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Evaluation of Some Attractive Materials in The Management of Red Palm Weevil, *Rhynchophorus ferrugineus* Oliv. (Coleoptera: Curculionidae by The Pheromone Lure-Food Based on Trapping System

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ABSTRACT

The obtained results explained that the higher or lower density of red palm weevil populations in each of inspected date palm orchards is mainly attributed to the old and the numbers of growing date palm varieties in particular, Zaghloul and Sammany ones, the old and density of interplanted fruit trees within the rows of growing palms, the followed agrotechnical practices and the prevailing agroclimatic conditions, which all in combination more or less affect on the increased or decreased population density of developing weevils that correspond to the occurring infestation level and in sequence reflects on the rate of catch weevils.

The calibrating delayed emergence of the insect pest during most months of the growing season was detected. The higher rates of catch weevils occurred during the periods of March-April, May-July and October-November in both investigated orchards. The determined efficiency of used aggregation pheromone lure with or without the tested chemical material or food baits in the tested traps proved that the utmost efficient one was the food baited pheromone trap with treacle + yeast + tap water, with total catch weevils reached to 279 and 565 insects; resembled 26.1 and 31.6% of the grand total of captured adults per year in 1st & 2nd orchards, respectively. The nextly ranked pheromone traps were those supplied by date fruits + yeast or ethyl acetate in respect, and/or the aggregation pheromone alone.

The supplemented traps with diluted treacle + yeast, date fruits + yeast and ethyl acetate alone were to more extent unefficient and gave rather decreased rates of catch weevils.

Moreover, the data showed that the same detected higher or lower efficieny of evaluated pheromone lure food based trapping system was proved also for the determined monthly periodic intervals of efficient captures all the year round and the calculated annual means of catch adults of both sexes in the inspectd orchards.

INTRODUCTION

The date palm, *Phoenix dactylifera* L. (Palmaceae) is the most common widely cultivated in the arid zones of the middle east and North Africa. (Jones, 1995). The red palm weevil *Rhynchophorus ferrugineus* Oliv. (Coleoptera, Curculionidae) is widely accepted in recent time as being one of the most destructive insect-pest of date palm, which nowdays is under threat in the Eastern Arab countries (Kaakeh *et al*. 2001). This insect pest was firstly discovered attacking palm in the Arabian peninsula, progressirely spreadto Gulf States, and crossed the red sea into north Africa (Cox, 1993; Abraham *et al*, 1998, 2002 and Faleiro, 2006); then invaded Egypt and was recorded for the first time by Saleh (1992) in the newly reclaimed area at New Salhia district, El-Sharkyia governorate. The rapid expansion and wide distribution of this insect-pest is mainly attributed to the wide uncontrolled translocation of offshoots, the agroclimatic conditions prevalent in these regions and the unique morphology of the palm; with intensive modern date palm pharming, which enhanced an ideal and intensive ecological habitat for the insect-pest (Abraham *et al*., 1998 and 2002).

Many attempts were tried to limitate its spreading by numerous control measures including quarantine, regular surveys, insecticides spraying,trapping and trunk injection of infested palms. Trapping system has been an integral part of weevil management programs in most countries for several years (Oehlschlager, 1999).

The objectives of conducted study is to determine the efficiency of evaluated aggregation pheromone lure, in food based on trapping system, using different chemical and natural food additives with or without the aggregation pheromone lure, to reduce infestation incidence of this serious injurious insect-pest. As an

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attempt to attain basic information that may be valuable for programming successive control of this insect-pest.

MATERIALS AND METHODS

Experimental site and investigated date palm orchards:

Two commercial date palm orchards at Kom El-Tarfaya village, Kafr EL- Dawar center were selected for the experiment throughout the elapsed period from Feb. 2007 till Jan. 2008 to evaluate each of the tested traps. The date palm varieties, numbers of young, old palm trees and their total number in each orchard are shown in Table (1). The followed intercropping system in both orchards was the same and carried out by interplanting citrus trees between the rows of date palm trees, in addition to planted rows of banana trees on the edges of existing ditches in the orchard, which had been dug at a rate of a ditch between each three rows of growing palm trees.

The structure of used plastic bucket trap:

The used trap (Fig. 1) consists of an eighteen liter inverted plastic bucket, 30 cm in height, with a diameter of 25 cm at its upper opening and 20 cm at the bottom,and 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 dimenstes on the cover of the bucket for the entrance of the attracted weevils.

Table, 1. A list of growing date palm varieties in both investigated orchards at Kom El-Tarfaya, Kafr El-Dawar, El-Beheira Governorate, (Feb. 2007 – Jan. 2008).

Date Palm Variety	Young trees	Old trees	Total
		1st Orchard *	
Zaghloul	-------	200	200
Hayane	-------	177	177
Sammany	------	150	150
Hellawe	------	08	08
The total	------	535	535
		2nd Orchard *	
Zaghloul	11	179	190
Hayane	------	160	160
Sammany	17	123	140
Bent-Aesha	------	10	10
The total	28	472	500

- Date palms trees in both orchards 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 a ditch between each 3 rows of growing palms.

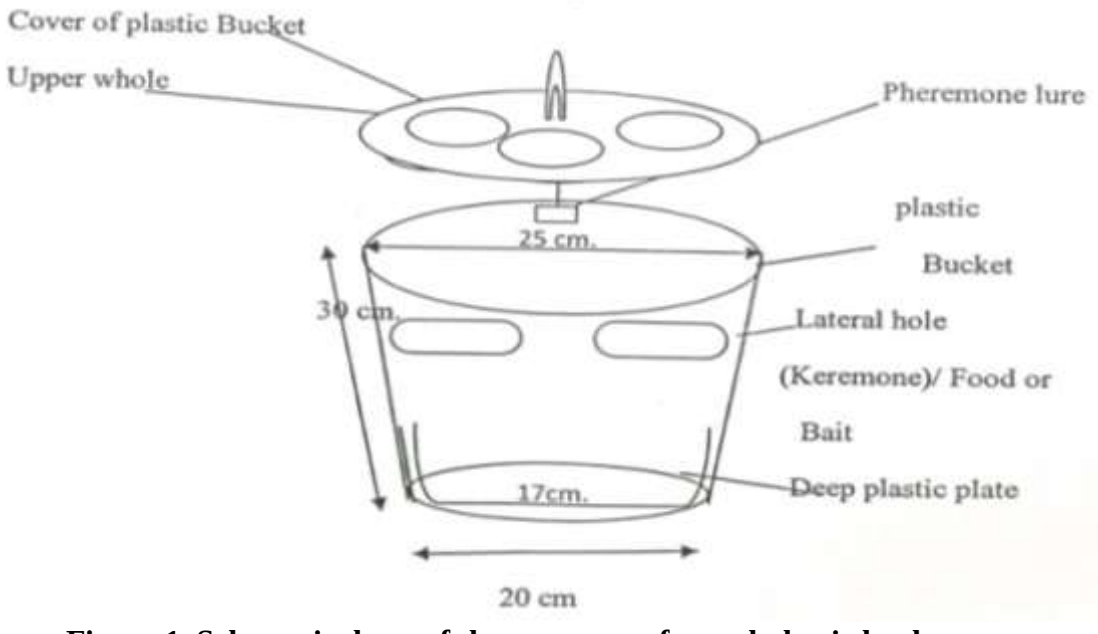


Figure 1. Schematic draw of the structure of tested plastic bucket trap

The components and placement of the pheromone food baited trap:

The seven evaluated traps supplied by a chemical attractant or/and three food baits with or without the aggregation pheromone lure are the following:

1)Aggregation pheromone lure + ethyl acetate.
2)Aggregation pheromone lure + 500 gm. crushed semi dry date fruits + 3 gm. brewers yeast + tap water.
3)Aggregation pheromone lure + 750 ml. diluted treacle + 3 gm. brewers yeast.
4) Ethyl acetate alone.
5) 750 ml. diluted treacle + 3 gm. brewers yeast.
6)500 gm. crushed semi dry date fruits + 3 gm. brewers yeast + tap water.
7) Aggregation pheromone lure alone.

Each of the aggregation pheromone lure known as ferrugineol pherocone RPW700 (4 methyl 5-nonanol), ethyl acetate, were put in 120 ml plastic bottle and hanged underneath the bucket cover. The attractive food additives were put in deep plastic plate (18-20 cm in diameter) placed on the bottom of the bucket.

To attain significant captures of RPW (Oelschlage *et al*., 1993) each of the seven tested traps were placed on the ground with the lower two thirds of each inserted in the ground between the palm rows; randomly distributed in the different cardinal directions and the middle of each farm, whereas each of the four made aperatures at the projecting upper third of the trap above the ground surface was oriented either to the north-south or the east-west directions. The aggregation pheromone lure was replaced with new one every 50 days. The tested food baits or the attractant chemical (ethyl acetate) were replaced fortnightly with new ones.

Annual occurrence of RPW population in investigated date palm orchards:

The effect of trapping by each of the seven tested traps on the Spatial pattern of fluctuating population density in each farm was based on the number of weevils cought per trap per specific period. Traps were inspected weekly from the beginning of Feb.the 23rd 2007 and inspection continued during the experimental period up to Jan.the 16th-2008. The trapped adults were collected, counted, identified as males and females. Also, the numbers of weekly cought adult weevils were calculated in monthly commulative numbers, proportioned to the counts of their monthly or yearly totals, to reveal and detect the actually resulting effects of the evaluated seven traps on the population pattern, size and fluctuating density in each investigated orchard throughout the growing season of Feb. 2007- Jan.2008, were determined.

Data were subjected to the analysis of variance test (ANOVA) & randomized complete block desigen (F-Test). The least significant differeces (L.S.D.) at the 5% level were determined according to computer program costat and Duncan"s multiple, range tests modified by Steel and Torrie (1980) are used to compare the averages numbers of trapped weevils during the period of study.

RESULTS AND DISCUSSION

The included results in Tables (2– 6) and Figures (1-4), show the calculated monthly cumulative numbers of weekly captured adults of red palm weevil in all or/and each of the tested traps. The seasonal variation of calculated percentages of the monthly captured adult weevils in proportion to the total captured males or females and the grand total of both sexes during the growing season from Feb. 2007 till Jan. 2008 were determined. The efficiency of evaluated chemical, food baits and aggregation pheromone lure for the management of red palm weevil by pheromone- food based trapping system were estimated under the prevailing agroclimatic conditions and followed agro-technical practices in each of both investigated date palm orchards at Kom EL-Tarfaya village, Kafr EL-Dawar center, EL -Beheira Governorate.

Obviously, prolonged annual intervals of delayed flight activity of the emerging adult weevils, that attracted to the evaluated traps were detected (Table 2), and confirmed the more or less fluctuating emergence of these captured adult weevils, which merely, occurred during most months of the year and lasts from 2nd half of feb. till December; showing that the seasonal abundance and seasonal activity of this insect-pest had two main active seasons annually and the higher flight activity of captured adults occurred during the consequent monthly intervals of Marsh-April; May-July and October-November (Figures 2 and 3).

That fact was ascertained by the deduced monthly averages of captured adults of red palm weevil in all the evaluated traps in both investigated orchards and exhibited in Table3. Herein, it could be seen that the higher calculated averages of attracted adult – males and females were recorded during the extending monthly periods of March – April, May–June and October – November in the 1st, and 2nd orchards; these averages of adult's catches, respectively amounted to 12.0–15.7, 17.4 – 17.5 and 18.3 – 16.7 weevils for the 1st orchard, and 39.14–55.28, 42.85–30.14 and 14.42–12.85 weevils for the 2nd orchard (Table, 3). Also, the numbers and calculated percentages of captured females were too a more extent higher and merely twice than that of the

Table 2. Numbers of monthly attracted adults of red palm weevil, *Rhynchophorous ferrugineus* Oliv. to all tested aggregation pheromone and food baited traps in the first and the 2nd inspected palm orchard, at kom El-Tarfaya village, Kafr El-Dawar, El-Beheira Governorate, in Feb. 2007-Jan.2008

Date of inspection	No of captured insects					
	The first inspected orchard			The second inspected orchard		
	Male	Female	Total	Male	Female	Total
Feb.-2007	12^{a}	41^{a}	53^{ab}	50^{b}	97^{c}	147^{ab}
Mar.-2007	25^{ab}	46^{a}	71^{ab}	96^{d}	178^{e}	274^{abc}
Apr.-2007	36^{ab}	74^{ab}	110^{ab}	127^{e}	260^{f}	387^{c}
May-2007	36^{ab}	86^{b}	122^{ab}	92^{d}	208^{e}	300^{ab}
Jun.-2007	36^{ab}	87^{b}	123^{ab}	76^{c}	135^{d}	211^{ab}
Jul.-2007	26^{ab}	79^{ab}	105^{ab}	40^{b}	64^{ab}	104^{a}
Aug.-2007	13^{a}	36^{a}	49^{ab}	14^{a}	34^{ab}	48^{a}
Sep.-2007	14^{a}	31^{a}	45^{ab}	24^{a}	46^{ab}	70^{a}
Oct.-2007	40^{b}	88^{b}	128^{b}	26^{ab}	75^{bc}	101^{a}
Nov.-2007	34^{ab}	83^{ab}	117^{ab}	28^{ab}	62^{ab}	90^{a}
Dec.-2007	29^{ab}	83^{ab}	112^{ab}	13^{a}	21^{a}	34^{a}
Jan.-2008	22^{ab}	20^{a}	42^{a}	4^{a}	12^{a}	16^{a}
L.S.D.	15.82	45.78	51.39	15.328	30.40	173.24
$F_{cal.}$	3.12	2.45	3.44	7.66	45.97	4.5

