



FACTORS AFFECTING INFESTATION PATTERN OF THE RED PALM WEEVIL, *RHYNCHOPHORUS FERRUGINEUS* OLIV. IN DATE PALM FARMS IN QATIF, SAUDI ARABIA

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ABSTRACT

The red palm weevil (RPW) *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) is the most destructive pest of date palm *Phoenix dactylifera* L. in Middle East particularly in Arab Gulf countries. Distribution of RPW infestations in relation to some factors was studied in date palm farms in Qatif Governorate, Eastern Saudi Arabia. For these studies, 80 farms containing over 11000 date-palm trees were inspected. A scale for grading the infestation severity was developed. Numerical, but not statistical differences were in infestation levels with RPW, were found among farms due to their location (desert or oasis), irrigation system (dripping or flooding), intercropping (with or without) and pruning condition (pruned or unpruned). However, too small farms (less than 100 palm trees/farm) or too large farms (over 1000 trees) were highly infested while farms of 400-800 trees/farm were the least infested. Over 42% of infestations were concentrated at or below the soil surface. Light or surface infestations formed 45% while severe or deep infestations formed 19% of total infestations. Trees of 5-10 years old were the most infested while trees over 15 years were the least infested.

INTRODUCTION

The date palm, *Phoenix dactylifera* L. is a strategic tree in Arabic region, where every part of it is useful. Arab countries produce two thirds of the world production of dates (6.7 million tons). Egypt being the first country in date production in the world produces over 1.1 million tons followed by

United Arab Emirates and Kingdom of Saudi Arabia (عبد الله وآخرون 1997). The date palm offers a good food source of high nutritive value for a considerable number of people and provides work to considerable numbers of farmers in rural areas. Furthermore, the date palm tree tolerates relatively harsh climatic and soil conditions under which no other crop may give reasonable returns. In fact, date palm which is an irreplaceable tree in irrigable desert lands, provides protection to under-crops from heat, wind and even cold weather, and plays a big role to stop desertification and give life to desert areas. The number of the date palms is about 100 million worldwide, of which 62 million palms can be found in the Arab world (عبد الله وآخرون 1997). The productivity of date palm plantations is now seriously in danger by an invasive exotic species: The red palm weevil (RPW) *Rhynchophorus ferrugineus* (Coleoptera: Curculionidae) is the most destructive pest of date palm trees in the Arabic region and Southern Europe. It also attacks other palm species like coconut, oil palms and *Washingtonia* palms (Kalshoven 1950). It invaded United Arab Emirates in 1985, Saudi Arabia in 1987, Iran in 1990 and Egypt in 1993 (Murphy and Briscoe 1999) and went west to Spain in 1994 (Barranco et al 1996). All cases of regional and international invasions of the introductions were through illegal transportation of infested date palm offshoots (القمة و الفعيط 2002).

Adults of the RPW are attracted to palm trees and females lay 300 eggs during their 2-3 months-life cycle. The hatched larvae tunnel into the trunk or the terminal bud leading directly to the death of

the tree (Griffith 1987, Sivapragasam *et al* 1990). El Muhanna *et al* (2000) reported that the pest can develop between 15 and 40°C. The larval stage has 12 instars and lasts mainly 60 days. Adult stage lasts up to 107 days. Population dynamics of adults of RPW was studied in Qatif by Hanounik *et al* (2000). It has two peaks of abundance and four overlapping generations annually.

This study aimed to more understanding the ecology and behavior and subsequently the management of the red palm weevil in Eastern Kingdom of Saudi Arabia. It was concentrated on the distribution of RPW infestations in date palm farms in Qatif Governorate and its relation to several factors like location of the farm, irrigation system and intercropping. It also investigated the vertical distribution of RPW infestations along the trunk as well as the distribution of infestations in relation to the age of the tree. A scale for grading the infestation rate was developed and the infestations were classified according it.

MATERIALS AND METHODS

Infestation pattern of the red palm weevil *Rhynchophorus ferrugineus* was studied in Qatif Governorate during May and June 2007. As many as 20 sites distributed in Qatif Governorate were visited. At each site, 4 date palm farms were randomly selected for this investigation. Trunks of date palms in each farm were inspected from soil surface to top and infestations with RPW were classified and recorded according the design given in Table (1). Obtained data were subjected to statistical analysis.

