

Importance and seasonal population dynamics of great date moth *Arenipses sabella* Hampson (1901) (Lepidoptera: Pyralidae) in Jordan Valley

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Abstract. Field trips were conducted at two date palm farms in Jordan Valley from April, 1999 to December, 2000. In addition, random observations for field pest status from 2001 to 2014 were carried out, in order to show economic and pest status, and the population trends of the great date moth. Diagnostic characters for the great date moth were provided. Pest status for the great date moth was mentioned with injury descriptions. The great date moth was found to be from the five main insect pests attacking the date palm fruits. Population trends studies on the great date moth in Ghor Kabid and Baquarah Farms, in Jordan Valley, from April, 1999 and August, 2000, were reported. The study showed that there were two generations per year for the great date moth in each of the two farms. The highest peaks of alive larvae showed up for the first generation, which were during April, 1999 and April-May, 2000 in Ghor Kabid Farm and were at late May-early June, 1999 and in 2000 in Baquarah Farm. The highest adult peak occurred in mid-March, 1999 and 2000 in both date farms.

Keywords: Great date moth, Date palm, Economic importance, Population dynamics, Jordan.

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Introduction

Date palm tree *Phoenix dactylifera* L. is an important component of Arab world flora, belonging to Family Arecaceae. The genus consists of fourteen species distributed in the tropical and subtropical regions. In Jordan, there are many locations that have old date palm trees, but in the recent years, there is an expansion in its plantation especially in those areas that have suitable environmental conditions, mainly Jordan Valley, Aqaba and Azraq. The tree productivity fluctuates

from year to another due to the pest's status in the field (Al Antary et al., 2014a). The production also fluctuates and differs from location to another. Of these pests (arthropod pests) which recorded in Aqaba (Mustafa-Al Antary and Sharaf, 1994) were grey date scale *Parlatoria blanchardi* (Homoptera: Coccidae), almond moth *Ephestia (Cadra) cautella* (Lepidoptera: Pyralidae), Old World date mite *Oligonychus afrasiaticus* (Acari: Tetranychidae) and fruit stalk borer *Oryctes elegans* (Coleoptera: Scarabaeidae) (Al Antary et al., 2015). In addition, greater

date moth *Arenipses sabella* (Lepidoptera: Pyralidae) and lesser date moth *Batrachedra amydranula* (Lepidoptera: Cosmopterygidae) has been observed attacking date palm in Jordan Valley (Al Antary et al., 2014b). In addition, keys for identifying insect and arthropods pests of date palm were reported (Al Antary et al., 2014c) which would be helpful worldwide.

In spite of the economic importance of some insect pests of date palm, which threatening the trees plantation and expansion in Jordan, there is only one published report (Mustafa-Al Antary and Sharaf, 1994) about recording some insects attacking palm in Aqaba (Al Antary et al., 2015). However, few studies (Al Antary and Khawaldeh, 2014; Al Antary et al., 2014) have been conducted yet on the number of pests, number of generations, and distribution in different localities in Jordan (Al Antary et al., 2015). During conducting the research, Mustafa-Al Antary and Salamah (1999) recorded the destruction red palm weevil *Rhynchophorus ferrugineus* in Jordan, which considered as a key pest in many countries. Four pests were observed in the field. These are greater date moth *Arenipses sabella*, lesser date moth *Batrachedra amydranula*, Old World date mite *Oligonychus afrasiaticus* and grey date scale *Parlatoria blanchardi* in Aqaba (Al Antary et al., 2015). The first two attack the floral parts; the later attacks the fruits in the pre- and post- harvest phase. As a result, the production significantly decreases annually. Strumpel (1969) studied the pests of date palm in North Africa, recording three species of mite and five species of insects. El-Haidari and Al-Hafideh (1986) published a table in which the economic importance and distribution of the important date palm insects in the near east and North Africa were listed including the great date moth.