$F_{tab} = 2.11$

Table 3. The calculated monthly averages of captured adults of red palm weevil *Rhyn. ferrugineus* Oliv., in the evaluated pheromone and/or food baited traps in the 1st and the 2nd orchards, at Kom El-Tarfaya, Kafr El –Dawar, El-Beheira Gov., Feb. 2007-Jan. 2008

Month	The first orchard						The second orchard					
	M		F		M + F		M		F		M + F	
Feb. 2007	1.714	**e**	5.852	**cd**	6.857	**d**	7.142	**d**	13.857	**cd**	21.0	**d**
Mar. 2007	3.571	**bcd**	8.428	**bc**	12.0	**c**	13.714	**b**	25.428	**b**	39.142	**b**
Apr. 2007	5.1428	**ab**	10.571	**ab**	15.714	**abc**	18.142	**a**	37.142	**a**	55.285	**a**
May 2007	5.1428	**ab**	12.285	**a**	17.428	**ab**	13.142	**b**	29.714	**b**	42.857	**b**
Jun. 2007	5.1428	**ab**	12.428	**a**	17.571	**ab**	10.857	**c**	19.285	**c**	30.142	**c**
Jul. 2007	3.714	**bc**	11.285	**ab**	15.0	**abc**	5.714	**de**	9.142	**def**	14.875	**de**
Aug. 2007	1.857	**e**	5.142	**cd**	7.0	**d**	2.0	**fg**	4.8571	**efg**	7.0	**d**
Sep. 2007	2.0	**de**	4.428	**d**	6.428	**d**	3.428	**ef**	6.571	**efg**	10.0	**efg**
Oct. 2007	5.714	**a**	12.571	**a**	18.285	**a**	3.714	**ef**	10.714	**de**	14.428	**de**
Nov. 2007	4.857	**abc**	11.857	**ab**	16.714	**ab**	4.857	**ef**	8.857	**def**	12.857	**ef**
Dec. 2007	4.142	**abc**	9.571	**ab**	13.714	**bc**	1.857	**fg**	3.0	**fg**	4.857	**gh**
Jan. 2008	3.142	**cde**	2.2857	**d**	6.0	**d**	0.571	**g**	1.714	**g**	2.285	**h**
$L.S.D._{.05}$	1.5596		3.14045		3.4693		2.2195		5.752		6.280	
F cal.	6..56199		9.880		15.581		51.01512		30.765		57.464	

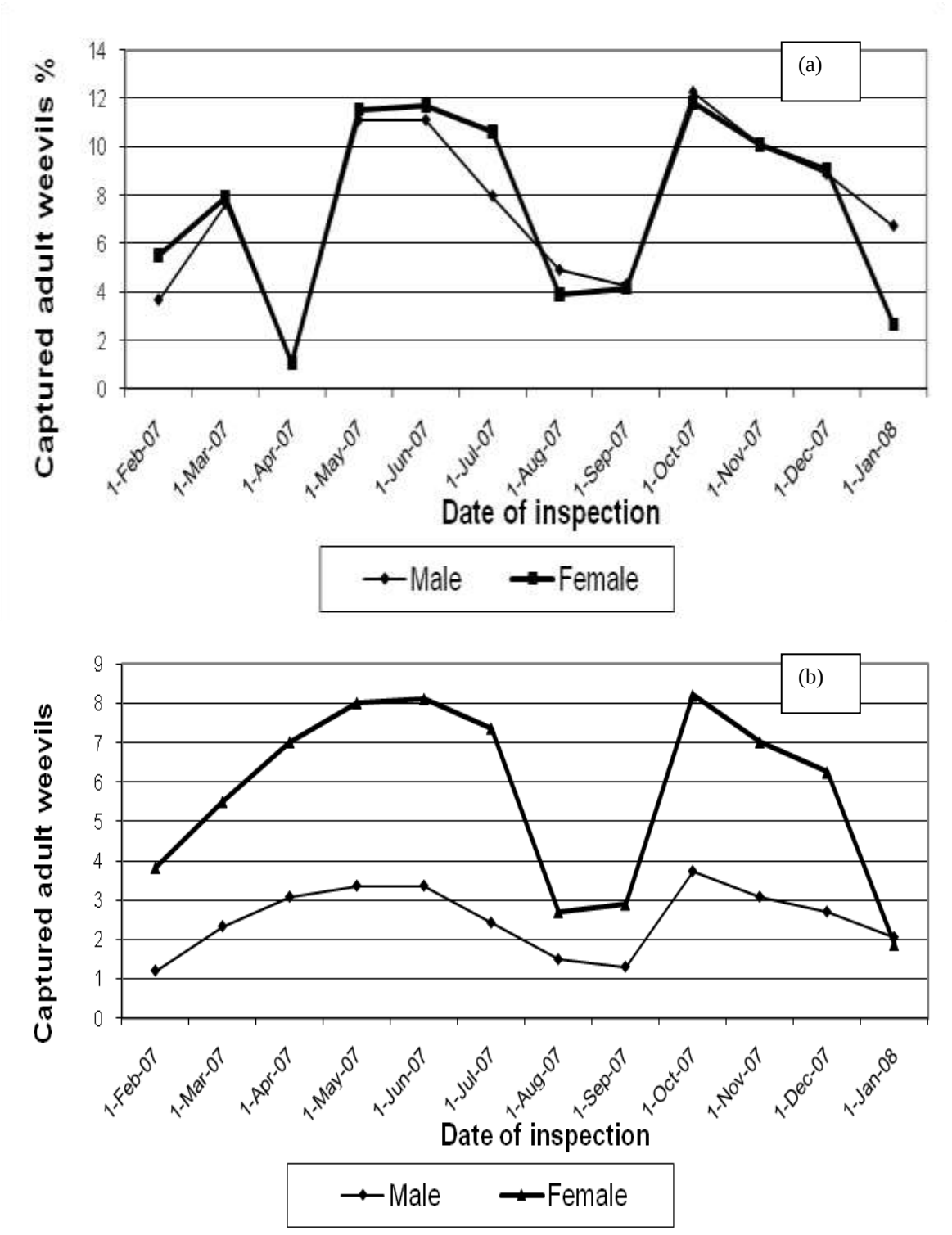


Figure 2. Dynamical fluctuation of calculated percentages of monthly captured males or/and females of the red palm weevil *Rhynchophorus ferugineus* Oliv. inproportion to (a) the total captured males or/and females; (b) the grand total of captured males and females per year in all the tested traps in first palms orchard at Kom El-Tarfaya village, Kafr El-Dawar, El-Beheira Governorate, in Feb. 2007 – Jan. 2008

