



Egyptian Journal of Plant
Protection Research Institute

www.ejppri.eg.net



Coccoidea species infesting ornamental plants in the Royal greenhouse, Al-Montaza palace garden, Alexandria, Egypt with new hosts record and a key of the adult female Coccoidea

Soad, I. Abdel-Razak^{1 2}

¹Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

²University of Hafr Albatin, Faculty of Science, Biology Dept., Saudi Arabia.

ARTICLE INFO

Article History

Received: 8 / 11 /2020

Accepted: 29 / 12 /2020

Keywords

Coccoidea ,ornamental plants , new hosts record a taxonomic key . Alexandria and Egypt

Abstract:

This Investigation covers a survey of the scale insects (Hemiptera:Coccoidea) infesting ornamental plants in the Historical Royal greenhouse at Al-Montaza Palace garden, Alexandria Governorate, Egypt. A total of nine Coccoidea species following nine genera belonging to 3 families were observed infesting twenty ornamental plants in the greenhouse. New hosts recorded for the first time during the study as well as a key of the adult female Coccoidea to help in future investigations and identification in Egypt were given.

Introduction

The Royal greenhouse at Al-Montaza garden, Alexandria Governorate, Egypt concedes one of the most historical touristic attractions in Egypt. In 1934 King Fouad established the Royal greenhouse to become the most magnificent nature reserves. It is in the Eastern side of Montaza palace garden in Alexandria, Egypt. It is about one faddan with ten-meter-high, with glass roof. It includes rare species of palm trees and finest rare ornamental plants species. Insect pests are regarded as one of the important injurious responsible for the deterioration of ornamental plants especially in greenhouses, the warm, humid conditions and abundant food in inside provide an excellent, stable environment for pest development. Out of that pests, the Coccoidea which constitute the most common insect pests of ornamental plants (Mourad *et al.*, 2001 and Abdel-Razak, 2000).

Scale insects have been reported as serious pests attacking a huge number of host plants around the world (Miller *et al.*, 2002; Miller, 2005; Germain, 2008; Kondo *et al.*, 2008; Franco *et al.*, 2009; Pellizzari and Germain, 2010; Mazzeo *et al.*, 2014 and Mansour *et al.*, 2017). These insects are found on various parts of their hosts, and infest leaves, twigs, branches and roots (Kondo *et al.*, 2008). They feed almost exclusively on the phloem of their host plants to which they cause direct damage, but they can also cause indirect damage by transmitting plant pathogens through injection or through the build-up of honeydew (Ross *et al.*, 2010). Overall, scale insects that have worldwide been reported as economically important belong to the families Diaspididae, Coccidae, and Pseudococcidae. Soft scales and mealybugs secrete large amounts of honeydew on which a black fungus, known as "Sooty mould" grows. The

fungus covers the leaves and reduces their photosynthetic ability (Abdel-Razak, 2007). Gutierrez and Ponti, (2014) stated that, climate change is expected to alter the geographic distribution and abundance of many species, to increase the invasion of new areas by exotic species and in some cases, to lead to species extinction as well as the world-wide commerce can spread the injurious Coccoidea over the earth, as they are so easily carried with many different ways. Therefore, identification morphological keys to identify exist and nonsexist adult female Coccoidea species must be considered to help in the future identification.

Therefore, the present study was initiated for surveying and identifying Coccoidea species associated with ornamental plants and palm ornamental species in the Royal greenhouse at Al-Montaza garden to help in preserve the natural historical magnificent of that place for better controlling the found Coccoidea species.

Material and methods

In order to survey the Coccoidea species infesting ornamental plants and rare palm ornamental inside the Royal green house at Al-Montaza palace garden, Alexandria Governorate, Egypt. A total of 70 ornamental plants and palms ornamental were chosen belonging to 10 plant families. The surveyed plants for the study were, *Adiantum* sp. , (Pteridaceae), *Codiaeum variegatum pictum* , (Euphorbiaceae), *Polyscias balfourina*, *Schefflera actinophylla*, (Araliaceae), *Monstera acuminata deliciosa*, *Anthurium andraeanum*, *Anthurium pentaplyllum*, *Epipremnum aureum*, *Dieffenbachia seguine*, (Araceae), *Sanchezia speciose*, (Acanthaceae), *Beaucarnea recurvate*, *Dracena Marginata*, (Asparagaceae), *Nephrolepis exaltata*, (Nephrolepidaceae), *Howea belmoreana*, *Caryota mitis*, *Chamaedorea elegans*, *Dypsis lutescens*, *latania borbonica*, (Arecaceae), *Zamia fairchildiana*, (Zamiaceae), *Ficus benjamina*, (Moraceae) (Table 1).

Table (1): Host plant families selected to survey Coccoidea species at the Royal greenhouse, El-Montaza palace garden, Alexandria, Egypt.

