Ecological aspects and pattern of red palm weevil infestation in date palm orchards

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ABSTRACT

The present work was carried out at the Middle East Regional station of red palm weevil, Quassasine, Ismailia governorate during the period of 2006-2008. The obtained results showed that RPW, Rhynchophorus ferrugineus (Oliv.) has two annual broods of activity, the first brood is considered the main and most economic important, this brood was occurred between March and early July. Four overlapping annual field generations were estimated, the first and second generations were the most important. Baited aggregation pheromone traps caught more adult females compared with adult males allover the year. Regarding vertical distribution of RPW infestation on trunk of date palm trees showed that 77.9% of infestation occurred on the lower part of the trunk up till 100cm height. About 98.7% of infestation occurred up till 200cm. Palm trees aged between seven and ten years was the most preferred for infestation. Significant differences were detected between the susceptibility of different varieties to RPW infestation. Such results are very essential for planning integrated management program of red palm weevil.

Key words: *Rhynchophorus ferrugineus*, Ecology, Pheromone traps, Infestation pattern.

INTRODUCTION

The date palm and date fruits are hosts for many insects and diseases which are seriously enough to inflict heavy losses if left uncontrolled. The red palm weevil, *Rhynchophorus ferrugineus* (Oliv.) is considered the most destructive insect pest of date palm trees which invade date palm plantation in the Arab region since 1985. The cause of the high rate of spread of this pest is human intervention, by transporting infested young or adult date palm trees and offshoots from infested to clean areas (Ferry and Gommez, 2002). So, nowadays the date palm crop in the Arab countries is under threat. Because of the concealed nature of red palm weevil larvae (The main stage cause the injury), effective methods for control this pest have been difficult to develop. During the last two decades all efforts to control *R. ferrugineus* in the Arab countries, focused on the use of traditional insecticides, modified cultural practices and recently pheromone traps (Abraham, *et al.* 1998). There is now a strong emphasis on the development of integrated pest management based on pheromone traps and biological control rather than on chemical insecticides (Murphy and Briscoe 1999).

The present study was aimed to through light on the seasonal abundance and pattern of red palm weevil infestation in date orchards as essential ecological information for construct management program.

MATERIALS AND METHODS

Field Experiments

Field trapping procedures was conducted based on number of adult captured weekly by baited aggregation pheromone traps. The recommended bucket traps

were distributed uniformly in the selected severely infested area at Quasasine district, Ismailia governorate for one complete year (Jan. – Dec. 2007).

Trap Design and Components

Bucket design traps were used in the present study. The traps were inserted slightly in the soil surface; a number of rounded holes were made to allow adult weevils to enter inside the traps safely and easy. The used traps commonly consist of plastic bucket (nine liters in size). The bucket was punctured around its wall with six holes each of 2.5 cm diameter at 15 cm from the bottom; another three holes of the same size were made in the cover. The commercially used pheromone "P028 Ferrolure +, 700 mg Lure" is a synthetic pheromone lures i.e., a mixture of 4-methyl-5-nonanol (nine parts) and 4-methyl-5-nonanone (one part), the purity of both components > 95 % imported from chem.. Tica Natural, Costa Rica was used for the present field trails. Pheromone sac was hanged underside the trap top surface. The pheromone releases its active chemicals through a plastic membran (3-10 mg/day) from 400 and 1500 N/tube, respectively. Selected kairomone was used as a synergist to activate the potent ability of releasing ethyl acetate blooms. Ethyl acetate bottles however were hanged from the underside surface of the trap top releasing chemicals through a fine plastic tube. Pesticide (Bestban 48% EC) was mixed with trap water inside bucket traps to prevent scape of captured weevils.

Monitoring the Fluctuation in the Population Activity of Adults

The changes in the population density of adults were determined by number of captured *Rhynchophorus ferrugineus* adults based on aggregation pheromone traps distributed uniformly in the selected area. Number of collected weevils caught in the pheromone traps was counted weekly, sexed, and grouped into date record contains monthly figures. All traps were maintained weekly. Ethyl acetate Kiromone and pheromone capsules within each trap were changed every 6-11 week according the seasons. The sum of half monthly counts of RPW caught in aggregation pheromone traps allover one complete year were worked out according the formula suggested by Audemard and Millaire, 1975 and Iacob, 1977 to estimate the field annual generations.

Varietal Resistance of Date Palm:

Regular visits were done in the farms of date palm trees during the period of Jan.-Dec., 2007. Weekly inspections of date palm trees were carried out to examine the infestation of the studied varieties (Zaghloul, Hyani, Semmani, Ommahaat, Omry and unknown (seed)). The height of infestation along the trunk, number of infested palm trees, with special concern to the age of infested date palm trees were considered.

