production. Florida Entomologists, Vol.88, issue 1 (March 2005).

Soroker, V; D. Blumberg; A. Haberman; M. Hamburger-Rishard; S. Reneh; S. Talebaev; L. Anshelevich and A.R., Harari (2005). Current status of red palm weevil infestation in date palm plantations in Israel. Phytoparasitica, 33(1): 97-106.

Weissling, T. J., R. M. Giblin-Davis, B.J. center and T. Hiyakawa, (1994). Fight behavior and seasonal trapping of *Rhynchophorus cruentatus (Coleoptera: Cucculionidae)*.Ann. Entmol. Soc. America, 87:641-647.

تأثير نظام الزراعات البينية (التحميل) علي الإختلافات السنوية لتعداد عشائر سوسة النخيل الحمراء في مزارع نخيل البلح في محافظة البحيرة– مصر.

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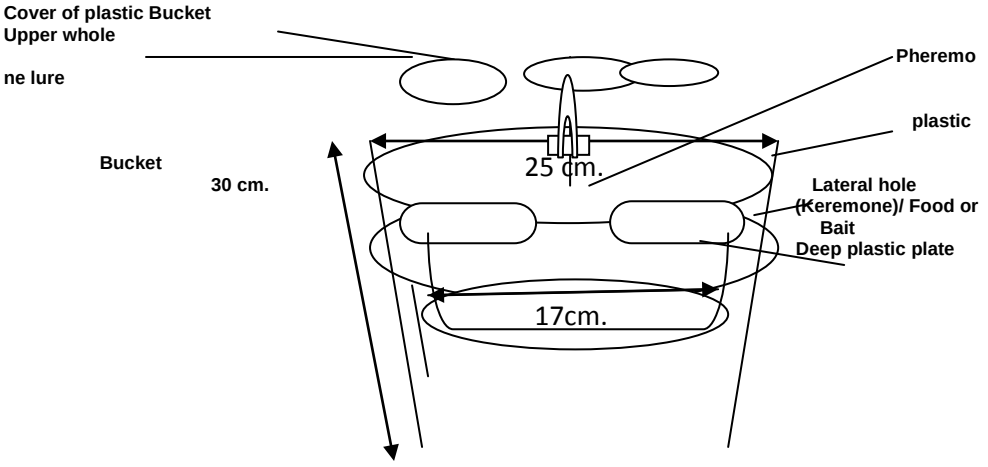
الملخص العربي

أوضحت الدراسة التأثير الشديد لأنواع المحاصيل المستخدمة فى الزراعات البينية (التحميل) فى ظل الظروف المناخية الزراعية السائدة بالمنطقة علي تواجد و كثافة مجاميع حشرة سوسة النخيل الحمراء ، حيث سببت إمتداد خروج و إستمرار نشاط كلا من الذكور والإناث خلال أغلب شهور موسم النمو ٢٠٠٦ – ٢٠٠٧، و أمكن تسجيل ثلاث قمم (Peaks) تمثل فترات نشاط واضحة لخروج و طيران الحشرة خلال أشهر مايو و يوليو و (أكتوبر / نوفمبر) مما يوضح احتمال وجود ثلاثة أجيال لحشرة سوسة النخيل الحمراء في محافظة البحيرة. و كان تعداد الإناث أعلي مرتين تقريبا عن الذكور ، حيث كانت النسبة الجنسية التى تم حسابها بين الذكور والإناث تعادل ١ ذكر إلي ٢.٣ أو ٢.٤ إنثي.

كما أوضحت النتائج أن إمتداد و طول فترة نشاط طيران الحشرات الكاملة خلال موسم النمو يرجع بشكل كبير إلي التأثيرات البيية المتداخلة و الناتجة عن نظام التحميل و نوعية المحاصيل المستخدمة فى الزراعات البينية بين صفوف أشجار نخيل البلح ، و العمليات الزراعية المختلفة و المتبعه تحت ظروف الحرارة والرطوبة السائدة ، وقد بينت قيم الإرتباط المحسوبه (r) بين أعداد الحشرات التى تم إصطيادها في المصائد المختبرة و قيم متوسطات درجات الحرارة و نسب الرطوبة خلال الموسم وجود علاقة معنوية عالية بين أعداد تلك الحشرات المتجمعة بالمصائد وكل من درجة الحرارة ونسبة الرطوبة اليومية.

وفى هذا الصدد تم تسجيل حالتى الإرتفاع و الإنخفاض فى أعداد الحشرات و بالتالى معدل الإصابة في حالة زراعة أشجار الموالح و الموز بين أشجار نخيل البلح أو زراعة أشجار

الجوافة أو المحاصيل الحقلية بين صفوف أو مع أصناف أشجار نخيل البلح على الترتيب ، حيث أدى ذلك إلى خفض نسبة الإصابة بحشرة سوسة النخيل الحمراء منسوبة إلى إجمالى أعدا د أشجار أصناف النخيل بالمزرعة في حالة زراعة أشجار الجوافة والمحاصيل الحقلية بين أشجار النخيل (٠.٩٨- ١.٦ %) ، بينما علي العكس من ذلك إزداد مستوي الإصابة بحشرة سوسة النخيل الحمراء في حالة زراعة أشجار الموالح و أشجار الموز بين أشجار النخيل (٣.٩- ٥.٤ %) ، في المزارع التي تم فحصها .


Cover of plastic Bucket
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