

Economic importance and seasonal population trends of grey date scale *Parlatoria blanchardi* (Targioni Tozzetti, 1892) (Homoptera: Diaspididae) in Jordan Valley

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Abstract. Field visits were carried out in two date palm farms in the Jordan valley from April, 1999 to December, 2000. Additionally, random observations were done from 2001 to 2014 to assess economic and pest status, as well as changes in the population of the grey date scale *Parlatoria blanchardi* (Targioni Tozzetti, 1892) (Homoptera: Diaspididae). Diagnostic characters for the grey date scale were provided. Pest status for this scale was mentioned with injury description. The grey date scale was found to be from five main insect pests attacking the date palm tree. Population trend studies on the grey date scale in Ghor Kabid and Baquarah farm in Jordan Valley between April, 1999 and December, 2000 were reported. The study showed that there were five close overlapped generations per year in the first farm and four overlapped generations in the 2nd farm. The highest peak of alive crawlers (first nymphal instar) was in mid May, 1999 and in late April, 2000 in the first farm. For alive 2nd nymphal stage and females, the highest peaks occurred in late June, 1999 and in late April and late June, 2000. In Baquarah (the 2nd farm), the highest peak of alive crawlers occurred in mid May, 1999 and in late April, 2000. For alive 2nd nymphal stage and females, the highest peak occurred in early June, 1999 and in late May, 2000.

Keywords: Grey date scale, Date palm, Economic importance, Population trends, Jordan.

1. Introduction

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 and Aqaba. The tree productivity fluctuates from year to year due to the status of pests in the field. The productions also fluctuate and differ from

one location to another. Some of these pests (arthropod pests) already recorded in Aqaba (Mustafa-Al Antary and Sharaf, 1994) are grey date scale *Parlatoria blanchardi* (Homoptera: Diaspididae), almond moth *Ephistia (Cadra) cautella* Walker (Lepidoptera: Pyralidae), Old World date mite *Oligonychus afrasiaticus* (McGregor) (Acarina: Tetranychidae), and fruit stalk borer *Oryctes elegans* Perll. (Coleoptera: Scarabaeidae). In addition, greater date

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moth *Arenipses sabella* Hampson (Lepidoptera: Pyralidae) and lesser date moth *Batrachedra amydraula* Meyric (Lepidoptera: Cosmopterygidae) have been observed attacking date palm in Jordan Valley.

In spite of the economic importance of some insect pests of date palm, due to threats they inflict to the trees plantations and to its expansion in Jordan, there is only one published report (Mustafa-Al Antary and Sharaf, 1994) about the recording of some insects attacking date palm in Aqaba. However, no studies have been conducted yet on the number of pests generations and the distribution in different localities in Jordan. During their research, Mustafa-Al Antary and Salameh (1999) recorded the destructive red (Indian) palm weevil in Jordan (*Rhynchophorus ferrugineus* F.), which is considered as a key pest in many countries. Four pests were observed in the field and these are the greater date moth *Arenipses sabella*, lesser date moth *Batrachedra amydraula*, old world date mite *Oryctes afrasiaticus* in Aqaba and grey date scale *Parlatoria blanchardi*. The first two attack the floral parts; the later attacks the fruits in the pre-and post-harvest phase and, as a result, the production significantly decreases annually.

Adult female of grey date scale is 0.8 mm long (Hussain, 1974; Avidov and Harpaz, 1969), cream yellow to dark red, and covered with an oval or elongated flat scale, which is 1.2-1.6 mm long and grey with a dark spot in the middle (Hussain, 1974). The grey date scale insect was distributed in Iraq Arabian Peninsula, Egypt, North Africa, Iran, Sudan, Pakistan and USA (Hussain, 1974), Palestine (Avidov and Harpaz, 1969; Kehat, 1968), Niger (Kaufmann, 1977), India (Batra and Sohi, 1974), and Jordan (Al Antary et al., 2014). Nymphs and adults suck the sap from the leaflet, midribs and the dates. A discolored area appears on the leaflet under each scale insect. Heavy infestation causes the leaflets to turn yellow and contributes to the prematurely dying of the fronds. Stunted growth was noticed on off shoot heavily infested with the grey date scale; but such heavy infestation did not cause the death of date palms or off shoots (Hussain, 1974).

