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A survey of the date palm borers species and an estimate of their population density and relative presence in palm orchards in Salah Al-Din Governorate

ABSTRACT

A field study was conducted in date palm orchards in Salah al-Din Governorate during the period from 1/10/ 2020 to 30/10/2021 to survey the species of date palm borers and estimate their population density and relative presence during the study period. The results showed the diagnosis of three species of palm borers belonging to Coleoptera of the family Scarabaeidae, which included *Oryctes elegans*, *Pentodon* sp and *Tanyproctus* sp. The relative presence of males and females for the three borers was (53.00, 47.00%), (51.98, 48.02%) and (52.76, 47.24 %), respectively., the highest population density for males and females of the three borers during the month of June was (224, 192), (145, 132) and (68, 57) respectively, and the sex ratio for each of the three borers was 1.1:1 The highest total of adults caught by IPM Russell traps during one year was for *O. elegans* and *Pentodon* sp. it reached 418 and 236.3 adults/trap, respectively, while the total of adults of the two insects in the local trap was 75.7 and 49.9 adults/trap, respectively. For the borer *Tanyproctus* sp., the local trap superior on other traps , in which the total number of adults caught was 312 adults/trap, while it was 50 adults/IPM Russell trap.

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INTRODUCTION

The date palm, *Phoenix dactylifera*, is one of the most important economically important fruit trees belonging to Arecaceae (Al Antary, et al., 2015). The global production of dates in 2020 was about 9.6 million tons (G.World, 2020) while Iraq's production amounted to 735,353 tons, and the number of palm trees reached 17,348,741 palm trees for the year 2020 (Central Statistics Agency, 2019). The date palm is exposed to many insect and non-insect pests, of which their species reach 132 species, most of which (about 41%) belong to the Coleoptera, palm borers are one of the most important pests that infect date palm trees in many countries of the world and the countries of the Arab world, including Iraq. (El-Shafie et al., 2017; Dechamber; and Lachaume, 2001; Elrehewy et al., 2020; Khalaf et al., 2021).

Palm borers cause severe damage to the trees and affect their productivity, this insects infect the stem, trunk, fronds and racemes by digging tunnels and feeding on them, which leads to infection with pathogens. Severe infestation often leads to the breaking of the fronds and stems, weakness and low productivity of the palm. The nutrition of the larvae in the heart of the palm causes weakness and small size of the fruits in addition to decrease in the marketing value, all these factors as well as the palm varieties play an important role in the degree of infection with the palm borers (Khalaf, 2016; Al-Kuraiti, 2015; Al-Saadi, 2019). the infection rate reaches 90% in old, neglected

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palm trees and also the strong palm tree (EL-Shafie, 2015). There are various species of palm borers that infect palm trees and cause severe damage to them. The severity of the infection varies according to the species, as well as the difference in their locations and numerical density according to the areas of palm tree cultivation in Iraq, including the palm borer *Phonapate frontalis* and the long-horned palm stem borer *Jebusaea* spp. including *J.hammerschmidtil* and *J.perseca* and the lone-horned palm borers of the genus *Oryctes* spp, followed by several species, including the palm racemes borer *O. elegans*, *O.sinaicus* and *O.agamnon*, which is followed by the Arab rhinoceros beetle *O. arabicus* and the root borer *Oamatthiesseni* (Khalaf, 2018)

For the importance of the palm borers, this study was conducted to survey and estimate the population density of the palm borers species spread in Salah al-Din Governorate.

