

Evaluate the Relationship Between Infestation Degrees, Age, Stem Height and Occurrence of the Red Palm Weevil, *Rhynchophorus ferrugineus* (Olivier) (Coleoptera: Curculionidae) on Certain Ornamental Palm Cultivars

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Abstract: The relationship between infestation degrees, age, stem height and occurrence of the red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier) were evaluated on four ornamental palm cultivars (Pritchardia, Meloky, Seykas and Canarien) in Dakahlia Governorate during two years (2018 and 2019) and occurrence of the insect stages were also recorded. Based on the date illustrated in the two years of study the most susceptibility cultivars on the different ornamental palm to infestation was Canarien palm while, the infestation by RPW was low on Pritchardia cultivar. The obtained results indicated that the infestation on the four palms was high in ornamental palm belonging to the age group of 0-3 years followed by the palms belonging to the age of 3-5 years. Meanwhile it was very low in the age group of 5-7 and >7 years. The results indicated that the maximum infestation by RPW on different ornamental palms was found in palms with stem height of 0-50cm, followed by the stem height of 50cm- 1m, 1-1.5m, while it was low in ornamental palms with stem height of >2m. In conclusion, the data suggested that the insect had two main active seasons annually, the first adult brood was observed in April and the second one was in August.

Key words: *Rhynchophorus ferrugineus* • Ornamental palm cultivars • Infestation degrees • Occurrence

INTRODUCTION

The red palm weevil is one of the most serious palm pests in recent years in the Middle East countries and has caused a great damage [1- 4]. The RPW is also one of the most severe pests of various palm species, including ornamental palms and is an economically important, tissue - chewing pest of date palm in many parts of the world. [5-8]. The RPW was discovered attacking palms in Sharquiya region of Egypt in 1992 Cox, [9]. Since its discovery, the weevil has expanded its range very rapidly. By 1995, it had infested over 10, 000 farms. In infested plantations, yields have been estimated to have dropped from 10 tones to 0.7 tones per hectare [10]. The weevils are attracted to dying or damaged parts of palms but it is possible that undamaged palms are also can be attacked [1-3]. *Rhynchophorus ferrugineus* can reared in a wide range of climates and this is largely because the larvae feed protected within their host palms [11]. This weevil is able to complete several generations in a year frequently, several generations can be passed in the same host tree

before the tree collapses [12]. Therefore, the objective of this study was to evaluate a thorough survey of RPW infestation to provide knowledge about the susceptibility of different ornamental palm cultivars to infestation, place of infestation on the stem and most susceptible age group of the ornamental palm to gather certain information about the pest incidence and to describe the occurrence of RPW.

MATERIALS AND METHODS

The infestation of RPW was carried out from thorough survey during 2018 and 2019 years in Dakahlia Governorate in nurseries of Mit mehsen village on the four ornamental palm cultivars namely Pritchardia, Meloky, Seykas and Canarien. The total number of ornamental palms, level of infestation and date of recording months were recorded half monthly. The infestation degrees were recorded as follows: low=dryness of the outer leaves and slight or no odor, Medium=oozing of brown fluid from the holes in the stem,

medium to large larvae are present after removing leaf base cover, damage stem tissues and no cocoon-if present, they will be only 1-5 cocoons and high=presence of chewed fibers mainly in stem, with bad smell, many cocoons are noticeable, yellowing of the third leaf-row, sometimes yellowing of internal leaves and the flag leaf, trunk lodging and death of palm.

The infestation by RPW on certain ornamental palm cultivars were categorized into four age groups as: 0-3, 3-5, 5-7 and >7 years. Total number of ornamental palms and number of infested palms were recorded under each age group. In addition, data were collected on RPW infestation in relation to stem height of ornamental palm. The height levels were categorized into five levels as: 0-50cm, 50cm- 1m, 1-1.5m, 1.5-2m and >2 m height from ground level. The number of infested ornamental palms under each height group was recorded.