RESULTS AND DISCUSSION

Seasonal Abundance and Approximated Number of Annual Field Generations

The number of half monthly count of *Rhynchophorus ferrugineus* adults caught in food baited aggregation pheromone traps is considered the most suitable measure for sampling infestation, this due to the positive corelationship between the population density of RPW adults and infestation in date palm trees. Figure (1) showed that the presence of two annual broods of activity for *Rhynchophorus ferrugineus*. The first brood is considered the main and most economic important. This brood start with a few number of adult weevils on mid January (1 weevil/ 12 traps/ 2 weeks), then the captured weevils increased gradually uptill mid February and rapidly increased on the second half of February, thus forming a broad peak, reaching its maximum during the first week of march (61 weevils/12 traps/ 2 weeks). The population continued high till the beginning of July, this blunt brood of activity may be includes three overlapping field generations. The overlap of generations in case RPW is attributed to the prolongation ovipostion period which extended for about two months and the long cycle of all developmental stages Hussein, *et al.* 1998 and El-Mohanna, *et al.* 2000 which allowed the interference of adult emergence from different generation.

From the beginning of August the population of RPW then decreased gradually reaching the lowest level during the season on the third week of September, (18 weevil/ 12 traps/ 2 weeks). This decline in the population density may be due to the high temperature and dry condition prevailed during July and August. The biological studies demonstrated that temperature between 27 and 30 ºC is the optimum range for development of different stages and flight activity of adults (Hegazy, *et al.* 2001).

The second brood of activity took place from the end of September until the end of November with relatively moderate peak size at the end of October, this peak represent the fourth field generation.

The results obtained in this study are in agreement with the finding of Hagley, 1963 in Coast-Rica who mentioned that population of RPW decreased obviously during the dry season. Weissling, *et al.* 1992 suggested that temperature and humidity may be a key factors governing the flight activity range in California.

The Estimated Number of Annual Field Generations:

A part of the study is dedicated to determine the number of annual field generations of red palm weevil under natural

conditions at Quasasine, Ismailia governorate. This study is based on the fluctuations in the population density of adult weevils caught in pheromone traps. For this purpose the number of weevils were worked out according the methods suggested by Audemard and Milliare, 1975 and Iacob, 1977 as shown in Fig. (2) in which each generation represented by regression line and slope express the developmental rate and economic importance of each generation. The following are briefly description of each generation:

1. First generation

Adult weevils of this generation were appeared from the second week of January and continued up to the second week of March with relatively high population density (first peak) 61 weevils/ 12 traps/ 2 weeks, this generation lasted for about 70 days.

2. Second Generation

This generation took place from the last week of March to the third week of June with similary number of weevils/ 12 traps/ 2 weeks, the peak of this generation occurred at early May and duration for about 90 days.

3. Third Generation

This generation occurred between the last week of June and the third week of September with about 80 days duration and similar population size with the two previous generations.

4. Fourth Generation

Adult weevils of fourth generation occurred in pheromone traps in relatively low number (20 weevils/ 12 traps/ 2 weeks) from the first week of October until the end of the season with peak on first of November. The population density of the fourth generation was relatively low as compared with the previous three generations. Number of weevilsreaches zero in the traps at the end of December as a result of temperature decline.

It could be concluded that both two methods i. e. normal distribution curve and method suggested by Audemard and Milliare, 1975 and Iacob, 1977 namely (Scale gauss) which followed to determine the number of annual field generations of RPW was confirmed each other and demonstrated that *Rhynchophorus ferrugineus* has completed four generations under field conditions. The results obtained are in are in agreement with the finding of many researchers such as Hagley, 1963 in Costa-Rica, Hussein, 1998 in Egypt, Abdel-Latif, 2000 in Egypt and Vidyasagar, et al. 2000 in Saudi Arabia.

Sex Ratio of RPW, *Rhynchophorus ferrugineus* (Oliv.) Caught in Aggregation Pheromone Traps

Data in Table (1) summarizes the total number of the sexed adults of red palm weevil caught in aggregation pheromone traps at four seasons. Data revealed that adult females tend to increase in number in pheromone traps than adult males all over the year especially during winter month. Out of 188 adults caught in winter 118 were females and 70 were males presenting a sex ratio of about 1.68:1. During spring and summer season, sex ratio were quite equal (1.11:1 and 1.12:1 respectively), whereas, out of 334 adults caught during spring, 176 were females and 158 were males and out of 250 caughted durng summer, 132 were females and 118 were males. The sex ratios recorded during autumn were quite equal for females and males (1.02:1).