MATERIALS AND METHODS

Survey of different palm borers species

Larvae and adults belonging to the genus *Oryctes* were collected by manual and direct collection method from palm trees during the palm pruning process under using the light traps conditions, the collection areas included three locations in Salah al-Din governorate, namely Tikrit, Dhuluiya and Mutasim during the period from 1/10/ 2020 to 30/10/2021. Larvae and adults were transferred to the Entomology Laboratory, Plant Protection Department / College of Agriculture, and all the information about the place, date and method of collection was recorded. Larvae were bred in the laboratory on a natural medium containing a pieces of pruned fronds and fibers in a ratio of 1:1 for the purpose of formation of the different insect stages. 10 larvae of similar ages were placed in each dish for three replicates, according to a completely randomized C.R.D design, and incubated at a temperature of 25 ± 2 °C, relative humidity of $65 \pm 10\%$, and a photoperiod of 12:12 (Al-Saadi, 2015). The adults formed in the laboratory as well as the adults that were caught from traps installed in the orchards were collected and separated from the females and males and sent to the Natural History Research Center and Museum of the Ministry of Higher Education and Scientific Research for the purpose of diagnosis.

Estimation of the population density of adult borers in palm orchards using two types of light traps

The study was conducted in three different regions belonging to Salah El-Din Governorate, the first site is in Al-Dibsa - Tikrit, one of the orchards with an area of 10 donum was chosen, the second site was in Al-Dhuluiya district with an area of 9 donum, while the third site was in Al-Mu'tasim district - Samarra district, with an area of 10 acres. The three orchards are planted with different varieties of date palms, citrus, and some deciduous trees. The date palm trees in those three locations suffer from infection by different palm borers species.

Two traps were used in each site, the first is the Russell IPM trap, which is imported by the Ministry of Agriculture / Department of Plant Protection, (Figure1) which is powered by automatic solar energy and equipped with a light source with a wavelength of 320-420 nm. The second, local trap was designed in this study (Figure2). The distance between one trap and another was 100 m, with an emphasis on not extinguishing the trap from the period before sunset until early morning. Readings are taken weekly.

The hunted adult insects were collected and preserved in plastic containers prepared for this purpose, the place, date of collection and the type of trap were recorded on it. Then, temperature and relative humidity rates were recorded by an Elcetric thermo hygograph device (Chinese origin), then transferred to the laboratory for the calculating the population density and isolating the existing species for the diagnosis and calculating the sexual ratio.



- Total trap height 2 m
- Energy source solar panels 45 watts
- The height of the transparent collision panels from the ground is 140 cm
- The diameter of the collecting funnel is 63 cm
- The depth of the collecting funnel is 18cm
- Funnel hole 9 cm
- The wavelength of light is 420-320 nanometers
- The color of the light is white

Figure (1) Russel IPM trap and its specifications



The trap cover is a plastic funnel with a radius of 25 cm and a depth of 7 cm, placed upside down

- Transparent panels made of transparent plastic glass, thickness of 2 mm, of Chinese origin, with four perpendicular panels + with a part cut off from the top for the purpose of installing the light bulb.

- Collection funnel made of transparent plastic measuring 10 cm in diameter and 20 cm in height, making a hole measuring 5 cm for the purpose of entering the captured insects into the collection tray. It was perforated from the bottom with several circular holes measuring 1 cm to prevent rainwater from collecting inside it.

The connecting rods are 1 cm thick for the purpose of fastening, and 0.5 m long, which connects the trap cover to the assembly suppression, while at the same time fixing the transparent panels.

- Holder base to install the light bulb.
- Electric lamp with a capacity of 50 watts.
- Electrical wires to connect the power supply and a switch to start and cut the main power

Figure (2) Local (Homemade) trap and its specifications

RESULTS AND DISCUSSION

A survey of the different species of date palm borers and their relative presence in Salah al-Din Governorate. The results of testing the adult insect samples, (whether those resulting from the larvae brought from the three sites which bred in the laboratory, or the adults caught by light traps, or the adults brought from the field farm), showed the identification of three species of date palm borers at the Natural History Research Center and Museum - University of Baghdad (table 1).