Plant families	Host plants				
Acanthaceae	<i>Sanchezia speciose</i>				
Araceae	<i>Monstera acuminata deliciosa</i>	<i>Anthurium andraeanum</i>	<i>Anthurium pentaplyllum</i>	<i>Epipremnum aureum</i>	<i>Dieffenbachia seguine</i>
Araliaceae	<i>Polyscias balfourina</i>	<i>Schefflera actinophylla</i>			
Arecaceae	<i>Howea belmoreana</i>	<i>Caryota mitis</i>	<i>Chamaedorea elegans</i>	<i>Dypsis lutescens</i>	<i>latania borbonica</i>
Asparagaceae	<i>Beaucarnea recurvata</i>	<i>Dracena Marginata</i>			
Euphorbiaceae	<i>Codiaeum variegatum pictum</i>				
Moraceae	<i>Ficus benjamina</i>				
Nephrolepidaceae	<i>Nephrolepis exaltata</i>				
Pteridaceae	<i>Adiantum cuneatum</i>				
Zamiaceae	<i>Zamia fairchildiana</i>				

The Survey of the studied plants started from March, 2013 up to February, 2014. Five ornamental and palm plants of each species were chosen to the survey study.

Five leaves and five small branches were picked out at random or counting in the greenhouse depending on the rare of the plant at two weeks 'intervals.

Samples and collecting insects transferred to the laboratory for counting and classifying the existing individuals of detected species. Both upper and lower surface of the leaves were examined.

As for classifying the collected species, either temporary or permanent slides making techniques were made of the mature adult female as stated by McKenzie, 1969; Ezz, 1965 and Sirisena *et al.*, 2013 and examined microscopically and then classified taxonomically using scale insect's keys.

In order to design a key to the adult female Coccoidea for identify exist and nonsexist adult female Coccoidea species in Egypt .

For helping in the future identification, information for the character was compiled from the literature, Hall, 1922, 1924, 1925, 1926a, 1926b, 1926c; Ferris, 1950, 1953; McKenzie, 1956, 1969; Ezzat, 1958; Ezzat and Hussein, 1969; Ezzat and Nada, 1986; Watson, 1988; Mohammad and Ghabbour, 2008; (Monammad *et al.*, 1995; Williams and Watson, 1990; Williams and Hodgson, 1994; Hodgson, 1994; Mohammad and Nada, 1995 and Mohammad *et al.*, 1997.

Results and discussions

Data in Table (2) asserted that a total of nine Coccoidea species following nine genera belonging to 3 families were observed infesting twenty ornamental plants in the Royal greenhouse at Al-Montaza palace garden, Alexandria, Egypt from March, 2013 up to Feb, 2014.

The collected scale insect species could be listed taxonomically as follows: The capparidis wax scale, *Coccus capparidis* (Green) (Coccidae); the hemispherical scale, *Saissetia coffeae* (Walker) (Coccidae); the barnacle wax scale, *Ceroplastes cirripediformis* Comstock (Coccidae); the urbicola soft scale, *Pulvinaria urbicola* Cockerell (Coccidae); the latania scale, *Hemiberlesia lataniae* (Signoret) (Diaspididae); the boisduval scale *Diaspis boisduvalii* Signoret (Diaspididae); the date palm scale, *Parlatoria blanchardi* (Targioni Tozzetti) (Diaspididae); the black scale, *Chrysomphalus aonidum* (Linnaeus) (Diaspididae) and the citrus mealybug, *Planococcus citri* (Risso) (Pseudococcidae). Considering the host ornamental plants infested with the abovementioned Coccoidea species, the results could be presented as follows (Table 2):

1. Family: Pteridaceae

1.1. *Adiantum cuneatum*

Two species of soft scale insects belongs to Family: Coccidae, were recorded infesting *Adiantum cuneatum* in the Royal green house. They were the capparidis wax scale *C. capparidis* and the hemispherical scale *S. coffeae* . Ben-Dov (1980 and 2012) recorded *C. capparidis* for the first time in the Mediterranean region infesting Myoporaceae: *Myoporum acuminatum*. Rutaceae: *Citrus aurantium*, *C. paradise*. According to ScaleNet (2020), *S. coffeae* recorded from several host plants belonging to Family: Pteridaceae and *Adiantum* sp. from them.

2. Family: Euphorbiaceae

2.1. *Codiaeum variegatum pictum*

Two Coccoidea species recorded infesting the above host plants, the capparidis wax scale *C. capparidis* and the citrus mealybug, *P. citri*. According to Gill (1977), *C. capparidis* recorded infesting *Codiaeum* sp. in North America. Ben-Dov (1994) listed *P. citri* infesting *Codiaeum variegatum*.

3. Family: Araliaceae

3.1. *Polyscias balfourina*

The data revealed that this plant was infested by two species, the capparidis wax scale *C. capparidis* and the citrus mealybug *P. citri*. Hammon and Williams (1984) listed *Polyscias balfourina* as a host of *C. capparidis* in Florida, USA. Lincango *et al.* (2010) recorded *P. citri* from *Polyscias scutellaria* in Ecuador.