Adult of great date moth is about 18 mm long with wing expanse of 33-35 mm in the male and 40-42 mm in the female. Head and thorax are light pale brown and the abdomen silvery white (Hussain, 1974; Al-Azawi, 1980). The distribution of the greater date moth includes Egypt, Iraq, Kuwait, Saudi Arabia, Algeria, Iran and India (FAO, 1974; Kamel

et al., 1977; Badawi et al., 1979; El-Haidari and Al-Hafidh, 1986; Abdul Salam, 1993). The eggs were generally laid on the inner and outer sides of the tip of the spathes and on the young leaflets, which were also damaged by larvae (FAO, 1974). The larvae cause various types of damage to palms. It attacks the frond, spathe and date bunches. During March and early April, the larva mines into the tip of the unopened spathe. The examination of 182 spathes on 30 palms in Basra (Iraq) showed an infestation of 49% among spathes and 70% among palms (Hussain, 1963, 1974). The larvae feed sometimes on the dropped fruits in the top of the tree. In high infestation all fruits will be damaged. Sometimes the insect attacks new leaves (El-Haidari and Al-Hafidh, 1986). When infestation is heavy, the whole bunch will be withered and fruit shriveled and dried, but remained attached to strand (FAO, 1974).

The study objectives are to monitor the seasonal changes for the great date moth in the field and to include the number of generations and date of appearance. In addition, to investigate the pest status and its economic importance on date palm. These studies could be helpful in controlling this pest with the proper agricultural practices and other means of integrated pest management to avoid pesticide resistance and to minimize environment contamination with insecticides.

Materials and methods

Collecting sites

Collecting sites were from date palm groves in Al Baqurah 125 km, Deir-Alla 50 km, Wadi Fannush 50 km, Ghor Kabid 50 km, Karamah 70 km, South Shuna 70 km and Aqaba 330 km from Amman, the Capital.

Collecting methods

In each previously mentioned collecting site, once every one month for two years (1999-2000), date palm trees were examined for any mite or insect infestation. In addition, random observations for field pest status from 2001 to 2014 to show economic and pest status different mentioned 12 regions in Jordan.

Random samples were collected by the following methods:

a) The base of the stem, trunk, leaves, bunches and the top of the trees were checked for any pest infestation including the great date moth. Insects found were collected and killed by using the killing jar. Soft body-small insects were preserved in 70% alcohol. And some infested parts of the trees were brought to the laboratory.

b) Six light traps (20 W Bio-lab. design-USA, manufactured in Jordan) were used. Three light traps were placed in each of the two farms (Ghor Kabid Farm and Baqura Farm). The distance between each two traps was more than 50 m and about 1 km from the electricity source. The trap consisted of plastic body in which an aluminum funnel placed on. A transparent plastic sheets were arranged as Y shape placed on the funnel. Lights neon was placed on a specific place in the plastic sheets. Galvanized steel cap cover the top of the trap. These traps were used to capture moths and other insects. The killing agent was potassium cyanide with the rate of a teaspoon (about 10 g/killing jar/week) covered with few amounts of dry wood and jepsom. Insects collected were weekly examined in the laboratory, sorted out and identified. The insect collection extended for two years from April, 1999 to November, 2000.

Diagnostic characters

Diagnostic characters for the great date moth were given. These characters were obtained from examined specimens and literatures.

Population dynamics of the great date moth

Two locations were chosen to conduct this investigation for about two years. These were Al Baqura Agricultural Station (Baqura Farm) and Ghor Kabid Farm in Jordan Valley. These farms were visited regularly at 1-2 week's interval from April, 1999 to December, 2000.

Ghor Kabid Farm. The area of this farm is 45 ha (450 dunums), established in 1982, located in Ghor Kabid Area, about 10 km to the South of Arida

Triangle and 10 km North of Southern Shuna. There were about 1,000 date palm trees, 3 ha (30 dunums) of grab, 0.8 ha (8 dunums) and the rest of the area was planted with vegetables. Date palm trees irrigated by plastic pipes, no pesticides usage and the cultivars grown in this farm were 300 trees, 18 years old of Dejlat Noor cultivars brought from Tunisia, 30 trees, 3.5 years old of barhe cultivar brought from Iraq. 30 trees, 3.5 years old. 50 trees of Ghars cultivar brought from Algeria planted on the street sides. 23 trees of Maktoom cultivar brought from Saudi Arabia planted on the street sides. 100 trees of zagloli cultivar brought from Egypt, and 250 trees, 2.5 years old of Midgold (or Maghool) brought from USA. The fieldwork was carried out in this farm on Dejlat Noor cultivar. The tree distribution was 15 rows and 20 trees in each row.