Infestation among date palm with the grey date scale was 70-100% in the middle and southern regions of Iraq (Hussain, 1974). Dabbour (1981) conducted a study about the distribution of insects on date palm trees; he found that the smallest numbers of insect were found at the top of the trees. Besides leaflets, it infested fruits thus lowering down their market price. The average number of individuals of various stages (except eggs) per unripe fruit was 1-22.5. As fruit maturation proceeded, the number of individuals decreased until it became zero on ripe fruits (Swyir et al., 1982). There was two generations per year in Iraq (Al-Sousi, 1965). Hussain (1974) mentioned that there were four generations in the middle region in Iraq, 4-5 generations in Palestine (Avidov and Harpaz, 1969). Abdoul-Ahed and Jassim (1983) conducted a study which revealed that it had 5 overlapping generations a year.

The study objectives are to monitor the seasonal changes for the grey date scale in the field and including the number of generations and date of appearance, and 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.

2. Materials and methods

2.1 Collecting sites

Collecting sites are Baqurah 125 km, Deir-Alla 50 km, Wadi Fannush 50 km, Ghor Kabid 50 km, Karameh 70 km, South Shuna 70 km, and Aqaba 330 km from Amman, the capital. The survey was mainly concentrated on the Jordan Valley main date palm groves. Some materials were also collected from Aqaba and these localities had several unidentified date palm cultivars.

2.2 Collecting methods

In each collecting site, once a month for two years (1999-2000), date palm trees were examined for any mite or insect infestation, including the grey date

scale. Random samples were collected by the following methods:

a) The base of the stem, stem trunk, leaves, banches and the top of the trees were checked for any pest infestation. Found insects were collected and killed by using the killing jar. Soft body-small insect were preserved in 70% alcohol. Some infested parts of the trees were brought to the laboratory for more examination. Random observations for field pest status were carried out from 2001 to 2014 in different parts of Jordan cultivated with date palm trees.

b) The farmers or governmental staff from Ministry of Agriculture collected insets sometime. These materials were considered as part of the survey, collector name was written on each sample.

2.3 Labeling

Collected samples were labeled with following data: the name of the locality, date of collecting, part of the tree in which the material was collected and other field notes.

2.4 Specimens preparation

a) Sorting

Adults of each arthropod collected on date palm trees were sorted preliminary into different morphs that are suspected to be a different species.

b) Preservation and pinning

Some of the specimens collected from date palm trees were permanently preserved in 70% alcohol. Other specimens were pinned or prepared on slides when needed especially for scale insects and mite materials.

2.5 Diagnostic characters

Diagnostic characters of the grey date scale were given. These characters were obtained from examined specimens and literatures.

2.6 Population dynamics

a) Location

Two locations were chosen to conduct this investigation on the grey date scale for about two years. These were Baqurah Agricultural Station (Baqurah Farm) and a farm in Kabid Valley (Ghor

Kabid Farm). These farms were visited regularly at 1-2 weeks interval from April, 1999 to December, 2000.

I - 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 1000 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 were irrigated by plastic pipes, no pesticides usage and the cultivars grown in this farm were 300 trees, 18 year old of Dejlat Noor cultivar brought from Tunisia, 30 trees 3.5 year old of Barhe cultivar brought from Iraq. Another 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 year old of Midgld (or Maghool) brought from USA. The field work was carried out in this farm on Dejlat Noor cultivar, the tree distribution was 15 rows and 20 trees in each row.