3.2. *Schefflera actinophylla*

Two Coccoidea species recorded infesting the above host plant, the capparidis wax scale *C. capparidis* and the citrus mealybug *P. citri*. The data agree with that obtained by Ben-Dov (2012) who recorded the citrus mealybug *P. citri* from *Schefflera* sp. According to ScaleNet (2020) the capparidis wax scale *C. capparidis* never recorded infesting *Schefflera actinophylla* before.

4. Family: Araceae

4.1. *Monstera acuminata deliciosa*

Four coccid species, *C. capparidis*, *C. cirripediformis*, *S. coffeae*, *P. urbicola*; one diaspidid, *C. aonidium* as well as one pseudococcid *P. citri* occurred on this plants during the period of the survey study. Nakahara (1981) recorded *C. cirripediformis* on a host plant belonging to Family: Araceae, *Philodendron* sp. in Hawaii. Abdel-Razak (2012) recorded *P. urbicola* for the first time in Alexandria, Egypt infesting *Cordia* sp. (Boraginaceae), *Psidium guajava* (Myrtaceae) and *Sanchezia speciosa* (Acanthaceae). In

Italy, Marotta (1987a) recorded *S. coffeae* infesting *Monstera deliciosa*. According to ScaleNet (2020) the capparidis wax scale *C. capparidis*; the black scale *C. aonidium* and the citrus mealybug *P. citri* never recorded infesting *Monstera acuminata deliciosa* before.

4.2. *Anthurium andraeanum*

Two species were found infesting the plant. They were, the soft scale *P. urbicola* and the diaspidid *C. aonidium*. Data obtained agree with Zimmerman (1948) who recorded *C. aonidium* infesting *Anthurium* sp. in Hawaii. According to ScaleNet (2020) the *urbicola* soft scale *P. urbicola* never recorded infesting *Anthurium andraeanum* before.

4.3. *Anthurium pentaplyllum*

The data revealed that this plant was infested by two species, the soft scale *P. urbicola* and the citrus mealybug *P. citri*. Ben-Dov (2012) listed *Anthurium* sp. as a host of *P. citri*. Although *Anthurium pentaplyllum* never recorded as host plant of the soft scale *P. urbicola* before (ScaleNet, 2020).

4.4. *Epipremnum aureum*

Both of the scale insects, *C. capparidis* (Coccidae) and *P. citri* (Pseudococcidae) were recorded infesting *Epipremnum aureum* in the Royal green house at Al-Montaza palace garden, Alexandria Egypt. The data agree with that obtained by Marotta (1987b) and Ben-Dov (1994) who recorded this plant species as a host of *P. citri*. *C. capparidis* never recorded as a pest of *Epipremnum aureum* before (ScaleNet, 2020).

4.5. *Dieffenbachia seguine*

It recorded infested by only one scale insect species during the study, the pseudococcid *P. citri*. The data agree with that obtained by Marotta (1987b) and Ben-Dov (1994) who recorded this plant species as a host of *P. citri*.

6. Family: Acanthaceae

6.1. *Sanchezia speciosa*

The plant is mainly infested by four Coccoidea species, three of them belongs to Family: Coccidae, *C. capparidis*, *S. coffee* and *P. urbicola* as well as *P. citri* Family: Pseudococcidae. The data agree with that obtained by Abdel-Razak (2012) who recorded *P. urbicola* for the first time in Alexandria, Egypt infested *Sanchezia speciosa* (Acanthaceae). Choi and Lee (2017) listed *Sanchezia* sp. as a host plant to *S. coffee* in Korea. *C. capparidis* and *P. citri* never recorded as a pest of *Sanchezia speciosa* before (ScaleNet, 2020).

7. Family: Asparagaceae

7.1. *Beaucarnea recurvata*

The main scale insects infesting the plant was the coccid *P. urbicola*. According to ScaleNet (2020) *P. urbicola* never recorded as a pest of *Beaucarnea recurvata* before, but also listed as a pest of other host plants belonging to Family: Asparagaceae.

7.2. *Dracena Marginata*

It was noticed infested with *P. citri*. Williams and Granara de Willink (1992) and Ben-Dov (1994) listed the mealybug as a pest of *Dracena* sp.

8. Family: Nephrolepidaceae

8.1. *Nephrolepis exaltata*

It was infested by the soft scale *S. coffeae* during the study. The same data obtained by Nakahara (1983) who recorded the insect infesting the same host plant *Nephrolepis exaltata* in United States Virgin Islands.