All stages (eggs, larvae and adults, as well as empty and occupied cocoons) were removed and counted from infested ornamental palms. All cocoons were opened to determine the stadium of the weevil (last instar larva, pre-pupa, pupa, or adult). Infested ornamental palm cultivars stems were sectioned with a chainsaw and a sharp and heavy-bladed knife.

Statistical Analysis: Data for RPW infestation in different ornamental palm cultivars, place of infestation on the stem and most susceptible age group of the ornamental palm were subjected to an analysis of variance (ANOVA) and means were separated by a Duncan's Multiple Range test when the ANOVA was significant at $P < 0.01$, according to CoHort Software [13].

RESULTS AND DISCUSSION

Survey the Infested Ornamental Palm Trees and Determination the Degree of Infestation: From 2018 and 2019 years, a total of 2585 ornamental palms were examined in Dakahlia Governorate on four ornamental palm cultivars namely Pritchardia, Meloky, Seykas and Canarien in order to determine the infestation percentage of red palm weevil (Table 1) The infestation level during the period of study on the four cultivars was 3.9, 3.4, 7.9 and 10.6% in Pritchardia, Meloky, Seykas and Canarien cultivars. The infestation was highest (11.2%) in Canarien cultivar while it was the lowest (4%) in both of Pritchardia and Meloky cultivars in 2018 year. Meanwhile in 2019 the infestation was highest (10%) in Canarien cultivar while it was the lowest (3%) in Meloky cultivar.

Infestation Degrees by RPW: The infestation by RPW on Pritchardia, Meloky, Seykas and Canarien ornamental palm cultivars between 2018 and 2019 in Dakahli Governorate was shown in Table (1). Out of 18 infested ornamental palms recorded during the survey of 2018 year in Pritchardia cultivar, 9(50%) ornamental palm were with the low infestation, 5 (27.7%) with medium infestation and 4 (22.2%) with high infestation. Meanwhile in 2019 year, 9 (50%) were with the low infestation, 6 (33.3%) with medium infestation and 3 (16.6%) with high level of infestation. Among the infested ornamental palm during 2018 year on Meloky cultivar 10 (66.6%) ornamental palm were with the low infestation, 3 (20%) with medium infestation and 2 (13.3%) with high level of infestation. While in 2019 year, 6 (50) ornamental palm were with the low infestation, 4(33.3%) with medium ornamental palm infestation and 2(16.6%) with high level of infestation.

The infestation level by RPW on Seykas ornamental palm cultivars in 2018 year was, 13(59.1%) palm were with the low infestation, 4 (18.1%) with medium infestation and 5(22.7%) with high level of infestation. Among the infested ornamental palms during 2019 year, 10 (76.9%) ornamental palms had low level of infestation, 3 (23.1%) with medium infestation and no high level infested were recorded on Seykas cultivar palms during 2019. Among the Canarien infested palms during 2018, 16 (59.2%) ornamental palm were with the low infestation, 5 (18.5%) with medium infestation and 6 (22.2%) ornamental palms with high level of infestation. Meanwhile, in 2019 the level of infestation in Canarien palms were 12(54.5%) with the low infestation, 7(31.8%) with medium infestation and 3(13.6%) with high level of infestation. Based on the statistical analysis, the low infestation was significant higher than the other two levels of infestation. From the date illustrated in Table (1) the most susceptible cultivar to infection was Canarien 10.6 % was the total percentage of infestation for it. The obtained results are in agreement with Giovino, *et al.* [14] who noted that the RPW recently introduced into Europe where it has destroyed many *Phoenix canariensis* palms, this weevil attacks different species of palms in different countries, mainly cultivated date palms (*Phoenix dactylifera*) in Egypt and cultivated canary palms (*Phoenix canariensis*) in Europe. In addition Anisul, *et al.* [15] noted that the date palm (*Phoenix dactylifera* L.) creating genuine monetary issues. Eventually, it changes the tourist's scenes in Spain and France, tending to the Canary palm (*Phoenix canariensis* Chabaud) and consequently that the European Union for a long times an Action Plan against red palm weevil.