II - Baqurah Farm

This farm is 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 27 dunums of grab and the rest of the area was planted with some citrus and vegetables. Date palm trees were irrigated by flooding, no pesticides usage and the cultivars grown in this farm were Talal red, Helwah, Dejlat Noor, Dejlat Musa, Khalkhe, Barhe, Kharib, Zainab, Faqer, Khestawi and Yabasi. These cultivars were brought from several countries. The field work was carried out in this farm on Barhe cultivars (12 year old). The tree distribution was 13 rows and 12 in each row.

b) Grey date scale sampling, examining and counting

Four trees were randomly chosen in each visit from the two above mentioned farms. Four leaflets of four leaves in the different directions on each tree were sampled, placed in the perforated plastic

small bags, labeled and kept in the Ice Box to be transferred to the laboratory. The number of scale insects were counted under the dissecting binocular microscope on the base of the insects covered with the scale (2nd nymphal instar-adult) and the insects under the females (1st nymphal instars).

c) Meteorological data

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

3. Results

3.1 Diagnostic characters

Parlatoria blanchardi (Targioni Tozzetti, 1862), *Parlatoria proteus palmae* Maskell, 1898, *Parlatoria palmae* McKenzie, 1945.

Diagnostic characters: Oval or elongate flat grey scale, slightly convex (female: 1.2-1.6 mm. Male 0.95-1 mm long) with dark spots in the middle of surface, female (under the scale) is cream yellow to red 0.7-0.85 mm long and 0.5 mm wide.

Material examined: A round the year in Jordan Valley, the University of Jordan Farm in AlGhor, May, 2013, Wadi-Shaeb, May, 2013, and Aqaba.

3.2 Economic importance

P. blanchardi: Grey date scale.

Infesting stage: Adult and crawlers.

Plant part and nature of infestation: it was observed that it did suck the sap from the leaflet, midrib and the dates, under the scale, a discolored area was observed on leaflet, turned yellowish then darker as a sign of dryness. Heavy infestation caused the frons to prematurely dying. This scale was found mainly on the leaflet especially the basal part.

Distribution and pest status: it was observed in all the fields in Jordan Valley and Aqaba, from all visits from 1999 to 2014.

3.3 Population dynamics

a) Population fluctuation of grey date scale in the Ghor Kabid Farm

The number of alive first and second nymphal instar scale and adult female scale per 16 leaflets, average temperature and relative humidity in south Shuna, in 1999/2000 are shown in Figure 1. Nine fluctuations were observed. The highest peaks of alive first nymphal instar was in late May 1999 and late March and mid-June, 2000. Also the population density of alive second and female scale were high in July, 1999 April and June, 2000.

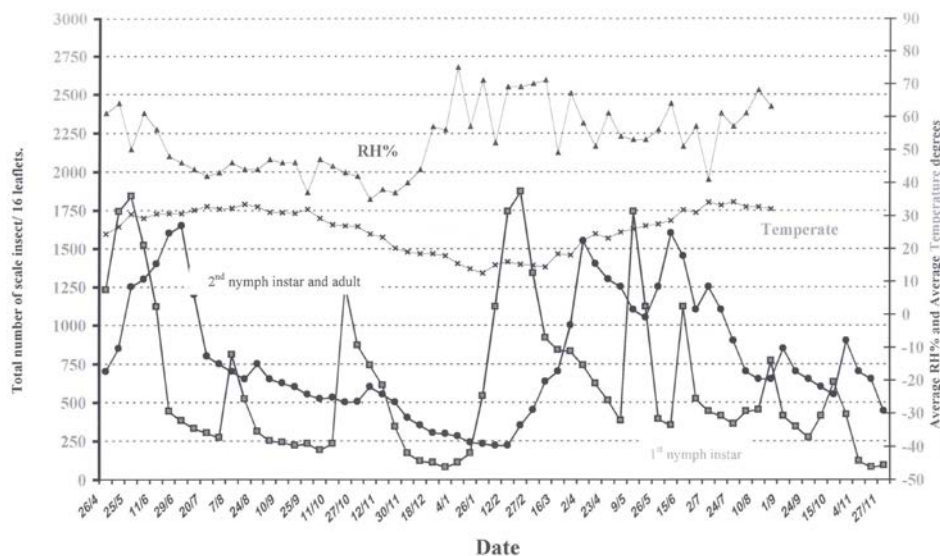


Figure 1. Grey scale population fluctuation in Ghor Kabid Farm, in 1999/2000.