These results are in harmony with the findings of Oehlschlager, *et al.* 1995 mentioned that twice as many females as male weevils were caughted, Falerio and Chellapan, 1999 noticed that the pheromone trap captures were female- dominated, El-Sebay, 2003a & 2003b stated that female density was higher than male density and constituted 52.8-57.8% of the total population in the field. Rao and sujatha, 2004 mentioned that the male to female ratio was 1.00: 1.44.

Vertical Distribution of RPW Infestation on Trunk of Date Palm Trees

The vertical distribution of RPW infestation was studied on date palm trees aged between 8-16 years and 3 m. height at Quasasine district, Ismailia governorate. Regardless the date palm varieties, all infestation site were divided into five groups according its height from soil surface i.e. (0.50 Cm, 51-100 Cm, 101-200 Cm and above 200 Cm) in addition the infestation occurred at trees crown. Data in Table (2) revealed that about 26% of the infestation took place at the trunk between soil surface up till 50 Cm height and about 51% of the infestation occurred between 51 and 100 Cm height, while about 21% of infestation occurred between 101 and 200 Cm height. Meanwhile no infestations were observed above 200 Cm and infestation rarely occurred at date palm tree crown (only 1.29% of infestations were recorded at the tree crown). The infestation which occurred at tree crown was observed after the deeply removed of the green leaves. These miss applications lead to expose the soft tissues of the trunk and release the volatile odor (kiromone) that attracts weevils for egg laying.

It could be concluded that about 78% of infestation with RPW occurred on the trunk up till 100 Cm height from the soil surface and about 98.7% of infestation took place up till

200Cm height, meanwhile no infestation was observed above 200Cm height and only 1.29% occurred at the tree crown

Frequency of RPW, *Rhynchophorus ferrugineus* (Oliv.) Infestation in Relation to Date Palm Tree Ages:

To determine frequency of RPW infestation in date palm tree of different ages, a survey of the infested trees was carried out in adjacent fields of date palm trees. The infestated date palm trees were divided into four categories according its age i.e. (2-6 years, 7-10 years, 11-14 years and above 15 years), the number of infested trees were assessed in each category. Data illustrated in Fig. (3) showed that 18.18% of the infestation occurred in date palm trees aged beteen 2 and 6 years after offshoot transplanting and about 67% of infestation occurred in the second category of date palm trees aged between 7 and 10 years, while the third category aged between 11 and 14 years harboured only 15.15% of infestation. Meanwhile, no infestations were observed in date palm trees of age above 15 years. It could be concluded that date palm trees of age between 7 and 10 years are the most preferred age for red palm weevil infestation, subsequently all attention must be give to protect the young trees of date palm trees.

These results are in agreement with those of Muralidharan, et al. 2000 who mentioned that the young date palm plants (2-5 years) are more prone to weevil infestation and Longo and Tamburino, 2005 stated that the insect causes severe damage to palm trees and can cause death within eight months, especially in trees aged 5-20 years.

Susceptibility of date palm varieties to infestation with RPW:

To determine the susceptibility of date palm varieties to infestation with RPW, a regular visits to date palm orchard at Quasasine district, were carried out during 2007. A number of 5197 trees were carefully examined and classified into different varieties based on the external morphology. The investigated palm trees were divided into three groups based on the number of trees belonging to each varieties, the first is the common varieties (cultivated in large number such as Zaghloul, Hyani and Semmani), the second is not common cultivated such as, Ommhaat and Omry while the third group include the unknown varieties (seed varieties). The numbers of infested trees within each variety were surveyed and recorded. Data in Table (3) showed that the surveyed number of palm trees belongs to both varieties Ommhaat and Omry were sufficient for evaluation. The unknown (seed) varieties showed highly susceptibility to infestation with RPW (out of 160 examined palm trees), six trees were infested, represent 3.75% infestation. Meanwhile the most common varieties, Zaghloul, Hyani and Semmani, showed different susceptible to RPW infestation. Hyani variety seemed to be the most susceptible to red palm weevil infestation (2.30%) compared to Zaghloul (0.82%) and semmani (1.75%).

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Tables

Table 1. Seasonal fluctuations in sex ratio of RPW, *Rhynchophorus ferrugineus* (Oliv.), Quasasine, Ismailia governorate, 2007.

Season	Sex ratio		Total no. of Weevils	
	♂	♀	♂	♀
Winter	1	1.68	70	118
Spring	1	1.11	158	176
Summer	1	1.12	118	132
Autumn	1	1.02	48	49

Table 2. Vertical distribution of RPW, *Rhynchophorus ferrugineus* (Oliv.), Quasasine, Ismailia governorate, 2007.