Table (1): Species of palm borers in palm orchards

Palm borers species	Order	Family
<i>Oryctes elegans</i> Prell	Coleoptera	Scarabaeidae
<i>Pentodon</i> sp	Coleoptera	Scarabaeidae
<i>Tanyproctus</i> sp	Coleoptera	Scarabaeidae

Pentodon sp and *Tanyproctus* sp are considered a new record for the first time in Iraq and Salah al-Din Governorate, in addition, *Pentodon* sp was the most prevalent in most countries of the world and in the Gulf countries, including Iraq. The previously registered date palm fruit stalk borer, *O.agagemnnon arabicus*, was registered in Iraq in 2013 as *Oryctes elegans*. (Abdul Rasoul, 2001; Khalaf, 2014; Al-Saadi, 2015; Khalaf et al., (2021). The diagnosis of the species was confirmed in the Department of Entomology - Natural History Museum / University of Baghdad.

The results in Table (2) showed that *O.elegans* was recorded in the three sites (Dhuluiya, Al-Mu'tasim and Tikrit) of Salah Al-Din Governorate, as its appearance and presence were simultaneous in the three sites, but with different densities. *O. elegans* outperformed with the highest relative presence of males, which amounted to 53.00%, compared to a decrease in the number of females, with a relative presence of 47.00%. The sexual ratio reached 1.1:1 (females: males) compared to *Pentodon* sp, which was recorded in the three sites with the lowest number in which relative presence of males, was 52.03%, and the relative presence of females was 47.97%, while the sexual ratio reached 1.1:1 (females: males), Relative presence of *Tanyproctus* sp was recorded in the Debsah site - Tikrit district, which appeared at the beginning of the first half of February 2021, the relative presence of males reached 52.76% compared to a decrease in the number of females, as the relative presence reached 47.24%, and the sexual ratio was 1.1:1 (female: male).

A decrease in the number of females and an increase in the number of males may be due to the fact that females die immediately after laying eggs and that males remain for a longer period, this is indicated by Al-Saadi(2015) and Soltani (2011) that female *Oryctes agagemnnon arabicus* borers die after the egg-laying process and that the duration of the longevity of males is longer than that of females.

Table (2): Relative presence and sex ratio of palm borers in palm orchards

Palm borers species	Females	Males	Total	Relative presence (%)		sex ratio (Females:males) ♂♂):(♀♀)
				Females	Males	
<i>Oryctes elegans</i>	696	785	1481	47.00	53.00	1.1:1
<i>Pentodon</i> sp	412	446	858	47.97	52.03	1.1:1
<i>Tanyproutus</i> sp	171	191	362	47.24	52.76	1.1:1

Estimation of the population density of types of palm borers using light traps

Estimation of the population density of *O.elegans* using light traps

The results of the study in Figure (1) showed that no adult insects of the species *O.elegans* were recorded in the light traps during the months of January and February. The first appearance of adult palm borers was during March, when the number of caught insects, males and females, reached 57 and 52 adults/month, respectively, when the average maximum and minimum temperatures were 30.46 and 21.38 °C (table 3), and the relative humidity was 71.35% (table 3), the increase in their numbers continued during April, in which the number of males reached and females 161 and 146 adults / month, respectively. When the average maximum and minimum temperatures were 33.85 and 22.23 °C, and the relative humidity was 68.43%. The adults of the date palm borer that appeared during March and April represent the adults overwintered between the bases of the fronds and the fibers in the head of the palm during the palm pruning process in