Table 1: Infestation degrees by red palm weevil on different ornamental palm cultivars during 2018 and 2019 years

Cultivars	Infestation degrees								Non infested ornamental palm	Total
	Low		Medium		Height		Total infested palm			
	No. (mean)	%	No. (mean)	%	No. (mean)	%	No.	%		
Year 2018										
Pritchardia	9(3)A ^c	50	5(1.66)B ^a	27.7	4 (1.33) B ^{ab}	22.2	18	4	432	450
Meloky	10(3.33)A ^c	66.6	3(1)B ^a	20	2 (0.66) B ^b	13.3	15	4	360	375
Seykas	13(4.33)A ^c	59.1	4(1.33)B ^a	18.1	5 (1.66) B ^a	22.2	22	9.5	208	230
Canarien	16(5.33)A ^a	59.2	5(1.66)B ^a	18.5	6 (2) B ^a	22.2	27	11.2	213	240
Total	48	58.5	17	20.7	17	20.7	82	6.33	1213	1295
Year 2019										
Pritchardia	9(3)A ^a	50	6(2)AB ^{ab}	33.3	3 (1) B ^a	16.6	18	3.9	442	460
Meloky	6(2)A ^a	50	4(1.33)AB ^{bc}	33.3	2 (0.66) B ^a	16.6	12	3	388	400
Seykas	10(3.33)A ^a	76.9	3(1)B ^c	23.1	0.0 B ^b	0.0	13	6.1	197	210
Canarien	12(4)A ^a	54.5	7(2.33)AB ^a	31.8	3 (1) B ^a	13.6	22	10	198	220
Total	37	56.9	20	30.7	8	12.3	65	5.03	1225	1290
General Total	85	57.8	37	25.1	25	17.0	147	5.68	2438	2585

Means followed by the same capital letter in a row between the different degrees of infestation in the same year and cultivar while the same small letter in a column between the same degrees in the different cultivars.

Infestation by RPW in Different Age Groups in Ornamental Palms: During 2018, red palm weevil infestation were high in ornamental palms Pritchardia, Meloky, Seykas and Canarien belonging to the age group of 0-3 years they were 61.1%, 74.1 %, 71.4 and 75.5% respectively. Followed by the ornamental palms belonging to the age group of 3-5 years. Meanwhile, the infestation was very low in palms belonging to the age group of 5-7 years and >7 years. These results indicated that young palms are preferred to attack by RPW and needs protection.

Red Palm Weevil Infestation at Different Stem Heights of Ornamental Palm Cultivars: The relationship between infestation by RPW and the stem height of ornamental palms illustrated in Table (3) for four cultivars (Pritchardia, Meloky, Seykas and Canarien) in Dakahlia Governorate during two years of study 2018 and 2019. Maximum infestation of RPW on the four cultivar in 2018 were found in ornamental palms with stem height of 0-50cm it were 44.4%, 40%, 40.9% and 48.1% respectively followed by the palms with stem height 0.50-1m. Meanwhile, the infestation was low in palms with stem height >2m. As shown in Table (3), Maximum infestation of RPW on (Pritchardia, Meloky, Seykas and Canarien) cultivars in 2019 were found in palms with stem height of 0-0. 50cm it were 38.8%, 33.3%, 46.1% and 50% respectively followed by 16.6%, 25%, 30.7% and 31.8% respectively in stem height of 50cm-1m. Maximum infestation of RPW on all cultivars in the two years of study was found in

ornamental palms with stem height of 0-50cm, while the infestation was less in ornamental palms with stem height of >2m. Based on the statistical analysis, there were significance differences between the different stem height of the same cultivar and between the different cultivars in the same stem height.

Occurrence of RPW: In Dakahlia Governorate, eggs, larvae at different larval instars, pupae and adults of *R. ferrugineus* were recorded during 2018 and 2019 on Canarien cultivar only to determine the population density. Data presented in Fig. (1) showed that in 2018, the population of insect stages increased gradually from the second week of April to reach its second peak in the second week of August. Total numbers of insect stages were decreased during September, October, November and December. The seasonal pattern was similar to observations during 2019.