Baqura Farm. This farm located in North Shuna agricultural directorate, about 1 km from the center of North Shuna to the North. The cultivars grown in this place were 2.7 ha (27 dunums) of grab and the rest of the area was planted with some citrus and vegetables. Date palm trees irrigated by flooding, no pesticides usage and the cultivars grown in this farm were Talal Red, Helwah, Dejlat Noor, Dejlat Musa, Khalkhe, Bahre, Kharib, Zainab, Faqer, Khestawi, Yabasi. Those trees were brought from several countries. The fieldwork was carried out in this farm on Bahre cultivar (12 years old). The tree distribution was 13 rows 12 trees in each row.

Great date moth sampling, examining and counting

Ten trees were randomly sampled in each visit 4 talehs (fluorescence of male date palm with pollens) from 4 bunches in different direction on each tree were examined. Larvae were counted in the field for the total of 40 talehs. 50 dropped fruits were randomly gathered from the ground placed in perforated plastic small bags, labeled and kept in the ice box to be transferred to the laboratory. Numbers of larvae were counted in the laboratory after examining. Adults found in the lights traps were separated, counted and recorded as a

total of the three lights traps in each location.

Meteorological data

Temperature and relative humidity data were obtained from the two meteorological stations Northern Shuna Station (300 m away from the field in Baqura) and Deir Alla Station (located 15 km from the Ghor Kabid).

Results

Diagnostic characters of the great date moth

Hind wing with vein 5 absent, forewing without a longitudinal fold in space 1 b. underside forewings with cell clothed with long fine hair-scales, more sparsely so in female, upper side forewing not as above. Forewings with vein 10 separate and arising from the cell. Vein 3, 4 and 5 more or less parallel and with the origins of vein 3 and 4 widely separated. Male with the forewing cell produced to a point at vein 5; lower discoidal vein present. Female forewing with vein 10 arising before the upper discoidal vein. Upper side forewing pale buff unmarked; upper side. Wing expand distance in males 34 mm and 40 mm in females, head and thorax slightly brownish light white, abdomen white, forewings very light white in colour, with corrugated edges, coastal region and median veins little dusted with black hairs, hind wings yellowish.

Materials examined: February-August in Jordan Valley and Aqaba in 2000, Al-Baqura in April 2012, 2013 and 2014.

Economic importance of the great date moth

Infesting stage: larvae.

Plant part and nature of infestation: It was observed that the larvae caused various types of damage. It attacked the fronds, spetha, bunches, and newly

recorded on attacking stem, dry fruits and the head of seedlings. After the spetha opening the larvae fed on the inflorescence or bored into the base of the fruit stalk, making a cylindrical dark mine as many of 27 small larvae were found. It did bore sometimes into the fruit stalk in Ghor Kabid Farm. Bunches so as Chemri were observed, which could be recognized by what could be called as a silken web, in which the larvae hide. Bores in the base of young fronds was seen fatal. Puparium was noticed high numbers on the stem and on the base of the old un-cleaned fronds. In Fannoush Area in Jordan Valley, the larvae seen to attack the stem itself, the stem was found attacked by other pest (*Urophorus humeralis*). The two pests were recorded for the first time attacking this part of the plant. Larvae were recorded attacking the head of new seedlings in Ghor Kabid. This also a new record for the pest attacking this part of the plant. The case was disaster. The seedlings were dead. Dry fruits were attacked by the larvae, all the fruit contents were attacked including the hard seed, and the outside (thin layer) was the only part not eaten.

Distribution and pest status:

Jordan Valley and Aqaba, 100% of trees were infested in Ghor Kabid Farm and Al Baqurah Farm. 45% and 55% of the bunches were found infested at the harvesting time. Recorded infestation was relied on symptoms.

Population Dynamics

Population fluctuation of great date moth in the Ghor Kabid Farm: Number of alive larvae per 40 bunches, average number of adults capture per light trap in Ghor Kabid Farm are shown on Figure 1. Average temperature (°C) and relative humidity in Dier Alla, in 1999/2000 are shown on Figure 2. Four larval and three adult fluctuations were observed. The highest peaks of alive larvae were in April, 1999 and April 2000. In the early season, the highest peak of captured adults was in February-April, 2000.