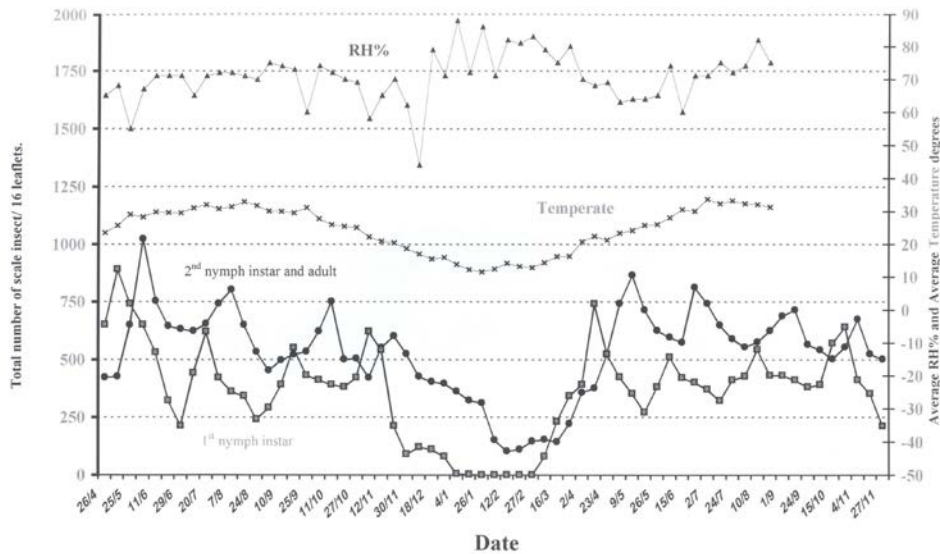


Figure 2. Grey scale population fluctuation in Baqurah Farm, in 1999/2000.

b) Population fluctuations of grey date scale in Baqurah Farm

Number of alive first nymphal instar scale second and adult female scale per 16 leaflets, average temperature and relative humidity in Baqurah in 1999/2000 are shown in Figure 2. Eight fluctuations were observed the highest peak of alive first nymphal instar was in May, 1999 and April/May, 2000. Also the population density of alive second and female scale were high in June, 1999 and May, 2000.

4. Discussion

The actual number of pest species on date palm trees that occurs in Jordan could 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 locally or abroad that could be infested with pests. Three insect pest species and one mite species were recorded from Jordan. Mustafa-Al Antary and Sharaf (1994) recorded three insect species and one mite from Aqaba area, namely *P. blanchardi* (Targioni Tozetti) (grey date scale), *O. elegans* Prell (fruit stalk borer), *E. cautella* (Walk) (almond or fig moth),

and *Olygonychus* (*Paratetranychus*) *afrastriticus* (Mc Gregor) (old world date mite).

Grey date scale was observed in all visited fields in Jordan it is considered one of the main economically important pests in Jordan, what is in agreement with Mustafa-Al Antary and Sharaf (1994). They reported that this infestation weakened the vegetative growth. Also, it was the major scale insect of the three recorded scale insects attacking date palm not only in Jordan but in the whole region. These results agreed with Kehat (1968) findings who considered this pest as the main pest attacking date palm in Palestine (before the introduction of red palm weevil). Al-Sousi (1965) found that this pest was more economically important than the other two recorded scales in Iraq what was confirmed by Abdul-Ahed and Jassim (1983) whom stated that this pest was very important in all date palm areas in the world except USA (irradiated). Hussain (1974) found that 70-100% of date palm trees were infested in the middle and southern region of Iraq. Bitaw and Ben-Saad (1990) found this pest in all visited fields in Libya with medium to very high population. This pest sucks the sap from the leaflet, midrib and the dates, heavy infestation caused the frons prematurely dying. Hussain (1974) added that heavy infestation of small seedlings retarding development dwarfing and death.

Avidov and Harpaz (1969) mentioned that, the insect is unable to cause death of the palm but it seriously stunts its development.