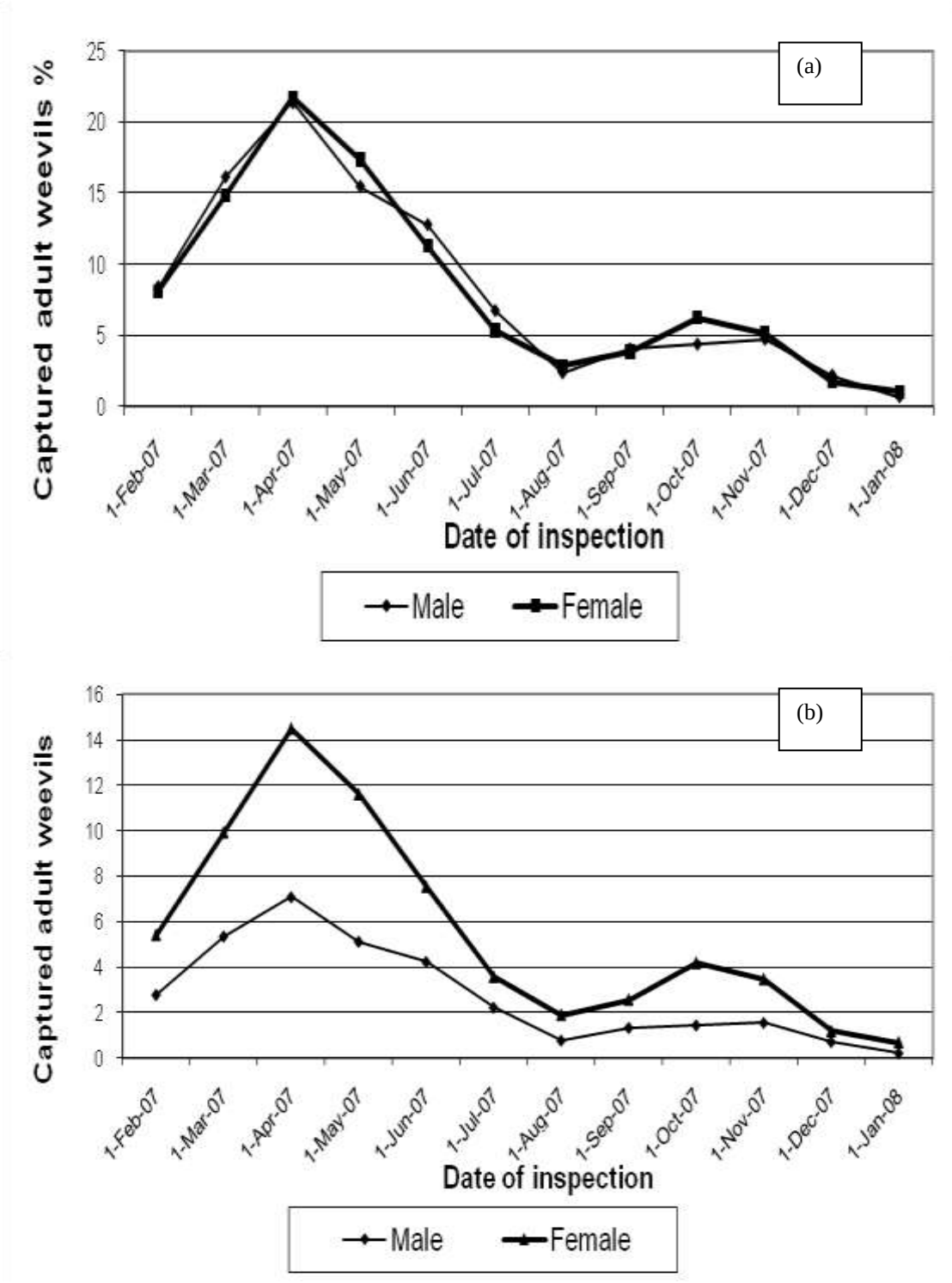


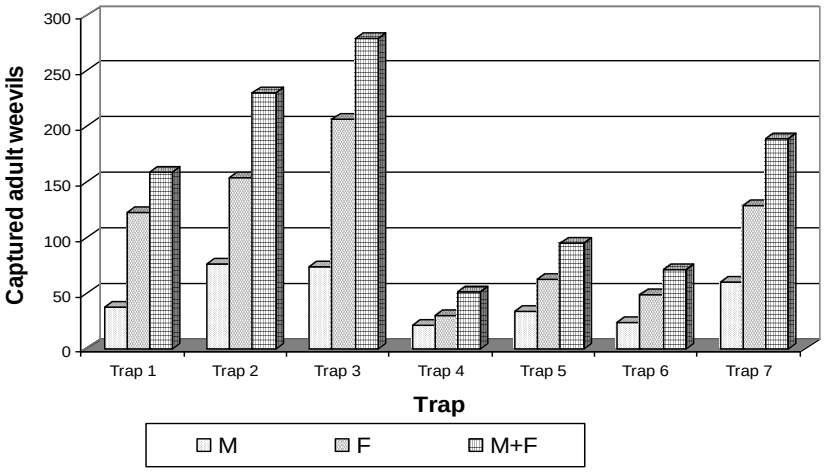
Figure 3. Dynamical fluctuation of calculated percentages of monthly captured males or/and females of the red palm weevil *Rhynchophorus ferrugineus* oliv.in proportion to (a) the total captured males or/and females; (b) the grand total of captured males and females per year in all tested traps in the second palms orchard, at Kom El- Tarfaya village, Kafr El-Dawar, El-Beheira Governorate, in Feb. 2007 – Jan. 2008

captured adult males throughout the whole growing season (Figures, 2 and 3)

Results of the measured efficiency of used aggregation pheromone lure in the traps with or without the tested food baits are exhibited in Figures (4 – 5) which declear the calculated total numbers and/or percentages of these captured adults in each of tested traps per year, in proportion to the grand total of captured adults in all placed traps in the first and second inspected date palm orchards.

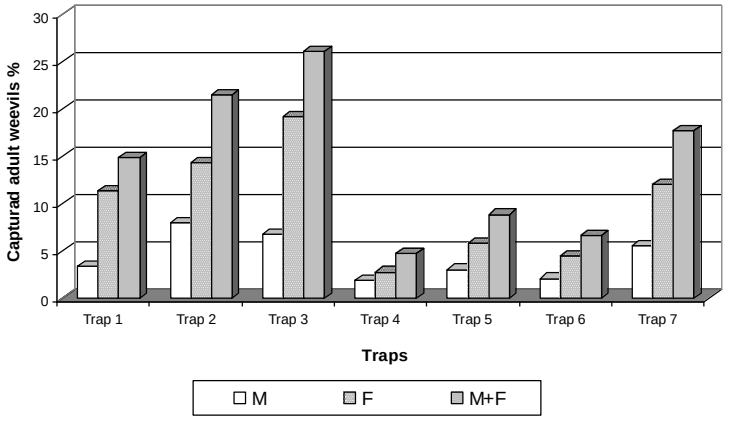
In both investigated orchards, the higher rate of captured adult weevils of both sexes was recorded for the food baited pheromone trap with treacle + yeast + tap water; whereas the total of caught adults – males and females amounted to 279 and 565; (Figures 4 and 5), represented to 26.1 and 31.6 % of the grand total of captured adults/year, in respect.