Table 1. Investigated factors affecting infestation of the red palm weevil in date palm farms in Qatif Governorate, Saudi Arabia

Factor under study	Groups
1- Location	Desert, oasis
2- Irrigation system	Dripping, flooding
3- Intercropping	With intercrops, without intercrops
4- Pruning state	Pruned, unpruned
5- Vertical distribution of infestations (height in meters)	Root, 0-0.5, 0.5-1.0, 1-3, >3, crown
6- Age of the tree (years)	<5, 5-10, 10-15, >15
7- Infestation severity	Surface ¹ , moderate ² , deep ³
8- Farm size (trees/farm)	<100, 100-<400, 400-<800, >800

1: Surface infestation is characterized by yellow liquid secretion comes out the infestation site. 2: Moderate infestation is characterized by brown fibers coming out the infestation site. 3: Deep infestation is characterized by a hole in the infestation site.

RESULTS

As many as 80 date palm farms (containing over 11000 palm trees) were studied for infestation distribution of *R. ferrugineus*. As shown in Table (2). The average infestation rate in studied Qatif farms (calculated from means of infestation in studied farms) was 3.69%. These farms differed in location (desert or oasis), irrigation system (dripping or flooding), intercropping (with or without), pruning condition (pruned or unpruned) and farm size (trees/farm). No significant differences in infestation level with *R. ferrugineus* were found due to these factors except for the factor of farm size. Farms of less than 100 trees/farm were highly infested with the pest (7.02%) while farms of 400-800 trees/farm were the least infested (1.12%).

Farms of over 800 trees had moderate infestation rates. Distribution of RPW infestations positively correlated to age of the tree until 15 years old. As much as 45% of infestations with the red palm weevil correlated with trees of 5-10 years old. Trees older than 15 years had only 8% of infestations. Palm trees of younger than 5 years of trunks embedded in soil had 16% of infestations Fig. (1).

Vertical distribution of infestations along the trunk of date palm trees Fig. (2) showed that over 42% of RPW infestations were occurred at or under soil surface. If infestations at 1 meter-height were added, the proportion of infestations becomes over 70%. Infestations above 3 meters of the trunk were approximately 8% of total infestations. Regardless of the tree-height crown or heart infestations represented about 15% of total infestations. In Qatif farms, surface infestations formed 45% of total infestations followed by moderate (36%) then deep infestations represented by 19% Fig. (3).

DISCUSSION

Distribution of RPW infestations in Qatif was studied in a wide area (80 farms containing over 11000 date palm trees). The general infestation rate in studied farms was 3.69%. Infestation rate of the red palm weevil was reduced from 9.7%

Table 2. Distribution of *Rhynchophorus ferrugineus* infestations in date palm farms in Qatif Governorate during May and June 2007

Factor	Groups	No. tested farms	Mean No. of trees/farm and (range)	No. infested trees/farm and (range)	% infested trees/farm and (range)	F value and significance among groups
Location	Desert	28	400.9 (80-2200)	10.9 (1-52)	3.16 ^a (0.6-14.33)	0.74 n.s.
	Oasis	52	156.9 (25-750)	4.2 (1-14)	3.97 ^a (0.5-22.5)	
Irrigation system	Dripping	24	269.42 (30-800)	7.16 (1- 43)	3.13 ^a (0.5-14.33)	0.67 n.s.
	Flooding	56	230.7 (25-2200)	6.27 (1-52)	3.92 ^a (0.5-22.5)	
Intercropping	With	66	239.46 (25-2200)	6.78 (1-52)	3.7 (0.5-22.5)	0.89 n.s.
	Without	14	264.77 (80-800)	5.69 (1-10)	3.84 (0.5-4.57)	
Pruning state	Pruned	22	179.80 (40-2200)	6.52 (1-52)	3.41 (0.5-14.33)	1.08 n.s.
	Unpruned	35	162.38 (25-400)	2.76 (1-10)	2.70 (0.5-8)	
Farm size (Trees)	<100	17	59.71 (25_90)	3.94 (1-12)	7.02 ^a (1.25-22.5)	6.67 ***
	100-400	49	184.86 (100-380)	5.84 (1- 43)	3.15 ^b (0.8-14.3)	
	400-800	9	512.22 (400-750)	6 (2-14)	1.12 ^c (0.5-3.5)	
	>800	3	1400 (800-2200)	36 (9-52)	2.53 ^b (1.1- 4.33)	
General		80	242.3 (25-2200)	6.53 (1-52)	3.69 (0.5-22.5)	