These results were in agreement with El-Garhy [16] who noted that captures rates of *R. ferrugineus* adult were highest in the months of April, May and June, which corresponds to the onset of warmer weather. 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 addition, El-Sebay [17] in Egypt, determined the seasonal abundance and seasonal activity of *R. ferrugineus* during 1996-2001. He found that *R. ferrugineus* had two main active seasons annually. The first adult brood was observed in April and the second one was in November.

Table 2: Effect of tree age of some ornamental palm cultivars on infestation by red palm weevil during 2018 and 2019 years

Cultivars	Tree age								Total infested palm	
	0-3		3-5		5-7		>7			
	No. (mean)	%	No. (mean)	%	No. (mean)	%	No. (Mean)	%		
Year 2018										
Pritchardia	12 (4) A ^a	66.6	3 (1) B ^a	16.6	2 (0.66) B ^a	11.1	1 (0.33) B ^a	5.5		18
Meloky	11(3.66) A ^a	73.3	3 (1) B ^a	20	1 (0.33) B ^a	6.6	0 B ^a	-		15
Seykas	15 (5) A ^a	68.1	4 (1.33) B ^a	18.1	2 (0.66) BC ^a	9.1	0 C ^a	-		22
Canarien	20 (6.66) A ^a	74.1	6 (2) B ^a	22.2	1 (0.33) C ^a	3.7	0 C ^a	-		27
Total	58	70.7	16	20.7	6	7.3	1	1.2		82
Year 2019										
Pritchardia	10 (3.33) A ^b	55.5	3 (1) B ^a	16.6	3 (1) B ^a	16.6	2 (0.66) B ^a	11.1		18
Meloky	9 (3) A ^b	75	2 (0.66) B ^a	16.6	1 (0.33) B ^a	8.3	0 B ^b	-		12
Seykas	10 (3.33) A ^b	76.9	2 (0.66) B ^a	15.3	1 (0.33) B ^a	7.6	0 B ^b	-		13
Canarien	17 (5.66) A ^a	77.2	4 (1.33) B ^a	18.2	1 (0.33) B ^a	4.5	0 B ^b	-		22
Total	46	70.7	11	16.9	6	9.2	2	3.1		65

Means followed by the same capital letter in a row between the different ages in the same cultivar while the same small letter in a column between the same age in the same year in the different cultivars.

Table 3: Effect of stem height of some ornamental palm cultivars on infestation by red palm weevil during 2018 and 2019 years

Cultivars	Stem height										Total of Infested palm
	0-50 cm		50cm-1m		1-1.5 m		1.5-2 m		>2m		
	No. (mean)	%	No. (mean)	%	No. (mean)	%	No. (mean)	%	No. (mean)	%	
Year 2018											
Pritchardia	8 (2.66) A ^b	44.4	4 (1.33) B ^b	22.2	3 (1) B ^a	16.6	2 (0.66) B ^a	11.1	1 (0.33) B ^a	5.5	18
Meloky	6 (2) A ^b	40	5 (1.66) A ^{ab}	33.3	2 (0.66) B ^a	13.3	1 (0.33) B ^a	6.6	1 (0.33) B ^a	6.6	15
Seykas	9 (3) A ^{ab}	40.9	6 (2) AB ^{ab}	27.2	3 (1) B ^a	13.6	3 (1) B ^a	13.6	0 C ^a	---	22
Canarien	13 (4.33) A ^a	48.1	7(2.33) B ^a	25.9	5 (1.66) BC ^a	18.5	1 (0.33) CD ^a	3.7	0 D ^a	---	27
Total	36	43.9	22	26.8	13	15.8	7	8.5	2	2.4	82
Year 2019											
Pritchardia	7 (2.33) A ^a	38.8	3 (1) B ^b	16.6	3 (1) B ^b	16.6	3 (1) B ^a	16.6	2 (0.66) B ^a	11.1	18
Meloky	4 (1.33) A ^b	33.3	3 (1) A ^b	25	2 (0.66) A ^b	16.6	2 (0.66) A ^a	16.6	1 (0.33) A ^a	8.3	12
Seykas	6 (2) A ^a	46.1	4 (1.33) A ^b	30.7	3 (1) B ^b	23.1	0 C ^b	---	0 C ^a	---	13
Canarien	11(3.66) A ^a	50	7 (2.33) B ^a	31.8	6 (2) BC ^a	27.2	0 C ^b	---	0 C ^a	---	22
Total	28	43.1	17	26.1	14	21.5	5	7.6	3	4.6	65