(a)



M= Male F= Female MF = Male + Female

(b)



M= Male F= Female MF = Male + Female

Figure 4. Total numbers of captured adults of red palm weevil in each evaluated trap per year (a), and their percentages in each trap per year in proportion to the grand total of captured adults in all tested traps(b), in the 1st palm orchard at koom El-Tarfaya village, kafr El-Dawar, El-Beheira governorate, in Feb. 2007– Feb. 2008; whereas: T_1 -pheromone + ethyl acetate; T_2 -pheromone +date fruits + yeast and tap water; T_3 -pheromone +treacle+ yeast and tap water; T_4 - ethyl acetate; T_5 - diluted treacle + yeast; T_6- date. fruits+ yeast and tap water and T_7 –pheromone alone

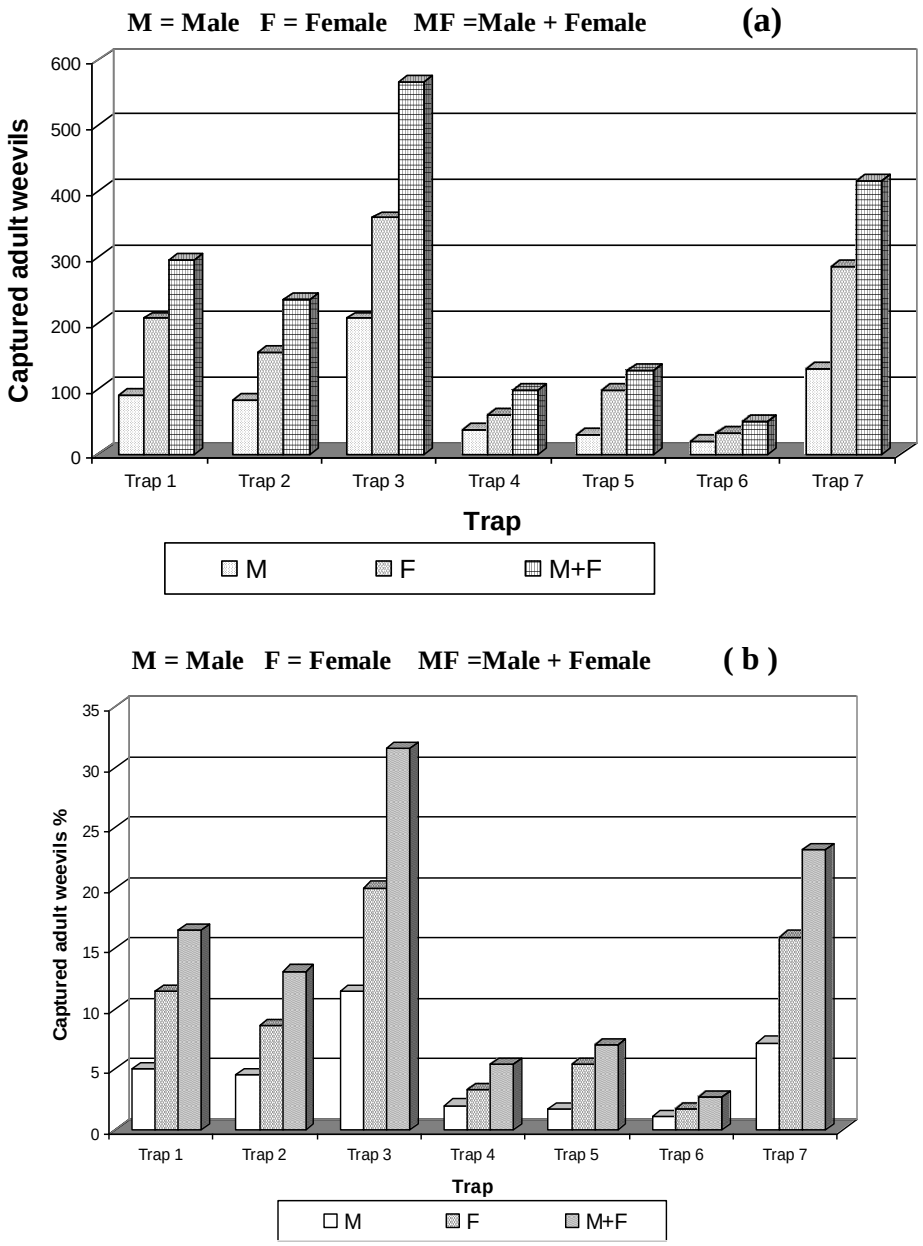


Figure 5. Total numbers of captured adults of red palm weevil in each evaluated trap per year (a), and their calculated percentages in each trap per year in proportion to the grand total of captured adults in all tested traps (b), in the 2nd palm orchard at kom El-Tarfaya village, kafr El-Dawar, El-Beheira Governorate, in Feb. 2007 – Jan. 2008; whereas: T_1 - pheromone+ethyl acetate; T_2-pheromone+date fruits + yeast and tap water; T_3 - pheromone+treacle + yeast and tap water; T_4 - ethyl acetate; T_5 - diluted treacle + yeast ; T_6 - date. fruits + yeast and tap water and T_7 –pheromone alone

That increased efficiency of supplied trap with the pheromone + treacle + yeast was followed by the less decreased efficiency of supplied traps by the pheromone + date fruits + yeast; the aggregation pheromone alone and the pheromone + ethyl acetate, which indicated more or less decreased total numbers of attracted adults comprised 230 and 235, 189 and 215 and 159 and 296; resembled 21.5 and 13.2, 17.6 and 23.2 and 14.8 and 16.5% of grand total/year, respectively.

In this concern, a more lowered capturing efficiency was detected for the other three evaluated traps which were supplied with diluted treacle + yeast, date fruits + yeast and ethyl acetate alone (Figures 4 and 5).

Morever, the illustrated results in Table (4) show the monthly periodic intervals of efficient capturing of the red palm weevil adults by each of tested trap in the 1st and 2nd date palm orchards. In general, the estimated population density of captured red palm weevil adults in the second investigated orchard was higher than that of the captured weevils in the 1st one.

The used symbols in table (4) declear the numerical range of caught adults of both sexes allover the extended period from Febrauary – 2007 up to January – 2008. Therefore, in the 2nd orchard, the supplied pheromone trap by treacle + yeast and tap water was ranked the first one and showed relatively more higher catch and prolonged periodic efficiency in attracting male and female – adults, extended from febrauary– 2007 till December 2007 and ranged between 10-20 weevils during the months of Aug., Sep. and Dec. and> 100 weevils in Apr. Also, a similar trend of superiority in attracting adult weevils by the same pheromone food baited trap was observed in the 1st date palm trees orchard in comparison to the other evaluated trap. (Table 4).