9. Family: Arecaceae

9.1. *Howea belmoreana*

During the Experiment period the palm ornamental *Howea belmoreana* observed infesting by four scale insects, one of them belongs to Family: Coccidae, *C. capparidis* and the others, *C. aonidium*, *H. lataniae*, *D. boisduvalii* belongs to Family: Diaspididae. Balachowsky (1932) listed *C. aonidium* and *H. lataniae* as

pests of the palm ornamental *Howea* sp. in France. Watson (2002) listed *Howea* sp. as a host plant of the diaspidid *D. boisduvalii*. *C. capparidis* never recorded as a pest of *Howea belmoreana* before (ScaleNet, 2020).

9.2. *Caryota mitis*

It was recorded infested with *C. capparidis* and *C. aonidium*. According to ScaleNet (2020) the obtained data revealed that it is the first record of the two scale insect species in *Caryota mitis* internationally.

9.3. *Chamaedorea elegans*

The observation on the palm ornamental, *Chamaedorea elegans* indicated that this Plant species is infested by the capparidis wax scale *C. capparidis*. Data obtained clarified that the *Chamaedorea elegans* is a new host to *C. capparidis* according to (ScaleNet, 2020).

9.4. *Dypsis lutescens*

The observed scale insect species infesting this plant species was the date palm scale *P. blanchardi*. From the data collecting during the investigation, the palm scale considered as a new pest to *Dypsis lutescens* (ScaleNet, 2020).

9.5. *latania borbonica*

During the experiment the *latania borbonica* palm observed infested by the latania scale *H. lataniae*. The data agree with that obtained by Hall (1923) who recorded the pest from *latania* sp. palm from Egypt.

10. Family: Zamiaceae

10.1. *Zamia* sp.

The data obtained revealed that *Zamia* sp. is recorded infesting by *S. coffeae* at the Royal greenhouse at Al-Montaza Palace garden during the Experiment time period. It is agreeing with that obtained by Hamon and Williams (1984) they recorded the insect from the same host plant in Florida.

11. Family: Moraceae

11.1. *Ficus benjamina*

Three species were found infesting this host plant. They were *C.capparidis*, *P. urbicola* and *P. citri*. According to ScaleNet (2020) *C. capparidis* and *P. urbicola* never

recorded infested in *Ficus benjamina* before. Moghaddam (2013) recorded *P. citri* infested *Ficus benjamina* trees in Iran.

Table (2): Host plants infested with Coccoidea in the Royal Greenhouse, Al-Montaza palace garden, Alexandria, Egypt.

Coccoidea species	Host plants
<i>Ceroplastes cirripediformis</i>	<i>Monstera acuminata deliciosa</i>
<i>Chrysomphalus aonidum</i>	<i>Monstera acuminata deliciosa</i>
	<i>Anthurium andraeanum</i>
	<i>Howea belmoreana</i>
	<i>Caryota mitis</i>
<i>Coccus capparidis</i>	<i>Adiantum cuneatum</i>
	<i>Codiaeum variegatum pictum</i>
	<i>Polyscias balfourina</i>
	<i>Monstera acuminata deliciosa</i>
	<i>Sanchezia speciose</i>
	<i>Schefflera actinophylla</i>
	<i>Epipremnum aureum</i>
	<i>Howea belmoreana</i>
	<i>Caryota mitis</i>
	<i>Chamaedorea elegans</i>
	<i>Ficus benjamina</i>
<i>Diaspis boisduvalii</i>	<i>Howea belmoreana</i>
<i>Hemiberlesia lataniae</i>	<i>Howea belmoreana</i>
	<i>latania borbonica</i>
<i>Parlatoria blanchardi</i>	<i>Dypsis lutescens</i>
<i>Planococcus citri</i>	<i>Codiaeum variegatum pictum</i>
	<i>Polyscias balfourina</i>
	<i>Monstera acuminata deliciosa</i>
	<i>Sanchezia speciose</i>
	<i>Dracena Marginata</i>
	<i>Schefflera actinophylla</i>
	<i>Anthurium pentaplyllum</i>
	<i>Epipremnum aureum</i>
	<i>Dieffenbachia seguine</i>
	<i>Ficus benjamina</i>
<i>Pulvinaria urbicola</i>	<i>Monstera acuminata deliciosa</i>
	<i>Sanchezia speciose</i>
	<i>Beaucarnea recurvata</i>
	<i>Anthurium andraeanum</i>
	<i>Anthurium pentaplyllum</i>
	<i>Ficus benjamina</i>
<i>Saissetia coffeae</i>	<i>Adiantum cuneatum</i>
	<i>Monstera acuminata deliciosa</i>
	<i>Sanchezia speciose</i>
	<i>Nephrolepis exaltata</i>
	<i>Zamia fairchildiana</i>

Climate change is expected to alter the geographic distribution and abundance of many species, to increase the invasion of new areas by exotic species and in some cases, to lead to species extinction as well as the world-wide commerce can spread the injurious Coccoidea over the earth, as they are so easily carried with many different ways. Therefore, identification Morphological keys to identify exist and nonsexist adult female Coccoidea species must be considered to help in future identification.