January, December and February. The number of adults caught in May continued to increase with the increase in the maximum and minimum temperatures, as the numbers of males and females reached 210 and 170 adults/month, respectively, when the average maximum and minimum temperatures were 37.27 and 24.82 °C and the relative humidity was 52.53% (table 3). The numbers of adults caught reached the peak in June, with a significant difference, and represented the peak of their activity, the numbers of males and females were 224 and 192 adults/month, respectively, when the average maximum and minimum temperatures were 43.57 and 27.32 °C, and the relative humidity was 46.55%. The numbers of adults caught began to decline in July with a significant difference compared to June, despite the presence of fluctuations in the maximum and minimum temperatures, in which, the numbers of males and females were 30 and 26 adults/month, respectively, when the maximum and minimum temperatures reached 48.66 and 30.43 °C and humidity Relative 36.94%, the number of adults continued to decline during the August, in which the numbers of males and females were 43 and 18 adults/month, respectively, when the average maximum and minimum temperatures reached 46.34 and 26.68 °C, respectively, and the relative humidity was 35.53%, while their numbers in September were 35 and 57 adults/month, respectively, at 22.48-38.85 °C, relative humidity 37.42% (table 3). The numbers of males and females continued to decline until they reached 25 and 35 adults/month during October, when the average maximum and minimum temperatures was 20.29 - 25.94 °C with the relative humidity 66.17%. The results of this study do not agree with Falah and Khalaf (2010), in which it was mentioned that the highest density of *O.elegans* was recorded during September in Iraq, while Al-Saadi (2015) and Al-Kurait (2015) indicated that the appearance of the palm raceme, *O.elegans* occurred during the March then increased until it reached the peak of its activity in the July and completely disappeared during the beginning of October.

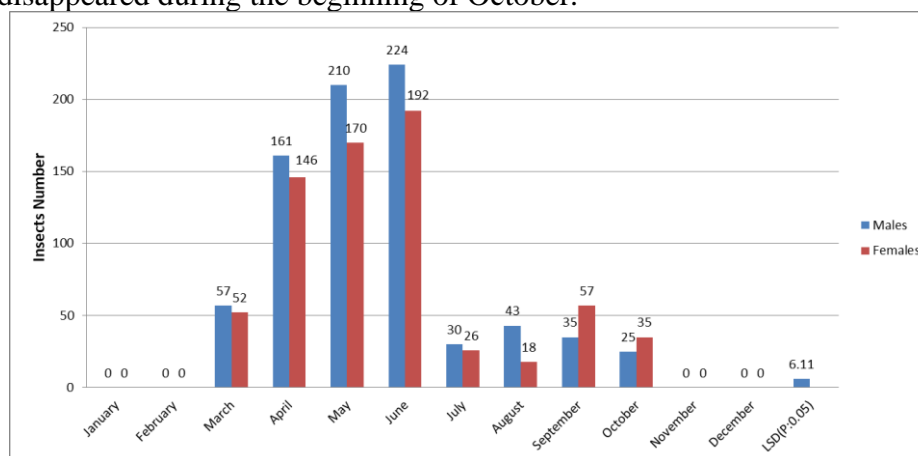


Figure (1) Population density and seasonal presence of males and females of *O.elegans* during the year 2021

Table (3) Relative humidity and Temperature during the year 2021

Months	Relative humidity (%)	Maximum Temperature (° C)	Minimum Temperature (° C)
January	91.80	12.82	2.41
February	78.64	27.13	16.88
March	71.35	30.46	21.38
April	68.43	33.85	22.23
May	52.53	37.27	24.82
June	46.55	43.57	27.32
July	36.94	48.66	30.43
August	35.53	46.34	26.68
September	37.42	38.85	22.48
October	66.17	25.94	20.29
November	72.17	17.49	11.53
December	86.27	13.89	2.92