The nextly ranked traps were either the supplied trap by pheromone + date fruits + yeast + tap water in the 1st orchard, or the supplied one by aggregation lure alone in the 2nd orchard. In this concern, the aggregation pheromone trap was relatively less high efficient in capturing the weevils during the growing season with a callibrating rate of attracted weevils ranged from 10-20 weevils in the months of March and November to > 100 weevils in May, with lowered numbers of captured adults (less than ten weevils) during Feb., Aug., Dec. 2007 and Jan. 2008. As to the supplied pheromone trap with date fruits + yeast + tap water, a less efficient captures of the existing populations of adult weevils in both the 1st and 2nd orchards were assessed and ranged in the 1st orchard between 10 – 20 weevils in Feb., April, May, June, Aug. 2007& January 2008; 20-40 weevils in Mars, Jul., Oct. and Dec. 2007 and 40 – 60 weevils in Nov. 2007. While in the 2nd one the efficient captures were recorded during Feb. until Jun. 2007 and ranged from 20 – 40 weevils in Feb., Jun. to 40 – 60 in March, Apr. and May with decreased numbers less than 10 weevils in the extended months from Jul. 2007 till Jan. 2008, except Nov. 2007, which showed a low number of captured adults comprised 10 – 20 ones (Table, 4).

The other tested traps in 2nd orchard indicated a more or less decreased cought weevils when compared to the superior one that contained the aggregation pheromone lure + treacle + yeast + tap water. Similar trend of results was also observed for the other tested pheromone -food bait traps in the 1st orchard, despite the detected lower densities of caught adult-weevils in these tested traps.

Remarkedly, the supplied traps with ethyl acetate alone revealed utmostly weak efficiency in attracting the emerged adult-weevils in both investigated orchards during all months of the growing season with a characteristic lowest numerical rate of less than ten individuals of captured weevils (Table 4).

Noticeably, the above demonstrated results of the evaluated pheromone -food bait trapping system; were confirmed by the calculated annual means of captured red palm weevils in each of the seven tested traps in both orchards (Table 5). In this concept, the highest calculated annual means of captured adults of both sexes was observed for the superior efficient trap-supplied with aggregation pheromone lure + treacle + yeast + tap water which amounted to 22.83 in the 1st orchard (Table, 5); and 47.08 in the 2nd one 69.91 in both orchards, followed by the secondly ranked trap of aggregation pheromone lure alone, which gave annual mean catches comprised 34.58 in the 2nd orchard, and 50.33 in both orchards. While, the other evaluated pheromone -food baited traps showed more or less decreased annual means catches ranged between the lowest means of 4.25 (for ethyel acetate alone in 1st orchard); 4.08 and 9.83 (for fruit dates+ yeast+ water in the 2nd and both orchards, in respect); and the lower means of 13.25, 24.66 and 37.91 (for the pheromone + ethyl acetate in 1st, 2nd and both orchards, respectively).

Remarkedly, the noticed and recorded lower numerical values of weevils catches in the 1st orchard, compared to the 2nd one in the same locality is mainly attributed to the relatively low density of existing red palm weevil population in the 1st orchard, versus the higher density of weevils population in the 2nd one.

Practically, as previously explained by Mesbah and Zayed (2010) one of the logic reasons of detected numerical variation in the estimated higher density of red palm weevil population in the 2nd orchard could be referred to its great dependance to the older trees of date palm trees and more increased numbers of growing Zaghloul and Sammany varieties in it, in comparison to the characterized 1st orchard by the younger trees of date palms and the fewer numbers of growing Zaghoul and Sammany varieties. Also due to the densily interpalnted older citrus and banana trees within the rows of these date palm varieties in the 2nd orchard); versus the relatively younger interpalnted citrus and banana trees in the 1st one. These agro-circumestances caused interaction effects with the applied agrotechnical

Table 5. The calculated annual mean of attracted adults of red palm weevil *R. Ferrugineus* Oliv., to each of the tested pheromone and/or food baited traps in the 1st, the 2nd and both orchards, at Kom El-Tarfaya, Kafr El –Dawwar, El-Beheira Gov., Feb. 2007-Jan. 2008

TRAP	The first orchard			The second orchard			Both orchard		
	M	F	M+F	M	F	M+F	M	F	M+F
Trap 1 Pheromone + ethyl acetate	3.083 **c**	10.17 **c**	13.25 **d**	7.5 **c**	17.7 **bc**	24.667 **c**	10.58 **c**	27.41 **bc**	37.917 **c**
Trap 2 Pheromone + date + yeast + water	6.33 **a**	12.83 **b**	19.176 **b**	6.75 **c**	12.83 **cd**	19.553 **c**	13.08 **bc**	25.67 **c**	38.75 **c**
Trap 3 Pheromone + dilution treacle + yeast	6.083 **ab**	17.17 **a**	22.833 **a**	17.167 **a**	29.917 **a**	47.083 **a**	23.25 **a**	47.08 **a**	69.917 **a**
Trap 4 Ethyl acetate only	1.75 **d**	2.5 **e**	4.25 **f**	3.0 **d**	5.0 **e**	8.0 **d**	4.91 **d**	7.5 **d**	12.417 **d**
Trap 5 dilution treacle + yeast	2.75 **cd**	5.17 **d**	7.917 **e**	2.5 **d**	8.0 **de**	10.5 **d**	5.25 **d**	13.17 **d**	18.417 **d**
Trap 6 date + yeast + water	1.917 **cd**	4.0 **de**	5.917 **f**	1.5 **d**	2.583 **e**	4.083 **d**	3.25 **d**	6.58 **e**	9.833 **d**
Trap7 Pheromone only	5.0 **b**	10.75 **bc**	15.75 **c**	10.75 **b**	23.83 **ab**	34.583 b	15.75 **b**	34.58 **b**	50.33 **b**
L.S.D. .05	1.396	2.293	1.7687	2.6422	6.788	8.307	2.869	8.429	9.7891
F calculated	34.4542	63.6573	187.706	52.667	25.354	41.799	74.460	37.832	60.128

practices under the prevailing agroclimatic conditions in the locality, which raise the enhancement of making the orchard as an adequate and favourable microecosystem. All combined factors increased population density of the developing weevils and consequently on the rate of weevils caught which were greatly higher in the 2nd orchard than the 1st one (Table, 5).

Moreover, the recorded variations in the delayed flight activity of developed adults and consequently the rates of recorded catches are also attributed to the resulting combined interactions of followed agro practices, growing date palm varieties, intercropped citrus and banana trees and the prevailing higrothermic conditions in each of investigated date palm orchards. Whereas, from Table, (6) it could be seen that, the calculated correlation coefficient (r) values between the numbers of red palm catch weevil in the tested traps and the estimated mean values of daily temperatures and realative humidaities throughout the growing season in the investigated locality; indicated the highly significant relationships between the counted numbers of captured adults and the studied parameters of prevailing higrothermic conditions in the location of inspected orchards.