Key to families of adult female Coccoidea

Note: Family names given in [] have not yet been recorded from Egypt.

- 1 Abdominal spiracles present . 2
Abdominal spiracles absent .. 5
- 2(1) Antenna with spine at apex; ovisac band present, containing spines; ovisac not attached to host
Ortheziidae
-- Antenna without spine at apex; ovisac band, if present, sometimes containing spines; ovisac attached to host --- 3
- 3(2) Front legs greatly enlarged, more robust than other legs
Margarodidae sensu stricto
-- All legs of similar size and shape----- 4
- 4(3) Anal tube well developed; sclerotized anal ring present; cicatrices present on venter of abdomen; on various hosts **Monophlebidae**
-- Anal tube weakly developed; sclerotized anal ring absent; cicatrices absent; on *Pinus* spp. only
[Marchalinidae (Marchalina helenica (Gennadius))]
- 5(1) 8-shaped pores present on dorsum and/or margin 6

- 8-shaped pores absent from dorsum and/or margin 9
- 6(5) Antenna 1 segmented 7
Antenna with more than 4 segments-- 8
- 7(6) Anal plate presents, triangular; posterior spiracular furrow forked; cribriform plates present on dorsum of abdomen; 8-shaped pores present on dorsum, often arranged in concentric patterns **[Cerococcidae]**
-- Anal plate absent; posterior spiracular furrow single; cribriform plates absent; 8-shaped pores forming row around margin, present or absent from dorsum
Asterolecaniidae
- 8(6) Anal plate present, lobed or butterfly shaped; posterior spiracular furrow forked; antenna with 6-8 segments; on broad-leafed hosts
Lecanodiaspididae
-- Anal plate absent; posterior spiracular furrow single; antenna 5 segmented; on oak (*Quercus* spp.) or very closely genera (Fagaceae)
..... **[Kermesidae (in part)]**
- 9(5) Dorsal setae truncate conical; clusters of quinquelocular pores present, each associated with a tubular duct; on *Opuntia* spp. or closely related cacti
..... **Dactylopiidae**
-- If dorsal setae truncate conical, then body without clusters of quinquelocular pores; on various hosts including cacti 10
- 10(9) Anal plate present 11
-- Anal plate absent 12
- 11(10) Anal plate single, almond shaped; hind margin crenulate, without anal cleft; antenna 1 segmented; legs absent or reduced to sclerotized points;

on grasses and bamboos (Poaceae) only

Aclerididae

-- Anal plates paired, often each triangular; anal cleft present; antenna 2-8 segmented; legs present; on various hosts including Poaceae **Coccidae**

12(11) Posterior abdominal segments sclerotized and fused so that segmentation is not evident, forming a pygidium; anal opening simple; legs absent or reduced to sclerotized points

13

-- If posterior abdominal segments sclerotized, then segmentation still evident; legs present or absent; anal opening simple or complex; legs present or absent

..... 14

13(12) Pygidium with dorsal ducts and a marginal fringe of lobes, and plates or gland spines; usually living beneath a scale cover containing exuviae of previous instars, but sometimes adult female remains inside exuviae of previous stage (pupillarial); if hinged operculum present, then never feeding on palms

..... **Diaspididae**

-- Pygidium simple, without lobes, plates or gland spines; adult female pupillarial; posterior end of exuviae of previous instar with hinged operculum surrounded by a sclerotized rim; on palms and Pandanaceae only

Halimococcidae

14(13) Anal opening situated at center of dorsum; legs absent; crawlers dimorphic; on broad-leafed hosts

[Stictococcidae]

-- Anal opening situated situated towards, or at, posterior end; legs usually present; crawlers monomorphic; on various hosts including Monocotyledonae

15(14) Anterior spiracles much larger than posterior spiracles; sclerotized

dorsal spine and brachial plates present; legs absent

[Kerriidae]

-- Anterior spiracles similar size to posterior spiracles; sclerotized dorsal spine and brachial plates absent; legs present or absent

16(15) Anal ring simple, with 2 setae and no pores; entire cuticle rugose; legs absent; antenna 1 segmented; on palms only

Phoenicococcidae

-- Anal ring simple or complex, with or without setae and pores; cuticle smooth; legs present or absent; antenna 1-9 segmented; on various hosts including palms

17(16) Possessing one or more of: paired ostioles; cerarii; one or more circuli; swirled trilocular pores

Pseudococcidae

-- Without paired ostioles; cerarii; one or more circuli; swirled trilocular pores -- 18

18(17) At least 1 posterior abdominal segment sclerotized, forming a pseudopygidium; multilocular pores present on both surfaces of abdomen; legs usually present, each with tibia and tarsus fused; tubular ducts absent

[Conchaspididae]