Abdul-Ahed and Jassim (1983) relied on first nymphal instar to study the fluctuations of grey date scale in Iraq they found that the crawlers left the female scale after one day of hatching. They also found that at all generations the hatching period was the same (three days). El Haidari and Al Hafidh (1986) found that crawlers took 36 hours to leave the female scale. So, first nymphal instar, that under the female scale, were counted instead of eggs to ease the work. Grey scale insect alive first nymphal instar (crawlers) were observed to be active on date palm trees leaves throughout the year in Baqurah except that during the period of late December-mid February, 1999/2000 (Figure 1), when the average of 10 days temperature was between 14-16.5 °C. This result agreed with Hussain (1974) findings in middle region of Iraq, who found the grey date scale crawlers active during the year except the period from early November to late June. The highest peaks of alive first instar nymph were occurred in mid-May, 1999 and in late April, 2000, when the average of 10 days temperature was between 22-26 °C in 1999 and between 20-25 °C in 2000. This result agreed with Hussain (1974) findings who found that the highest peak was during April in middle region of Iraq. These two high peaks might be due to the existence of the preferable environmental conditions. Also environmental condition might be considered the main reason of the high mortality in the late peak (November, 1999 and 2000) at early winter.

Grey scale insect alive second nymphal instar and female were observed to be active on date palm trees leaves throughout the year in Baqurah except that during the period of late December-mid late March (Figure 2) in which only second nymphal instar was observed as the stage in which the insect overwintering with. Females were not observed alive in this period and started to be observed only after mid March. This result agreed with Hussain (1974) findings, who found that the activity deceased during the period from late December to late March in middle region of Iraq. He added the second nymphal inster

was the overwintering stage. The highest peaks of alive second instar nymph and females occurred in early June, 1999 and in late May, 2000 when the average of 10 days temperature was between 25-29 °C in 1999 and between 23.5-26 °C in 2000. El Haidari and Al Hafidh (1986) found that the highest peak during May/June period in Iraq these high two peaks might be due to the existence of the preferable environmental conditions. Also environmental condition might be considered the main reason of the high mortality in the late peak (early December, 1999 and November, 2000) at early winter.

Alive first nymphal instar of grey scale insect was observed to be active on date palm trees throughout the year in Ghor Kabid expect that during the period of late December- late January, 1999/2000, when the average of 10 days temperature was between 12-18 °C. This result agreed with Abdul-Ahed and Jassim (1983) findings. They found that the crawlers activity was not observed during the period of early December to early January in Iraq the highest peaks of live first instar nymph occurred in mid-May, 1999 and in early April, 2000, when the average of 10 days temperature was between 29-32 °C in 1999 and between 25-29 °C in 2000 (Figure 1). These high two peaks might be due to the existence of the preferable environmental conditions. Also environmental condition might be considered the main reason of the high mortality in the late peak (late November, 1999 and 2000) at early winter. Avidov and Harpaz (1969) found that high mortality of carwlers was observed in late summer and early winter Palestine. Alive second nymphal instar and females of grey scale insect were observed to be active on date palm trees throughout the year in Ghor Kabid except that during the period of late December - mid late February in which only second nymphal instar was observed as the stage in which the insect overwintered. Females were not observed alive in this period and started to be observed only after early March. This result agreed with Abdul-Ahed and Jassim (1983) finding. They found that the females were not observed during the period of early December to early February in Iraq. The highest peaks of alive second nymphal

instar and females were noticed in late June, 1999 late April and late June, 2000, when the average of 10 days temperature was between 29-32 °C in 1999 and between 25-29 °C in 2000. These high three peaks might be due to the existence of the preferable environment conditions. Also environmental condition may be considered the main reason of the high mortality in the late peak (mid November, 1999 and late November, 2000) at early winter. Avidov and Harpaz (1969) found that high mortality of crawlers were observed in late summer and early winter in Palestine. Abdul-Ahed and Jassim (1983) related the high mortality to the decrease of temperature degrees which caused reduction in the biological activity of the insect.