Estimation of the population density of *Pentodon sp* using light traps

The results listed in Figure (2) showed that no adult insects of *Pentodon sp* were recorded in the light traps during January and February, the first appearance of the adult borers was during month of March, in which the number of caught insects of males and females were 10 and 7 adult / month, respectively when the average maximum and minimum temperatures were 30.46 and 21.38 °C respectively and the relative humidity was 71.35%. The increase in their numbers continued during the April, the numbers of males and females were 118 and 112 adults/month, respectively, when the average maximum and minimum temperatures were 22.23 -33.85 °C and the relative humidity was 68.43% (table 3). The adults of the borer *Pentodon sp*, which appeared during March and April, represent the adults overwintered between the bases of the fronds and the fibers in the head of the palm during the pruning process in January, December and February, the numbers of adults hunted increased with the increase in the maximum and minimum temperatures during the May until it reached its peak during the June, in which the numbers of hunted males and females were 145 and 132 adults/month, respectively, when the average maximum and minimum temperatures were 43.57 and 27.32 °C, respectively, and the relative humidity was 46.59%. The numbers of adults hunted began to decline in July, despite the presence of fluctuations in maximum and minimum temperatures. The numbers of males and females reached 15 and 11 adults/month, respectively, when the average maximum and minimum temperatures were 48.66 and 30.43 °C, respectively, and the relative humidity was 36.94% then the numbers of adults continued to decline during the August and September, in which the lowest number of males and females, were 7 and 5 adults/month, respectively, when the average maximum and minimum temperatures were 25.94 and 20.29 °C, respectively and the relative humidity was 46.99% (table 3) . The results of the present study are in agreement with other studies mentioned by Lacroix (2007) and Krell, Bezděk (2016) That this genus belongs to the subfamily Dynastinae, as in the case for the borer *Oryctes spp.*, In fact, they are very similar, and the appearance of *Pentodon spp* occurred during the March and began to increase until it reached the peak of its activity in the month of June and completely disappeared in early October.

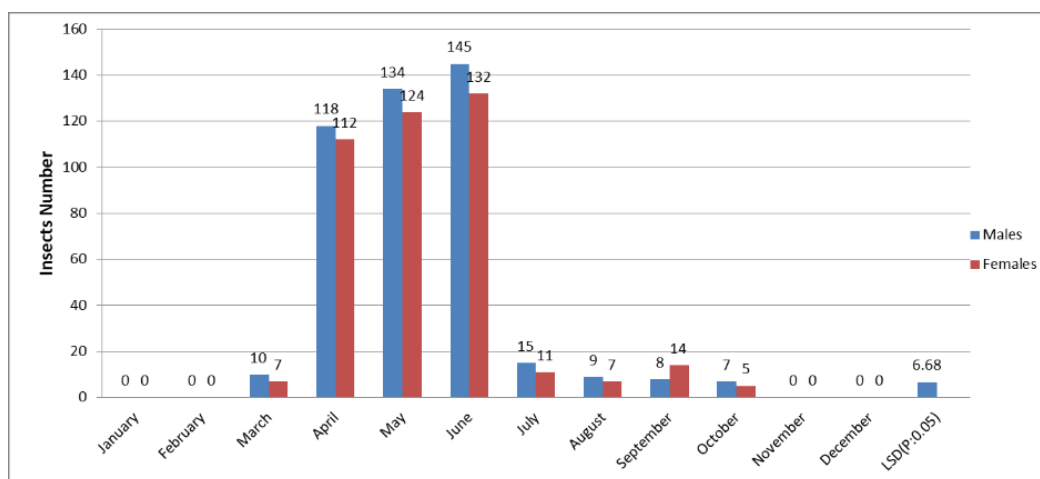


Figure (2) Population density and seasonal occurrence of males and females of *Pentodon sp* during the year 2021

Estimation of the population density of the species *Tanyproutus sp.* using light traps

The results in Figure (3) indicated that no adult insects of *Tanyproutus sp.* were recorded in light traps during January and February. The first appearance of adult palm borer was during the second half of February, when the number of hunted insects of males and females reached 7 and 5 adults /month, respectively, when the average maximum and minimum temperatures were 27.13 and 16.88 ° C and relative humidity 78.64% (table 3), then increase in their numbers continued during the March, in which the numbers of males and females were 10 and 14 adults / month, respectively, when the average maximum and minimum temperatures were 30.46 and 21.38 °C, and

the relative humidity was 71.35% (table 3) . Their numbers also increased during April and May with the increase in maximum and minimum temperatures to reach 49 and 41 adults/month, respectively, when the average maximum and minimum temperatures were 37.27 and 24.82 °C, and the relative humidity was 52.53% during the May. The numbers of males and females reached their peak during the June with a significant difference to reach 68 and 57 adults/month, respectively, when the average maximum and minimum temperatures were 43.57 and 27.32 °C, and the relative humidity was 46.55%. The numbers of *Tanyproctus* sp. adults began to decline gradually during the July, August and September to reach their lowest density in October, as the numbers of males and females reached 3 and 5 adults / month, respectively, when the average maximum and minimum temperatures were 25.94 and 20.29 °C and the relative humidity was 66.17%.