Infestation height above soil surface	No. of infested Palm trees	Infestation (%)	Accumulated Infestation (%)
0-50 cm	40	25.97	25.97
51-100 cm	80	50.95	77.92
101-200 cm	32	20.78	98.70
Above 200 cm	00	00	98.70
At crown of palm tree	2	1.29	100
Total	154	-	100

Table 3. Susceptibility of date palm varieties to infestation with RPW, Quasasine, Ismailia governorate, 2007.

	Date palm variety	No. of infested trees	Total number of inspected trees	% infestation
Common varieties	Zaghloul	21	2549	0.82
	Hyani	54	2345	2.30
	Semmani	2	127	1.57
Not common varieties	Ommahaat	2	9	22.2
	Omry	1	7	14.28
Seed varieties	Unknown(Seed)	6	160	3.75
	Total	80	5197	1.54

Figures

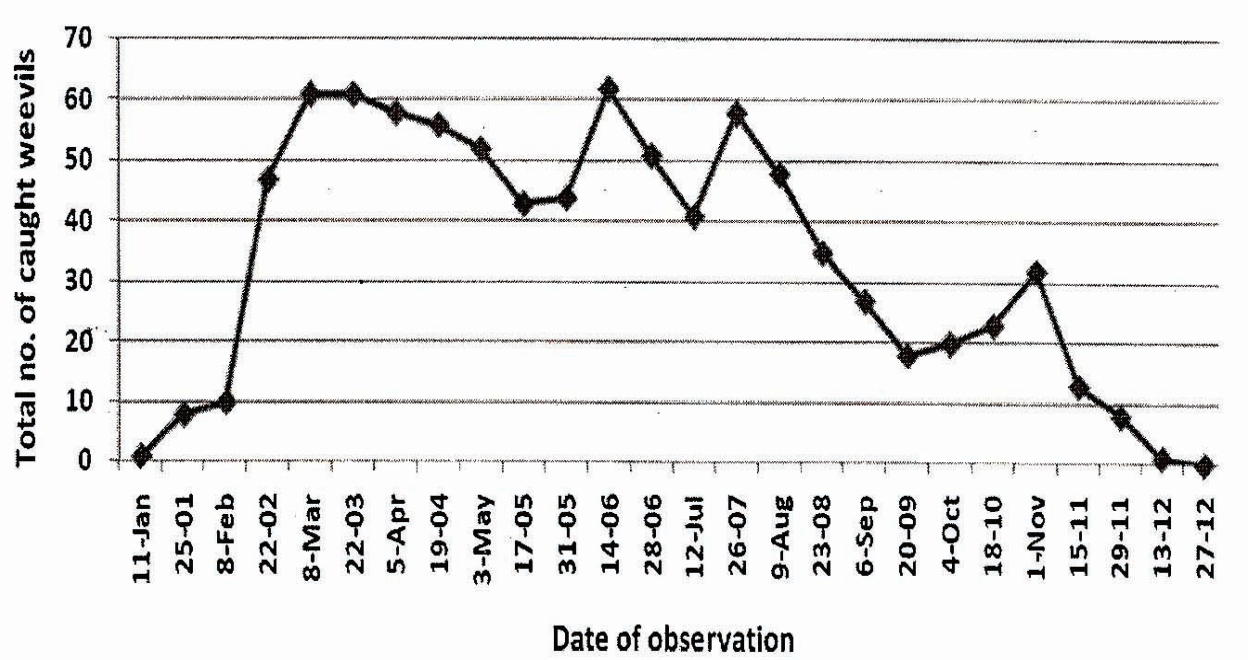

Fig. (1): Fluctuations in the population density of RPW, *Rhynchophorus ferrugineus* (Oliv.) as indicated by total number of weevils caughted in pheromone traps at Quasasine, Ismailia governorate, 2007.