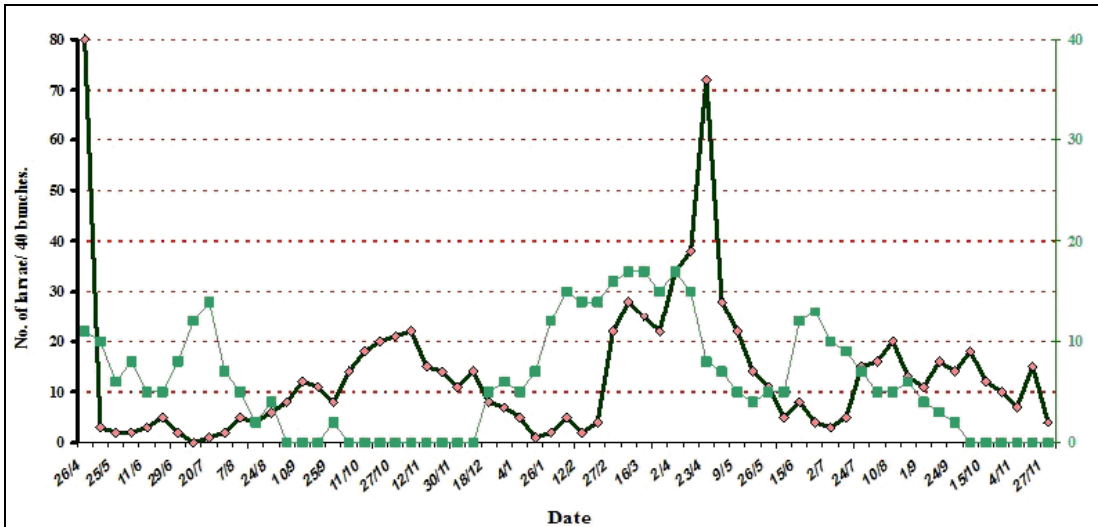


Figure 1. Great date moth populations fluctuations in Ghor Kabid in Jordan in 1999/2000.

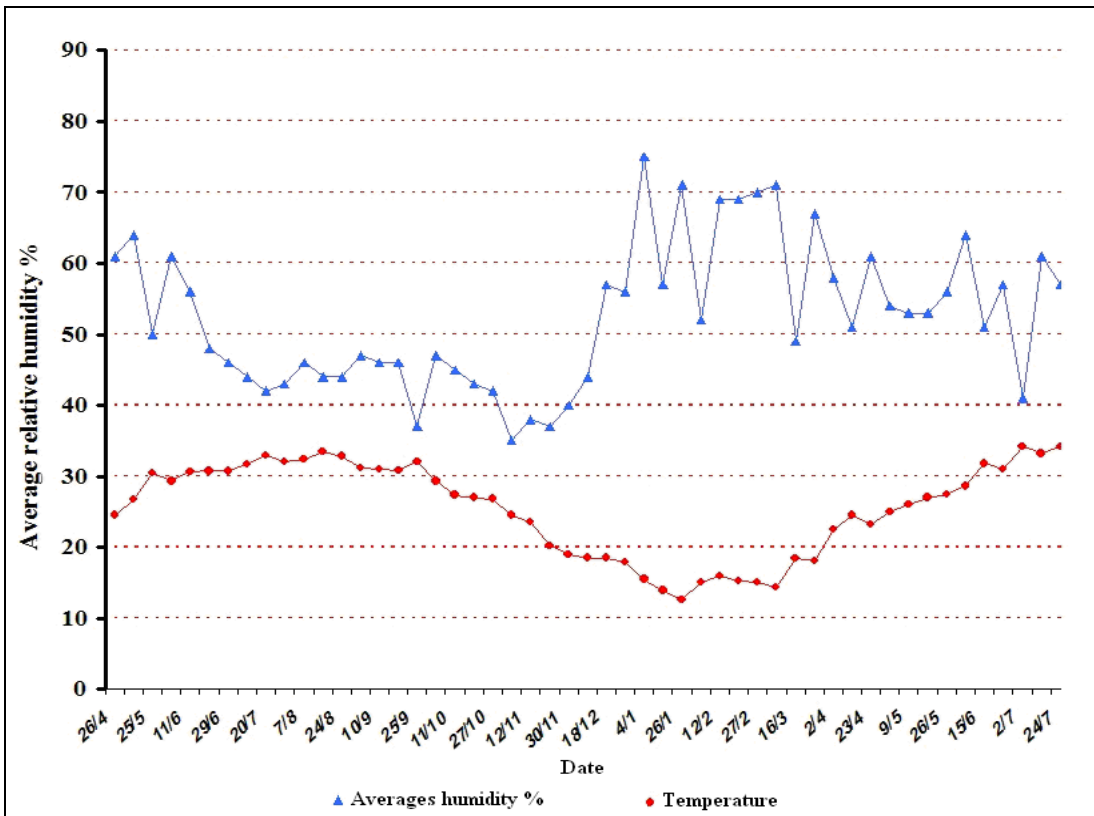


Figure 2. Average temperatures and relative humidity %/10 days in Ghor Kabid in Jordan 1999/2000.