-- Posterior abdominal segments not sclerotized to form a pseudopygidium; multilocular pores often confined to venter of abdomen, legs with tibia and tarsus separate; tubular ducts present, each with cup-shaped inner end

19(18) Anal ring bearing setae; anal lobes usually protruding (but sometimes absent); ventral macrotubular ducts, if present, scattered; microtubular ducts present; on various hosts including oaks

Eriococcidae

-- Anal ring without pores or setae; anal lobes not protruding; large ventral tubular ducts present in

submarginal zone; microtubular ducts absent; on oak (*Quercus* spp.) or very closely related genera (Fagaceae)
..... [Kermesidae (in part)]

It can be concluded that, a total of nine Coccoidea specie following nine genera belonging to 3 families were observed infesting twenty ornamental plants in the Historical Royal greenhouse at Al-Montaza palace garden, Alexandria Governorate, Egypt. New hosts recorded for the first time infesting with Coccoidea species during the study were illustrated and discussed as follows: the capparidis wax scale *C. capparidis* recorded for the first time infesting *Schefflera actinophylla*, *Monstera acuminata deliciosa*, *Epipremnum aureum*, *Sanchezia speciose*, *Howea belmoreana*, *Caryota mitis*, *Camaedorea elegans* and *Ficus benjamina*. The black scale *C. aonidum* recorded for the first time infesting *Monstera acuminata deliciosa* and *Caryota mitis*. The urbicola soft scale *P. urbicola* recorded for the first time infesting *Anthurium andraeanum*, *Anthurium pentaplyllum*, *Beaucarnea recurvate* and *Ficus benjamina*. The citrus mealybug *P. citri* recorded for the first time infesting *Monstera acuminata deliciosa* and *Sanchezia speciose*. From the data collecting during the investigation, the palm scale *P. blanchardi* considered as a new pest to *Dyopsis lutescens*. A key of the adult female Coccoidea were given for helping researchers in the future identification and investigation.

Acknowledgements

Appreciation is extended to Dr. Gillian W. Watson, for identifying many species collecting from the greenhouse as well as her support for designed the Key to families of adult female Coccoidea in Egypt.

References

- Abdel-Razak, S.I. (2000)** Studies on certain abundant scale insects attacking ornamental plants in public gardens. M.S.c. Thesis. Plant Prot. Dept. Fac. of Agric. (Saba-Bacha), Alexandria University.
- Abdel-Razak, S.I. (2007):** Studies on some scale insects and mealy bugs of deciduous fruit trees in western north coast and new localities. PhD. Dissertation. Alexandria University.
- Abdel-Razak, S.I. (2012):** First record of the Urbicola soft scale, *Pulvinaria urbicola* Cockerell, 1893 (Hemiptera: Coccidea) in Egypt. Alexandria Science Exchange Journal, 3(3):206-208.
- Balachowsky, A.S. (1932):** Étude biologique des coccides du bassin occidental de la Méditerranée.. Encyclopédie Entomologique, XV P. Lechevalier and Fils Paris pp 214, LXVII.
- Ben-Dov, Y. (1975):** A new species of *Crisicoccus Ferris* from mangrove in the Sinai Peninsula. Rev. Zool. Africaine, 89 (2): 451-454.
- Ben-Dov, Y. (1980):** Observations on scale insects (Homoptera: Coccoidea) of the Middle East. Bulletin of Entomological Research, 70: 261-271.
- Ben-Dov, Y. (1994):** A systematic catalogue of the mealybugs of the world (Insecta: Homoptera: Coccoidea: Pseudococcidae and Putoidae) with data on geographical distribution, host plants, biology and economic importance. Intercept Limited Andover, UK pp 686.
- Ben-Dov, Y. (2012):** The scale insects (Hemiptera: Coccoidea) of