The data of samples used to study the fluctuations of grey date scale immature and females moth in Ghor Kabid and Baqurah showed that there were five main peaks/year, representing five close overlapped generation in Ghor Kabid and four main peaks/year, representing four close overlapped generations/year in Baqurah. This result disagreed with Al-Sousi (1965) findings, who found two generation in Basra and Baghdad in Iraq, but agreed with findings of Abdul-Ahed and Jassim (1983) who found five close overlapped generations in Iraq. Avidov and Harpaz (1969) found four to five overlapped generations in Palestine. Hussain (1974) found four overlapped generations in the middle regions of Iraq. The insect overwintering stage was the second nymphal instar. This agreed with Hussain (1974) findings in middle regions of Iraq. The first and second generations were the highest and might be considered the most economically important this agreed with Al-Sousi (1965) findings, who found that the high density which responsible of the economic damage was in the period of May and July. The difference in the prevailing environmental conditions might be the reason that there were five generations in the south and four generations in the north. The same reason might be responsible to the case of the difference in the number of generations from four to five in the surrounding countries.

When running a regression analysis for climatic parameters (temperature and R.H%, separately) versus date palm scale % infestations, it was found the following:

1. r^2 for the correlation between % infestation of 2nd nymphal instar and adult versus temperature during the period between December 9, 1999 up to August 20, 2000 was positively moderate (0.42) (Figure 1). In case of R.H.% the r^2 was positive weak (0.04) at the same previous period, while it was positive strong (0.58) during the period between April 4, 1999 up to December 9, 1999 (Figure 1). For overall (April 26, 1999 up to August 20, 2000), The r^2 were positive moderate (0.27) and positive weak (0.10) for temperature and R.H.%, respectively for 2nd nymphal instar and adult, and 1st nymphal instar infestation % (Figure 1).

2. Other correlations were weak at periods between December 4 and December 9, 1999, December 9, 1999 and August 20, 2000, and overall (April 26, 1999 to August 20, 2000) for temperature and R.H.% with % infestations of 2nd nymphal instar and adult, and 1st nymphal instar infestation, separately analyzed.

3. r^2 for the correlation between % infestation of 2nd nymphal instar and adult versus temperature during the period between December 9, 1999 up to August 20, 2000 was positively strong (0.58) (Figure 2). In case of R.H.% the r^2 was negative weak (0.14) at the same previous period, while it was negative weak (0.21) during the period between April 4, 1999 up to December 9, 1999 (Figure 2). For overall (April 26, 1999 up to August 20, 2000), the r^2 were positive moderate (0.45) and positive moderate (0.39) for temperature and R.H.%, respectively for 2nd nymphal instar and adult, and 1st nymphal instar infestation % (Figure 2).

4. Other correlations were weak at periods between December 4 and December 9, 1999, December 9, 1999 and August 20, 2000, and overall (April 26, 1999 to August 20, 2000) for temperature and R.H.% with % infestations of 2nd nymphal instar and adult, and 1st nymphal instar infestation, separately analyzed.

In conclusions, climatic factors, particularly temperature and R.H.% do affect the percentage of infestation for grey scale stages in a correlation ranged from weak to moderate and sometimes strong in the two date palm farms in Jordan, depending on the infestation period and the grey scale stages.

5. Conclusions and recommendations

5.1 Conclusions

From the present results the following points can be concluded:

1. Jordan is located in the middle of the countries which had the most date palm trees number in the world. This might explain why there was relatively high number all pests attacking date palm.

2. Grey date scale was the main scale pest attacking date palm trees in Jordan.

3. There were five close-overlapped generations of grey date scale per year occurring in Ghor Kabid farm and four generations year occurred in Baqurah. The highest peaks of alive crawlers occurred in late April/mid May. The highest peaks of alive second nymphal instar and females occurred in late April and June in Ghor Kabid and May/June in Baqurah farms.

5.2 Recommendation

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 trees in borders and between different areas in Jordan.

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

3. Minimizing the insect pest population by using control measures is recommended for the first generation of grey date scale, which might start in April/May.

4. Date palm pests need more ecological studies.

5. 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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