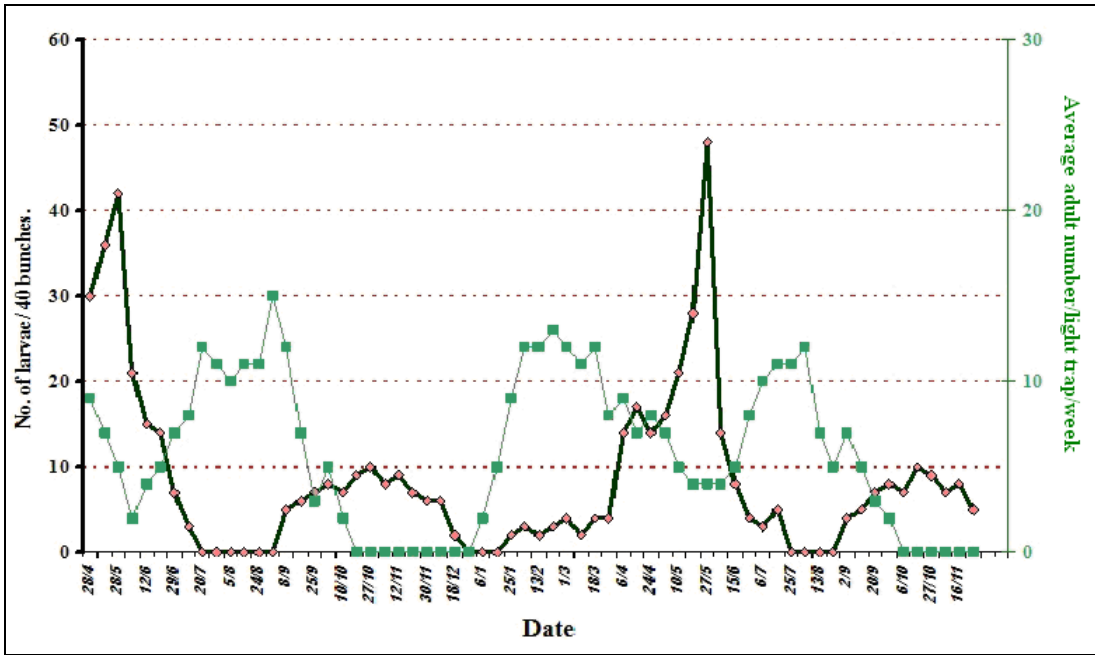


Figure 3. Great date moth population fluctuations in Baqurah in Jordan in 1999/2000.