The seasonal presence and the increase in the number density of the three date palm borers belonging to the family Scarabaeidae with high temperatures and low relative humidity confirm the influence of environmental factors on the life and activity of palm borers. The increase in the number of adults during the June with a significant difference compared to the rest months is may be due to the emergence and activity of palm borers which spent the winter season in the adult stage , in addition, the emergence of adults during the March is consistent with what Khalaf et al. (2014) indicated that the emergence of adults in warm years as a result of drought and lack of rain in winter and that the decrease in population density between males and females during July and August is due to the frequent hunting of adults and their death by taking samples from the study areas, as well as the surrounding environmental conditions and the mating behavior that occurs during July and August, and after the females complete laying eggs, most of them die.

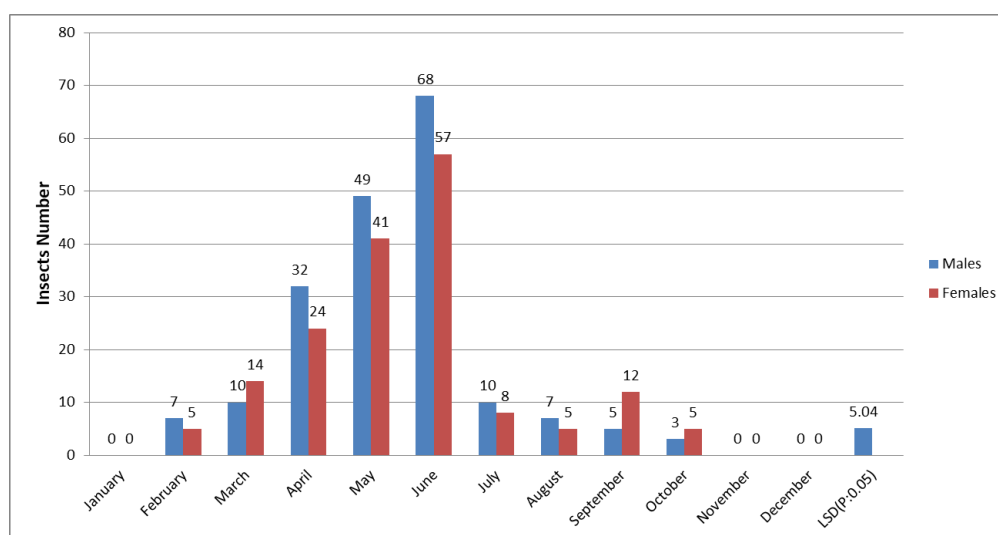


Figure (3) Population density and seasonal presence of males and females *Tanyproctus* sp during the year 2021

Evaluation of the efficiency of the light traps in attracting the palm borers adults

Figure (4) showed that the type of trap had a significant effect on attracting the adults of the three borers *O. elegans*, *Pentodon* sp, and *Tanyproctus* sp. The highest total of adults (male and female) hunted by IPM Russell traps during one year was for the two insects *O. elegans* and *Pentodon* sp. It reached 418 and 236.3 adults/trap, respectively, while the total of adults of the two insects in the local trap was 75.7 and 49.7 adults/trap, respectively. For the borer *Tanyproctus* sp, the local trap was superior on other trap in which the total number of hunted adults was 312 adults/trap compared to 50 adults in IPM Russell trap.