- Israel-checklist, host plants, zoogeographical considerations and annotations on species. *Isr. Jour. Entomo.*, 41–42: 21–48.
- Choi, J., and Lee, S. (2017):** Taxonomic review of the tribe Saissetiini (Hemiptera: Coccidae) in Korea. *Journal of Asia-Pacific Entomology*, 20: 101-111.
- Ezz, A. I. (1965):** The morphology and biology of *Icerya aegyptiaca* (Douglas) (Homoptera: Margarodidae). M.Sc. thesis, Fac. of Agric. Cairo University.
- Ezzat, Y. M. (1958):** Classification of the scale insects, Family Diaspididae as known to occur in Egypt (Homoptera: Coccoidea). *Bull. Soc. Entom. Egypte*, X LII, 233-251.
- Ezzat, Y. M. and Hussein, N. A. (1969):** Redescription and classification of the family Coccidae in U.A.R. (Homoptera: Coccidae). *Bull. Soc. Entom. Egypt*, 51: 395-426.
- Ezzat, Y. M. and Nada, S. M. A. (1986):** List of super family Coccoidea as known to exist in Egypt. *Bull. Lab. Entomol. Agr. Filippo Silvestri*, 43: 85-90.
- Ferris, G.F. (1950):** Atlas of the Scale Insects of North America. (ser. 5) [v. 5]. The Pseudococcidae (Part I). Stanford Univ. Press, Palo Alto, California, pp. 278.
- Ferris, G.F. (1953):** Atlas of the Scale Insects of North America, [v. 6], The Pseudococcidae (Part II). Stanford Univ. Press, Palo Alto, California, pp.506.
- Franco, J.C.; Zada, A. and Mendel, Z. (2009):** Novel approaches for the management of mealybug pests. In: Ishaaya I., Horowitz A.R. (eds): *Biorational Control of Arthropod Pests-Application and Resistance Management*. Dordrecht, Springer: 233–278.
- Germain G.F. (2008):** Invasive scale insects (Hemiptera: Coccoidea) recorded from France. In: Branco M., Franco J.C., Hodgson C. (eds): *Proceeding XI International Symposium on Scale Insect Studies*, Sept 24–27, 2007, Oeiras, Portugal. Lisbon, ISA Press: 77–87.
- Gill, R.J.; Nakahara, S. and Williams, M.L. (1977):** A review of the genus *Coccus* Linnaeus in America north of Panama (Homoptera: Coccoidea: Coccidae). *Occasional Papers in Entomology, State of California, Department of Food and Agriculture*, 24: 44.
- Gutierrez, A.P. and Ponti, L. (2014):** Analysis of invasive insects: links to climate change. In: Ziska L.H., Dukes J.S., (eds.), *Invasive Species and Global Climate Change*. CABI Publishing, Wallingford, UK, 45-61.
- Hall, W. J. (1922):** Observations on the Coccidae of Egypt. *Egypt Min. Agr. Tech. and Sci. Serv. Bul.* 22.
- Hall, W.J. (1923):** Further observations on the Coccidae of Egypt. *Bulletin, Ministry of Agriculture, Egypt, Technical and Scientific Service* 36: 1-61.
- Hall, W. J. (1924):** Four new species of Coccidae from Egypt. *Min. Agr. Tech. and Sci. Serv. Bul.* 46.
- Hall, W. J. (1925):** Notes on Egyptian Coccidae with descriptions of new species of Egypt. *Min. Agr. Tech. and Sci. Serv. Bul.* 64.
- Hall, W. J. (1926a):** Contribution of the knowledge of the Coccidae of Egypt. *Min. Agr. Tech. and Sci. Serv. Bul.* 72.

- Hall, W. J. (1926b):** Miscellaneous notes on Egyptian Coccidae with descriptions of three new species. Soc. Roy. Ent. Egypte Bull., 10: 267- 287.
- Hall, W. J. (1926c):** Miscellaneous notes on Egyptian Coccidae with descriptions of three new species. Soc. Roy. Ent. Egypte Bull., 10: 267- 287.
- Hamon, A.B. and Williams, M.L. (1984):** The soft scale insects of Florida (Homoptera: Coccoidea: Coccidae). Arthropods of Florida and Neighboring Land Areas. Fla. Dept. of Agric. and Consumer Serv. Div. Plant Ind. Gainesville, pp. 194.
- Hodgson, C.J. (1994):** The Scale Insect Family Coccidae: An Identification Manual to Genera. CAB International, Wallingford, Oxon, pp. 639. <http://scalenet.info/>
- Kondo, T.; Gullan P.J. and Williams D.J. (2008):** Coccidology: The study of scale insects (Hemiptera: Sternorrhyncha: Coccoidea). Revista Corpoica – Ciencia y Tecnología Agropecuaria, 9: 55–61.
- Lincango, M.P.; Hodgson, C.J.; Causton, C. and Miller, D.R. (2010):** An updated checklist of scale insects (Hemiptera: Coccoidea) of the Galapagos Islands, Ecuador. Galapagos Research, 67: 3-7.
- Mansour, R.; Grissa-Lebdi, K.; Suma, P.; Mazzeo, G. and Russo, A. (2017):** Key scale insects (Hemiptera: Coccoidea) of high economic importance in a Mediterranean Area: Host plants, Bio-Ecological Characteristics, Natural Enemies and Pest Management Strategies – a Review. Plant Protection Science, 53(1):1-14.
- Marotta, S. (1987a):** An annotated list of the Italian mealybugs. Bollettino del Laboratorio di Entomologia Agraria Filippo Silvestri Portici, 43: (1986, Supplement): 107-116.
- Marotta, S. (1987b):** Coccidi (Homoptera: Coccoidea: Coccidae) segnalati in Italia, con riferimenti bibliografici sulla tassonomia, geonomia, biologia e piante ospiti.. Bollettino del Laboratorio di Entomologia Agr. Filippo Silvestri, 44: 97-119.
- Mazzeo, G.; Longo, S.; Pellizzari, G.; Porcelli, F.; Suma, P. and Russo, A. (2014):** Exotic scale insects (Coccoidea) on ornamental plants in Italy: a never-ending story. Acta Zoologica Bulgarica, 6: 55–61.
- McKenzie, H. L. (1956):** The armored scale insects of California. Bulletin of California insect survey, Vol. 5, University of California. Text book.
- McKenzie, H. L. (1969):** Mealybugs of California, with taxonomy, biology and control of north American species (Homoptera, Coccoidea: Pseudococcidae) VIII, 526pp. 25 cal. PIS. 205 Figs. 193 maps. Berkeley and Lost Angeles, California.
- Miller, D.R. (2005):** Selected scale insect groups (Hemiptera: Coccoidea) in the southern region of the United States. Florida Entomologist, 88: 482–501.
- Miller, D.R.; Miller, G.L. and Watson, G.W. (2002):** Invasive species of mealybugs (Hemiptera: Pseudococcidae) and their threat to U.S. Agriculture. Proceeding of the Entomological Society of Washington, 104: 825–836.