Means followed by the same capital letter in a row between the different stem height in the same cultivar while the same small letter in a column between the same stem height in the same year in the different cultivars.

Also, Al-Ajlan and Abdulsalam [18] in Saudi Arabia reported that the monthly mean number of captured adults increased gradually from February to April, reaching the peak in April and then decreased from May to November on date palms in Al Qatif district, Al Jush. The highest mean number of captured adults was recorded in April. The population of *R. ferrugineus* was lowest from September to October and highest during April. According to Abbas, *et al.* [19], the insect population increased gradually from January to reach its peak

in March, April, or May in the United Arab Emirates. In general, the insect had two main active seasons annually. The first adult brood was observed in February and the second one was in August. The active seasons varied from Governorate to another and from season to another season due to the climatic conditions.

Meanwhile, Abdel-Salam, *et al.* [20] reported that the insect had two main active seasons annually. The first adult brood was observed in February and the second one was in August.

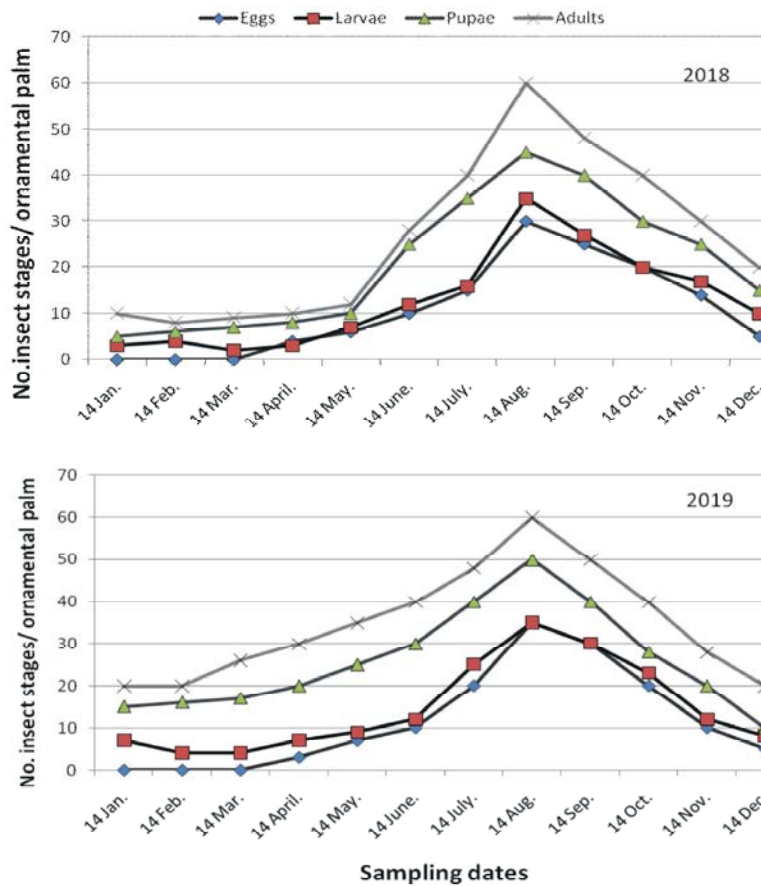


Fig. 1: Numbers of insect stages for RPW/ date palm reared on Canarien cultivar in Dakahlia Governorate for two years

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