(Means in the same cell with different letters are significantly different $P > 0.05$).

in 1992 to 2.28 % in 1999 as a result of control practices (السيهاتي والسبيعي 2000). In the present study, 52 farms in Qatif Oasis were compared to 28 farms in the near desert. Although the numerical difference between means of infestation percentage in desert (3.16%) and Oasis (3.97%) locations was remarkable, it was statistically insignificant. This statistical insignificance may be due to the very wide range of infestation levels in sampled farms (0.6-14.33% in desert and 0.5-22.5% in Oasis). Insignificance in the effect of irrigation system (dripping, 3.13 % or flooding, 3.94%) and pruning condition (pruned, 3.4% or un-pruned, 2.7%) on

infestation distribution of the red palm weevil looked due to the same reason. The irrigation system and the intercropping condition are correlated to the level soil humidity in the farm. Results of (الدريهم و خليل 2002) showed that the red palm weevil behavior was greatly affected by soil humidity. Pruning of date palm trees usually releases kairomones which attract the red palm weevil adults to the cut soft tissues for feeding and oviposition. This may cause new infestations with the red palm weevil. Kalshoven (1950) and Lever (1969) stated that volatiles released from damaged palms attract palm weevils.

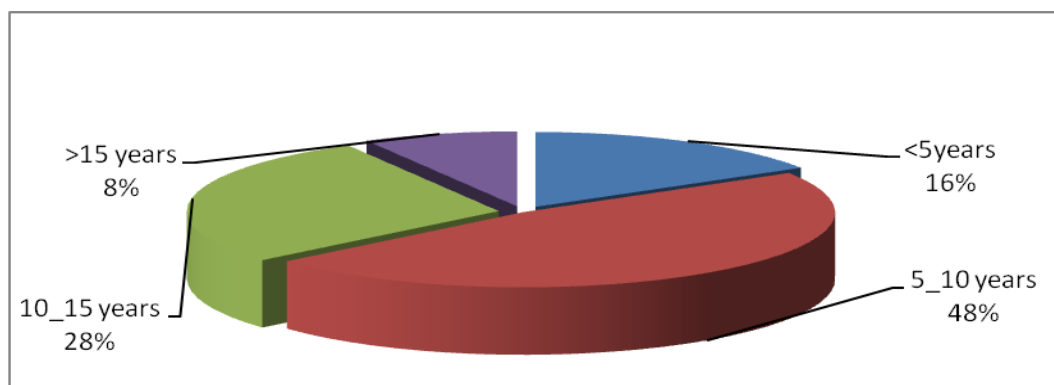


Fig. 1. Distribution of infestations of *Rhynchophorus ferrugineus* in date palm trees according to age of the tree in Qatif Governorate