- Moghaddam, M. (2013):** A review of the mealybugs (Homoptera: Coccoidea: Pseudococcidae, Putoidae and Rhizoecidae) of Iran, with descriptions of four new species and three new records for the Iranian fauna. *Zootaxa*, 3632 (1): 001–107.
- Mohammad, Z. K. and Nada, S. M. A. (1995):** The Pseudococcidae of Egypt (Coccoidea: Homoptera). *Egypt J. Agric. Res.* 13(3).
- Mohammad, Z. K.; Mohammad, S. K. and Mohammad, M. A. (1997):** Taxonomic studies and survey of four families of Coccoidea (Homoptera) in Egypt. *Journal of the Egyptian German Society of Zoology*, 22: 189-233.
- Mohammad, Z.K. and Ghabbour, M.W. (2008):** Updating list of Superfamily Coccoidea (Homoptera) as known to exist in Egypt. *J. Egypt German Soc. Zool. Entomology*, 56E: 147-162.
- Monammad, Z. K.; Ezzat, Y.M. and Aly, A.G. (1995):** Recent review of Egyptian little known species of Coccoidea. *J. Egypt German Soc. Zool. Entomology*, 16(E): 477-533.
- Mourad, A.K.; Mesbah, H. A.; Fata, A. A. S.; Moursi, K. S. and Abdel-Razak, S. I. (2001):** Survey of scale insects of ornamental plants in Alexandria Governorate, Egypt. *Mededelingen (Rijksuniversiteit te Gent. Fakulteit van de Landbouwkundigen Toegepaste Biologische Wetenschappen)*, 66(2b):571-80.
- Nakahara, S. (1981):** List of the Hawaiian Coccoidea (Homoptera: Sternorrhyncha). *Proceedings of the Hawaiian Entomological Society*, 23: 387-424.
- Nakahara, S. (1983):** List of the Coccoidea species (Homoptera) of the United States Virgin Islands. United States Department of Agriculture, Plant Protection and Quarantine, APHIS [Mimeograph], 8142: 1-21.
- Pellizzari, G. and Germain, G.F. (2010):** Scales (Homoptera, Superfamily Coccoidea). *BioRisk*, 4: 475–510.
- Ross, L.; Pen, I. and Shuker D.M. (2010):** Genomic conflict in scale insects: the causes and consequences of bizarre genetic systems. *Biological Reviews*, 85: 807–828.
- Scale Net (2020):** The database of the scale insects on the net. <https://data.nal.usda.gov/dataset/scalenet-scale-insects-coccoidea-database>
- Sirisena, U.G.A.I.; Watson, G.W.; Hemachandra, K.S. and Wijayagunasekara, H.N.P. (2013):** A Modified Technique for the Preparation of Specimens of Sternorrhyncha for Taxonomic Studies Tropical Agricultural Research, 24 (2): 139-149.
- Watson, G.W. (2002):** Arrthropods of Economic Importance: Diaspididae of the World. (Series Title: World Biodiversity Database).. ETI Information Services (Expert Center for Taxonomic Identification) Amsterdam, Netherlands.
- Williams, D. J. and Watson, G.W. (1990):** The Scale Insects of the Tropical South Pacific Region. Pt. 3: The Soft Scales (Coccidae) and Other Families.

- CAB International Institute of Entomology, London. pp. 267.
- Williams, D.J. and Watson, G.W. (1988).** The scale insects of the tropical South Pacific Region. Pt. 2: The Mealybugs (Pseudococcidae). CAB International Inst.Ent., London, pp .260.
- Williams, D.J. and Granara de Willink,**
- M.C. (1992):** Mealybugs of Central and South America. CAB International London, England 635 pp.
- Zimmerman, E.C. (1948):** Homoptera: Sternorrhyncha. Insects of Hawaii, 5: 1-464.