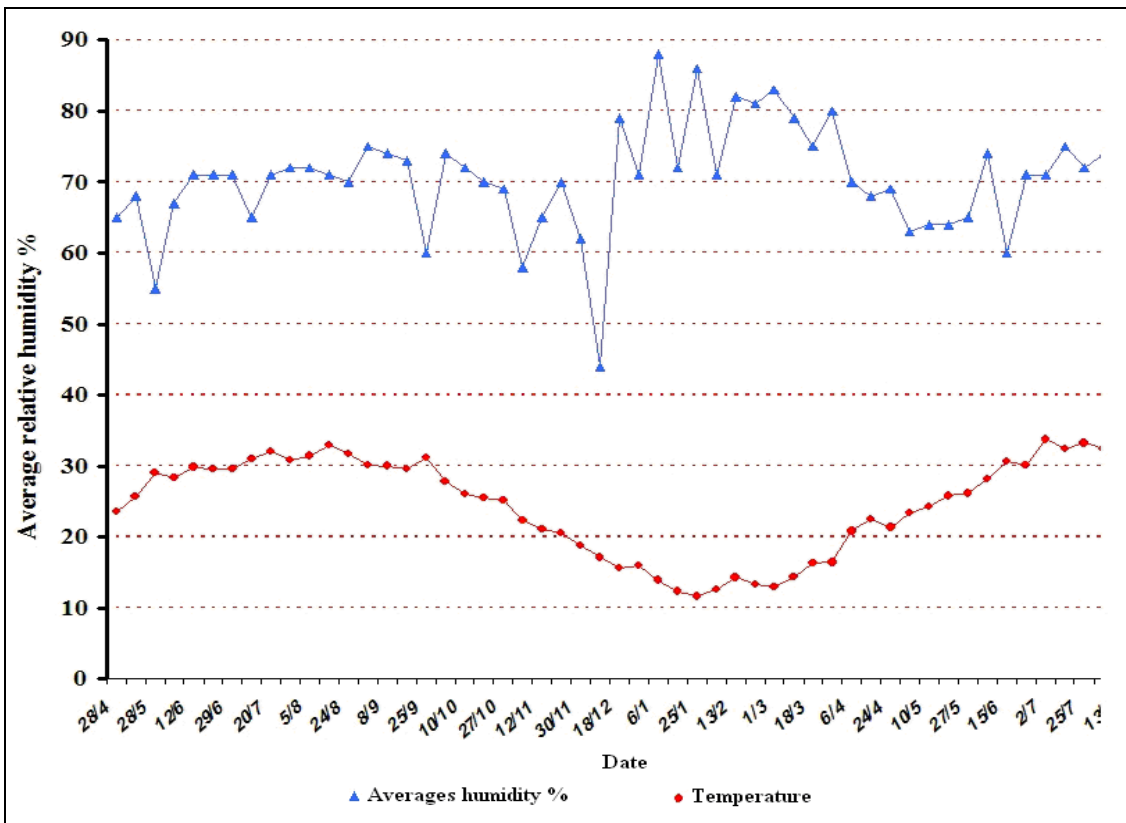


Figure 4. Average temperatures and relative humidity % /10 days in Baqurah in Jordan in 1999/2000.

Population fluctuation of great date moth in the Baqurah Farm. Number of alive larvae per 40 bunches, average number of adults capture per light trap in Baqurah farm are shown on Figure 3. Average temperature (°C) and relative humidity in Baqurah, in 1999/2000 are shown on Figure 4. Four larval and three adult fluctuations were observed. The highest peaks of alive larvae were in late May/early June, 1999 and late May early June, 2000. The highest peak of captured adults was in mid March.

Discussion

The actual number of species that occurs in Jordan can be closely estimated only by conducting a survey for long time, collecting materials from all date palm planted areas in Jordan. Also, it should be taken in consideration that new species might be introduced into the country with the introduction of plant materials from any area that could be infested with pests, as the case of some pests which will be discussed later.

Great date moth considered to be one of the most economically important pests in Jordan, all trees found infested in the Ghor Kabid and Baqurah Farms, 45% and 55% of the bunches found infested. Hussain (1974) found 70% of the trees were infested and 49% of the bunches were infested in Basra in Iraq. The consideration of this pest as a major pest did not agreed with some workers (Hussain, 1947; Kamel et al., 1977; El-Haidari and El-Hafidah, 1986) who consider it not as that important. These results agreed with FAO (1974).

They reported an outbreak and new record of this pest in India. The present results agreed with Bitaw and Ben Saad (1990) findings. They found that the insect occurred in all grooves visited in Libya. The larvae observed making severe damage. Several workers (FAO, 1974; Hussain, 1974; Kamel et al., 1977; Al Azawi, 1980; El-Haidari and El-Hafidah, 1986) agreed that the larvae attack the frond, spethe, date bunches and sometimes feed on the dropped fruits. In addition to that, in Ghor Kabid in Jordan, the larvae were observed attacking the stem itself with the association with pineapple beetle. The

two pests causing considerable damage to the top part of the stem. This was the first record for such injury. Larvae were also recorded for the first time attacking new seedlings in Ghor Kabid in Jordan, resulting that all attacked seedlings were dead.

These results were confirmed in University of Baghdad during the 2nd co-author visit to Iraq in 2000. During the Seventh Arab Congress of Plant Protection, Dr. Ibraheem Al Juburi of University of Baghdad declared that the importance of this pest were arisen and investigations were carried out to understand on the real economic situation to this pest in Iraq.