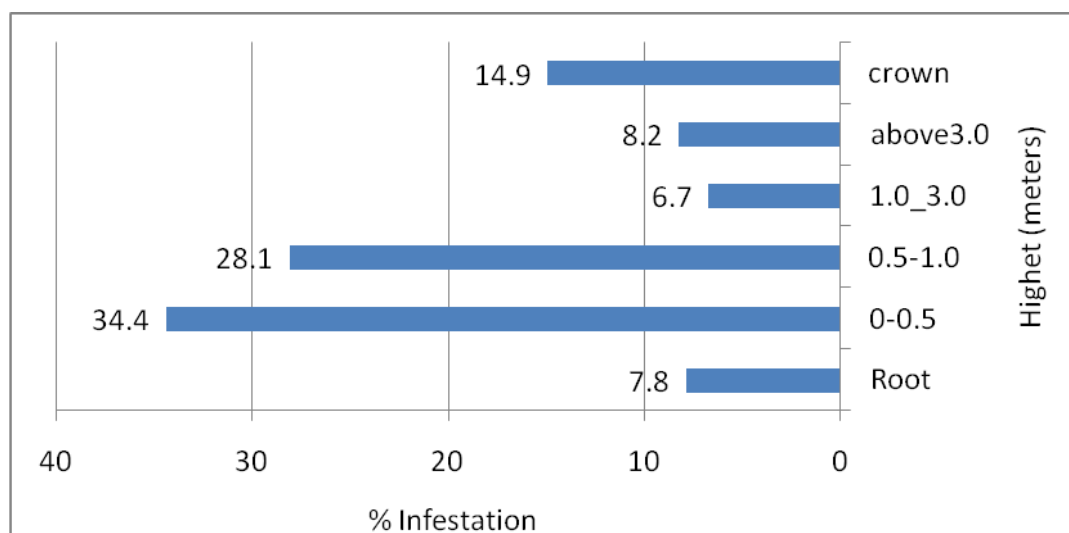


Fig. 2. Vertical distribution of infestations of *Rhynchophorus ferrugineus* in date palm trees in Qatif Governorate

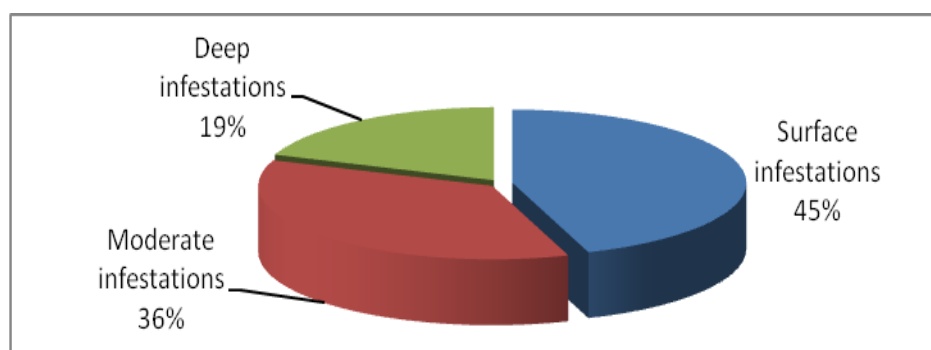


Fig. 3. % infestation of *Rhynchophorus ferrugineus* in date palm farms in Qatif during May and June 2007

This may explain why Ministry of Agriculture usually warn date-palm farmers from leaving the pruning remnants without spraying or dusting with chemical insecticide or at least covering the cut-sites with soil after pruning.

Farms of 100 trees/ farm or less were found highly infested with the pest (7.02%) while farms of 400-800 trees/farm were the least infested (1.12%). Farms of over 800 trees had moderate infestation rates. These differences refer mostly to financial reasons. Poor farmers (having 25-90 trees) usually cannot take enough care of infestations and leave following up the infestations or controlling them. The farm size of 400-800 trees/farm seems the most suitable for Qatif farmers. Over this size (up to 2200 trees) Qatif farmers cannot take much care of such oversize farms.

Distribution of infestations with *R. ferrugineus* positively correlated to age of the tree until 15 years old. As much as 45% of infestations correlated with trees of 5-10 years old. These young trees seemed preferable for infestation with RPW because of their soft tissues and the off-shoots around them. Trees older than 15 years had only 8% of infestations. Trees of younger than 5 years (usually of trunks embedded in soil) had 16% of infestations. Results showed that over 42% of the red palm weevil infestations were at or under soil surface. This makes a very good chance to soil-born biological control agents to be used in the management of this pest. **Abbas et al (2000)** and **Saleh and Alheji (2003)** successfully used entomopathogenic nematodes in the management of the red palm weevil in United Arab Emirates and Kingdom of Saudi Arabia, respectively. Regardless of the tree-height, crown or heart infestations represented about 15% of total infestations. Crowns of date palms in Saudi Arabia are usually subjected to regular spraying with chemical insecticides for controlling RPW **(السبيهي والسبيعي 2000)**.

Infestations of RPW were classified to three grades according to their deep from the trunk surface (surface, moderate and deep). In Qatif farms, surface infestations formed 45% of total infestations followed by moderate then deep infestations. This grading system is very important in determining the control method. For instance injection with chemical or biological insecticides, work only on surface or moderate infestations while deep (severe) infestations mostly require removing of the whole tree. **(السبيهي والسبيعي 2000)** reported that over 400 000 date-palm tree either neglected or severely-infested with RPW were removed from Qatif region between 1992 and 1999.

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