Similary, numerous research workers, gave detailed reports and literary information on the efficient role and valuable use of aggregation pheromone lures either alone or with food baits in the management of their followed trapping system for red palm weevil, i.e. Mayilvaganan and Nair (2003), Faleiro and Satarkar (2003a, b & 2005), Kalleshwaraswamy and Mohan (2005), Muthiah *et al.* (2002), Abbas *et al.* (2006), Muthiah and Nair (2007) Muthiah *et al.* (2005), Al-Saoud (2007) and Oehlschlager (2007).

El-Garhy (1996) stated that many more adults were captured during the warmer summer months than during the cooler winter months. The higher capture rates during this period were probably due to the emergence of broods whose development was slowed by the cooler winter months. In India, Muralidharan *et. al.* (1999) using bucket traps baited with pheromone (ferrugineol) and food showed that the highest populations were observed in May, March and December. A significant number of weevils were attracted to bucket traps baited

with sugarcane, followed by traps baited with coconut exocarp. Date fronds were the least preferred bait. The capture rate was reduced by trapping by 75.17% within 3 years.

Faleiro and Satarkar (2002)evaluated the efficiency of 6 food baits, i.e. (1) coconut petiole + yeast + acetic acid + toddy (coconut palm wine), (2) sugarcane, (3) pineapple, (4) coconut petiole + yeast, (5) toddy and (6) coconut petiole, in the trapping of red palm weevil populations. These food baits were added to the trap containing a pheromone lure (ferrugineol) and 0.03% carbofuran. They concluded that the highest weevil captures were recorded when pineapple was used as food bait (12.22 weevils per trap), followed by sugarcane (7.7 weevils per trap). Muthiah *et al.* (2002) explained that trapping of adult weevil population with food baited aggregation pheromone traps is becoming an important eco-friendly component of the integrated pest management programme. They revealed that pheromone + palmyrah fruit juice captured significantly more number of weevils and it was on par with pheromone + tender coconut water. The treatment involving pheromone alone captured only a minimum number of weevils. Female weevils are attracted more for the pheromone trap than males.

Faleiro and Satarkar (2003 a and b) stated that of the six formulations tested, Pherobank RPW 400 mg lure recorded significantly superior mean cumulative weevil captures. Also the synthetic RPW pheromone lure (Ferrolure+) was significantly superior in attracting RPW adults compared to the kairomone releasing food bait (coconut petiole) when the pheromone and food bait were tested separately. Weevil captures were significantly higher when the synthetic pheromone and food bait were used together in the trap, signifying synergism between the two. All food-baited pheromone traps recorded female dominant weevil captures.The same authers (2005) studied the attractiveness of different food baits along with ferrugineol-based pheromone lures to the red palm weevil, *Rhynchophorus ferrugineus.* And showed that each of dates and sugarcane recorded the best weevil captures. Addition of a food bait helped in the maintainace of the trapping efficiency of the pheromone lure.

Kalleshwaraswamy and Mohan (2005) determind that The incidence of infestation level of the RPW was reduced from 5.6 to 2.9% during the trapping period. When marked weevils were released at different distances downwind from the pheromone trap, they were attracted to the trap even from one km distance within a week. Therefore, the increase in infestation could be due to the attraction of weevils from neighbouring gardens to the experimental site. Also, Muthiah *et al.* (2005) showed that the treatment involving pheromone combined with different food baits captured significantly higher number of weevils than the pheromone alone. The treatments of pheromone+sugarcane molasses attracted significantly the highest number of weevils, followed by pheromone+tender coconut water (7.58 weevils /week); compared to the fewer numbers attracted to the control traps without any attractant.

Abbas *et al*. (2006) showed that the red palm weevil population increased gradually from January to reach its peak in March, April, or May. The tested pheromone traps could capture 4.4 to 20.7% of the resident populations of *R. ferrugineus* in the inspected different date palm plantations. Individuals of marked weevils released in date palm plantations migrated 1-7 km from the plantations in which they were released. The released marked weevils were recaptured, mostly, within 3-5 days post release.

The efficacy of different tested food baits combined with pheromones in attracting red palm weevil, *Rhynchophorus ferrugineus* was also determined by Muthiah and Nair (2007) and Muthiah *et al.* (2007). They revealed that pheromone + palmyrah fruit juice captured significantly more number of weevils and it was on par with pheromone + tender coconut water. The control traps without any food attractant captured less number of weevils. While, the pheromone alone captured only a minimum number of weevils. Female weevils were more attracted to the pheromone traps than males. The treatment of pheromone in combination with sugarcane molasses attracted significantly more number of weevils followed by pheromone in combination with tender coconut water. The highest weevil capture in pheromone traps was obtained by using food baits such as palmyrah fruit juice, sugarcane molasses and tender coconut water.

Moreover, in four date palm plantations, at Al-Rahbba (United Arab Emirates) Al-Saoud (2007) set twelve pheromone traps in each plantation, to evaluate the effect of adding dates as a bait, on the capture of the red palm weevil The traps contained the aggregation pheromone 4-Methyl-5-Nonanol 90% + 4-Methyl-5-Nonanol 10% and 350 g of dates, and compared with the traps containing either the pheromone alone or dates alone.The number of red palm weevil captured in the tested traps were significantly different. Whereas, the red palm weevil adult weevils were present throughout the year, and the number of females was higher than the number of males. The reason behind the variation in numbers was explained by a variety of factors such as farm practices, differences in tree age and source, and farmer knowledge. Also in Middle East, Oehlschlager (2007) managed *R. ferrugineus* infestation of date palm.

Table 6. The calculated correlation coefficient (r) values between the prevailing parameters of temperature and relative humidity and number of attracted red palm weevil adults to the placed pheromone and food baited traps in the investigated localities at El-Beheira Governorate; in Feb 2007- Jan 2008

Physical parameter	Locality	1st orchard Kom El-Tarfaya village			2nd orchard Kom El-Tarfaya village			Kafr El-Dawar center		
		M	F	M+F	M	F	M+F	M	F	M+F
Temperature C0	Max. Temp C0	0.69	0.67*	0.67*	0.65*	0.63*	0.64*	0.63*	0.55	0.539
	Min. Temp C0	0.23	0.28	0.34	0.22	0.20	0.30	0.33	0.34	0.52
	Mean C0	0.30	0.42	0.44	0.25	0.25	0.45	0.42	0.46	0.49
	Thermic amplitude C0	0.22	0.37	0.48	0.43	0.53	0.57	0.36	0.49	0.59
% Relative humidity	Max. RH	0.65*	0.48	0.69*	0.76**	0.68*	0.70**	0.69*	0.52	0.79**
	Min. RH	0.50	0.52	0.71**	0.51	0.16	0.24	0.59	0.78**	0.77**
	Mean. RH	066*	0.86**	0.82**	0.68*	0.76**	0.98**	0.78**	0.87**	0.91**

M = Males
F = Females

by periodic survey, treatment or removal of infested palms and trapping. Whereas, trapping, in combination with spraying decreased infestation by 64% while trapping alone reduces infestation by 71%. Trapping was most efficient for all palm weevils if aggregation pheromone is combined with, ethyl acetate and moist. He also showed that propylene glycol extends the effective life of trap food bait from 2 weeks to 7 weeks.