Great date moth alive larvae were observed to be active on date palm trees in Ghor Kobid Farm during the periods of April-May, 1999 and early March-early June, 2000 (Figure 1). This agreed with Al Azawi (1980) finding. He reported that it starts to appear active on bunches on March and April. The larvae were observed alive but not active as overwintering stage during the period from late August, 1999 to end of January, 2000, and from late July, 2000 to December, 2000. The highest peaks of alive larvae were occurred in April 1999 and in April-May 2000 when the average of 10 days temperature was between 25-29 °C in 1999 and between 25-28 °C in 2000. These results agreed with Al Azawi (1980) results, who observed the highest peak in late April in Baghdad. This might be due to similarities in the environmental condition between Baghdad and Ghor Kabid. These high two peaks might be due to the existence of the preferable fruit stages namely Talleh, Hababoak (4-5 weeks) and Chemri (5-6 weeks) stages. Another reason might be due to the preferable temperatures, which prevailed in that period. The results were also confirmed by the biological studies that discussed by Al Antary and Al-Khawaldeh (2014).

Flight activity of great date moth was monitored using three light traps were occurred in Dier Alla (Figure 1) during the periods July-September, 1999, late January-May, 2000 and July-early October, 2000. The highest peak was occurred in mid March. Great date moth alive larvae were observed to be active on date palm trees in Baqurah during the periods of April-June 1999 and 2000. The larvae were observed

alive but not active as overwintering stage during the period September, 1999-early January, 2000, and from September, 2000 and still observed in December 2000 (Figure 3). The highest peak of alive larvae were occurred in late May/early June 1999 and the same in 2000 when the average of 10 days temperature was between 26-31 °C in 1999 and between 25-31 °C in 2000. These high two peaks might be due to the existence of the preferable fruit stages namely Talleh, Hababouk and Khalal stages. Another reason might be due to the preferable temperatures, which prevailed in that period which confirmed by the biological studies conducted by Al Antary and Al-Khawaldeh (2014).

Great date moth which captured using three light traps were observed in Baqurah during the periods June-September, 1999, late January-early May, 2000 and July-early October, 2000. The highest peak was occurred in mid March (Figure 3).

The data samples used to study the fluctuations in great date moth in Ghor - Kabid and Baqurah showed that there were two main peaks/year, representing two generations. The first one was active and made the economic losses and the second one came late in the season. The insect overwintered as diapaused larvae. These results agreed with several authors (Hussain, 1974; Al Azawi, 1980). They found that there were two generations for this insect in Iraq, the second one was the overwintering generation, which took 6-8 months, larvae entered diapause to pass winter period. Also, the results agreed with Hussain (1963) and El-Haidari and Al-Hafidh (1986). They found two generations for great date moth in Iraq and Egypt. The active first generation was observed in April and May.

Conclusions and recommendations

Conclusions

Form the present results, the following points can be concluded:

1. Jordan located in the middle of the countries which had the most date palm trees numbers in the world. This might explain why there were relatively high

numbers recorded attacking date palm .The possibility of the introduction of new pest from other area is highly expected.

2. Great date moth was considered as one of the key pests due to the high infestation rates, that might exceed 100% of trees and 55% of bunches during the season. It was observed to infest fronds, sphethe and date bunches. For the first time infestation was also observed in the stem and new seedlings leading of the death of these seedlings. Light traps were good method for collecting the adults during the season.

3. There were two generations of great date moth per year. The first generation was the responsible for losses, and the highest peak of the alive larvae was during April/May in Ghor Kabid Farm and May/June in Baqurah Farm. Adult peak was in mid March in the two locations.

Recommendations

The following suggestions are recommended to help in minimizing the damage occurred to date palm trees in Jordan.

1. Using the study results to activate quarantine measures concerning date palm in borders between different areas in Jordan.

2. Removing the old leaf base on the trunk (Cleaning).

3. Light traps could be used in monitoring the first appearance of great date moth.

4. Many of the insects overwintered inside the tree head. Control measures could be used as oils.

5. Minimizing the insects pest population by using control measures is recommended for the first generation of great date moth which might start in March/April.

6. Date palm pests need more ecological studies.

7. Biological control studies should be encouraged.

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Conflict of interest statement

Authors declare that they have no conflict of interests.

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