From the results it is clear that the IPM Russell trap has excelled in attracting the adults of the palm borers *O. elegans* and *Pentodon* sp, while the local trap has excelled in attracting the adults of *Tanyproctus* sp., this may be due to the type of lamps used, their luminous strength and the type of rays emitted (wavelength), as shorter wavelengths (ultraviolet, blue, and green light) are more visible to insects than longer wavelengths (yellow, orange, and red light), and therefore they are

more affected and attracted to them (Al-Kuraiti, 2015). Ali and Abdullah (1984) found that violet and ultraviolet rays attract the largest number of insects, while red rays attract low insects numbers, including household lamps, in addition to the different types of insects in the extent of their vision of different wavelengths.

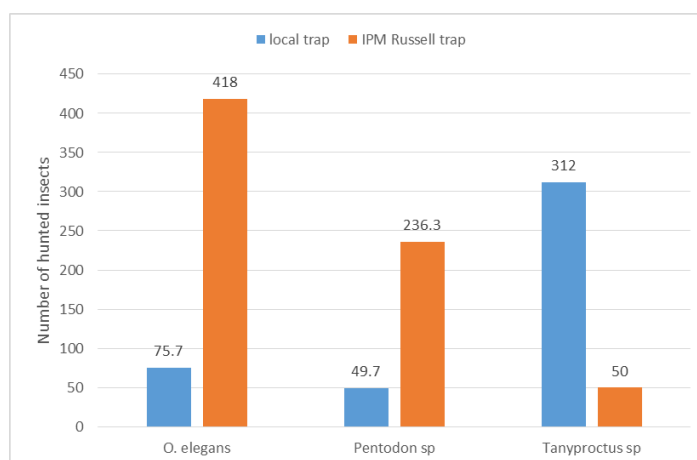


Figure (4) Number of adults caught in the two light traps (IPM Russell trap and local trap) during 2021

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مسح لأنواع حفارات نخيل التمر وتقدير كثافتها السكانية وتواجدها النسبي في بساتين النخيل في محافظة صلاح الدين

حيدر علي رضا 2

عبدالله عبد الكريم حسن 1

صفاء زكريا بكر 1

1 وقاية النبات- كلية الزراعة-جامعة تكريت- العراق

2مديرية زراعة صلاح الدين-العراق

الخلاصة

أجريت دراسة حقلية في بساتين نخيل التمر في محافظة صلاح الدين خلال المدة من 1 //10 2020 ولغاية 30 //10 2021 لمسح أنواع حفارات نخيل التمر وتقدير كثافتها السكانية وتواجدها النسبي خلال مدة الدراسة. أظهرت النتائج عن تشخيص ثلاثة أنواع من حفارات النخيل تعود الى غمدية الاجنحة من عائلة Scarabaeidae شملت *Oryctes elegans*، *Pentodon sp* و *Tanyproctus sp*، وبلغ التواجد النسبي للذكور والاناث للحفارات الثلاثة (53.00 ، 47.00% ، 51.98 ، 48.02%) و (52.76 ، 47.24 %) على التوالي ، وكانت اعلى كثافة سكانية للذكور واناث الحفارات الثلاثة خلال شهر حزيران بلغت (224 ، 192) ، (145 ، 132) و (68 ، 57) على التوالي، وبلغت النسبة الجنسية لكل من الحفارات الثلاثة 1:1(الاناث: الذكور). كان اعلى مجموع بالغات اصطادته مصائد IPM Russell خلال عام واحد للحشرتين *O. elegans* و *Pentodon sp* بلغ 418 و 236.3 بالغة/مصيدة على التوالي بينما بلغ مجموع البالغات للحشرتين في المصيدة المحلية 75.7 و 49.7 بالغة/مصيدة على التوالي، اما بالنسبة للحفار *Tanyproctus sp* فقد تفوقت المصيدة المحلية اذ بلغ مجموع البالغات المصطادة 312 بالغة/ مصيدة بينما بلغ 50 بالغة / مصيدة IPM Russell.

الكلمات المفتاحية:

انواع حفارات نخيل التمر ،
الكثافة السكانية، النسبة الجنسية ،
مصائد ضوئية