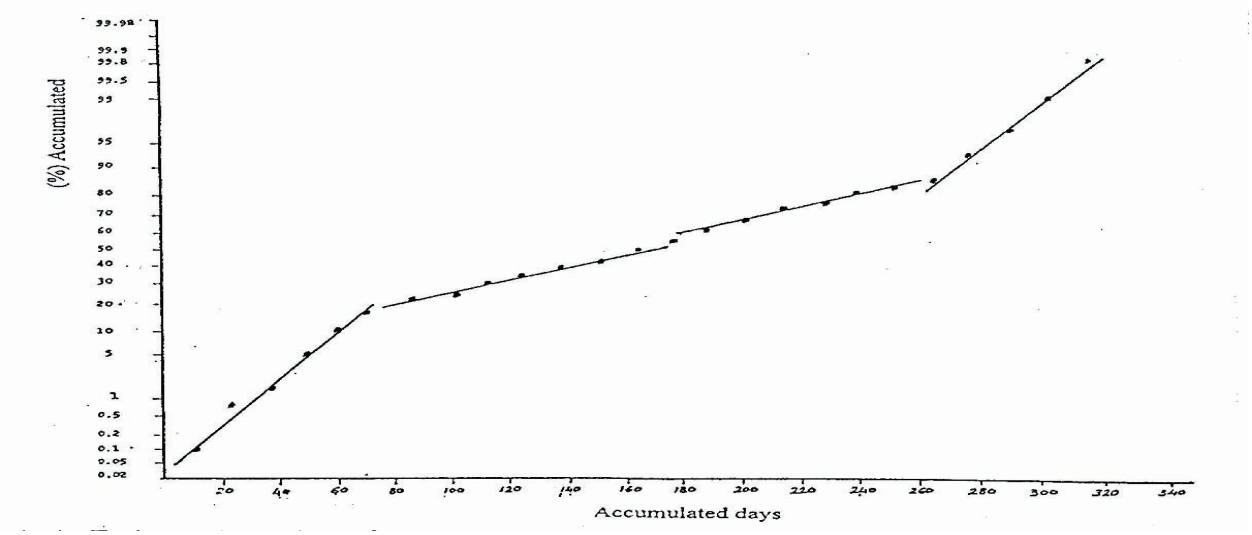

Fig. (2): Estimated number of RPW, *Rhynchophorus ferrugineus* (Oliv.) Aannual field generations, Quasasine, Ismailia governorate, 2007.

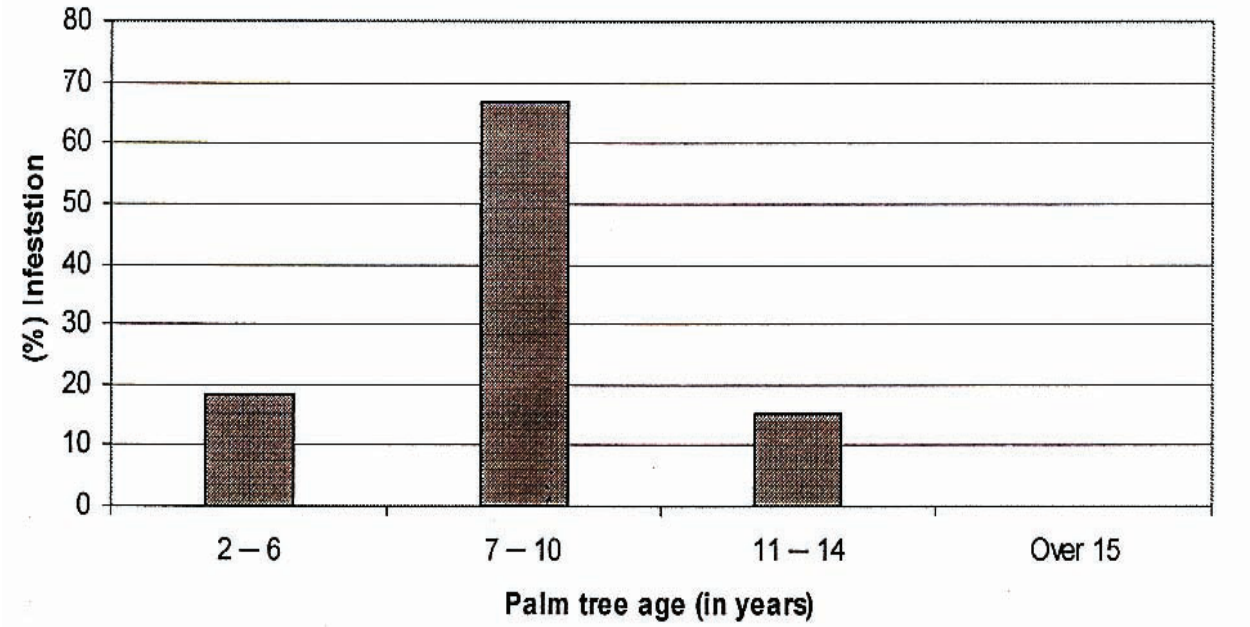

Fig. (3): Percentage of infestation of RPW, *Rhynchophorus ferrugineus* (Oliv.) in relation to date palm age category, Quasasine, Ismailia governorate, 2007.