From the above mentioned results it could be seen the determined efficiency of evaluated aggregation pheromone lure with or without the tested food baits in the inspected traps in each of the first and second date palm orchards. The highest efficient aggregation pheromone food baited trap that gave higher rates of the captured adult - weevils of both sexes was the tested pheromone food baited trap with diluted treacle + yeast; its superiority was followed by nextly ranked efficiency of the pheromone baited trap by either date fruits + yeast or acetyl acctate alone; and the aggregation pheromone lure alone. The supplemented traps by tested food baits only were comparatively less efficient; while the use of ethyl acetate alone in the trap, to more extent, indicated greater unefficiency with rather lowered rates of adult catches, not exceeded 10 weevils allaround the months of growing season.

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الملخص العربي

تقييم بعض المواد الجاذبة (غذائية/كيميائية) في الإدارة المتكاملة لسوسة النخيل الحمراء، بإستعمال المصائد الفرمونية التجميعية

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أوضحت النتائج تأثر الكثافة العددية لعشيرة سوسة النخيل الحمراء بعمر شجرة النخيل للأصناف المنزرعة إضافة إلي أصناف أشجار الفاكهة المحملة بين صفوف النخيل، والعمليات الزراعية المتبعة والظروف الجوية السائدة كما أكدت النتائج إمتداد فترة نشاط وطيران الحشرات المنجذبة إلى المصائد المختبرة خلال معظم أشهر السنة للموسم الزراعي 2007-2008، وأن أعلى هذه النسب المرتفعة للحشرات المنجذبة كانت خلال الفترات الشهرية (مارس وأبريل)، (مايو ويونيو)، (أكتوبر ونوفمبر)، بمتوسطات عددية لتلك الحشرات المنجذبة ناهزت 12.0-15.7، 17.4-17.5 و18.3-16.7 حشرة للبستان الأول؛ 39.14-55.28، 42.85-30.14 و14.42- 12.85 للبستان الثاني و50.58-71.28؛ 60.28-47.71 و32.71-29.57 لكلا البستانين علي التوالي.

كما أوضحت النتائج الخاصة بتحديد فعالية وكفاءة الفرمون التجميعي المستخدم مع أو بدون جاذب غذائي في المصائد المختبرة أن أعلي نسبة حشرات تم إصطيادها (من الجنسين) كانت بالمصيدة المزودة بالفرمون التجميعي مع العسل الأسود المخفف وخميرة البيرة حيث كان العدد الإجمالي للحشرات بالمصيدة 279 و565، وهوما يعادل نسبة 26.1%، 31.6% من المجموع السنوي الكلي للحشرات الكاملة التي تم إصطيادها في كلا البستانين علي التوالي. وقد تلى هذا التفوق في الترتيب المصيدة المزودة بالفرمون التجميعي وثمار التمر كجاذب غذائي إضافة إلي خميرة البيرة والماء ثم المصيدة المزودة بالإثيل أسيتيت مع الفرمون التجميعي، بينما كانت المصائد التي تم تزويدها بالعسل الأسود المخفف أو ثمار التمر مع خميرة البيرة والماء أو المزودة بإثيل الأسيتيت فقط أقل كفاءة لحد كبير وأعطت نسب جذب منخفضة إلي حد كبير.

أكدت نتائج حساب معدلات تعداد الحشرات التى تم إصطيادها بالمصائد المختبرة خلال الشهور المختلفة لموسم النمو في كل من البستان الأول أوالثاني بقرية كوم الطرفاية، أن المصائد المزودة بالمحلول المخفف من العسل الأسود مع خميرة البيرة كانت دوما في الترتيب الأول مقارنة بالمصائد الأخري. كذلك كانت أعداد الحشرات المنجذبة لهذه المصيدة المزودة بالفرمون+ عسل اسود مخفف+ خميرة البيرة في البستان الثاني أعلي منها في البستان الأول(10-20 حشرة) في أغسطس وسبتمبر وديسمبر إلي أكثر من 100 حشرة في أبريل، بينما في الأشهر الأخري كانت نسبة هذه الحشرات المنجذبة متذبذبة مابين (20-40حشرة)، (80-100حشرة) في كل من البستان الأول والثاني علي الترتيب. علي العكس من ذلك كانت المصائد المزودة بإثيل أسيتيت فقط هي الأقل كفاءة في كافة شهور الموسم الزراعي حيث أعطت أقل معدل من الأعداد المنجذبة حيث وصلت لأقل من 10 حشرات للمصيدة.

كذلك تم تأكيد فاعلية وكفاءة المصائد المزودة بالعسل الأسود المخفف مع الفرمون التجميعي وخميرة البيرة من المتوسطات السنوية المحسوبة لأعداد الحشرات التى تم إصطيادها بكل مصيدة حيث كانت أعلي المتوسطات السنوية المحسوبة للحشرات الكاملة المنجذبة من كلا الجنسين(22.83 ، 47.08 و89.91 في كل من البستان الأول والثاني وكلا البستانين علي الترتيب) . يليها فى ذلك المصائد المزودة بالفرمون التجميعي فقط، بينما أظهرت باقي المصائد المختبرة معدلات أكثرأوأقل إنخفاضا في متوسطات أعداد تلك الحشرات المنجذبة والتي تراوحت ما بين 4.5 في حالة الإثيل اسيتيت بمفرده في البستان الأول و23.25 ، 24.66 و37.91 في حالة وجود الفرمون مع الإثيل أسيتيت فى كل من البستان الأول والثاني وفي كلا البستانين علي التوالي.

أوضحت النتائج أن إرتفاع أو إنخفاض تعداد(عشيرة) سوسة النخيل الحمراء يرجع لحد كبير إلي عمر أشجار النخيل، عدد وأصناف أشجار النخيل المنزرعة خاصة صنفي الزغلول والسماني، وكذلك عمر ونوعية اشجار الفواكه المنزرعة التى تم تحميلها بين أشجار النخيل بالإضافة إلي الطرق والأساليب الزراعية المتبعة

والظروف المناخية الزراعية السائدة في كلا البستانين محل الدراسة، والتي أظهرت تأثيراتها بدرجة كبيرة أوقليلة على تذبذب مستويات الإصابة بحشرة سوسة النخيل الحمراء والتي إنعكست بدورها علي بمعدلات الزيادة أوالنقصان في التغيرات العددية لمجموع الحشرات الكاملة على مدار الموسم وبالتالي علي نسبة الحشرات المنجذبة للمصائد.