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RESEARCH ARTICLE

Survey of mealybugs and their natural enemies at Qena Governorate, Egypt

Maha F. Drder [1], K.M. Mohanny [1], Angel R. Attia [2] and Ghada S. Mohamed [1]*

[1] *Plant Protection Department, Faculty of Agriculture, South Valley University, 83523 Qena, Egypt.*
[2] *Plant Protection Research Institute, Agriculture Research Center, 12619 Giza, Egypt.*

Abstract

A survey of mealybugs and their associated natural enemies was carried out in different regions at Qena governorate during the two years 2022-2023. Four pseudococcid species; *Phenacoccus solenopsis* Tinsley, *Ferrisia virgate* (Ckll.), *Maconellicoccus hirsutus* (Green), Planococcus *citri* (Risso) and one monophlebid species, *Icerya purchase* Maskell were recorded. The primary parasitoid, *Aenasius arizonensis* (Giraut) and the hyperparasitoid, *Prochiloneurus aegyptiacus* (Mercet) (Encyrtidae) were recorded as associated with *P. Solenopsis*. The two encyrtid primary parasitoids; *Blepyrus insularis* (Cameron), *Acerophagus sp.*, and and the signiphorid hyperparasitoid, *Chartocerus subaenus* (Forster) were secured from *F. virgate*. On the other hand, no parasitoids were recorded associated with the two mealybug species; *Maconellicoccus hirsutus* (Green) and *Planococcus citri* (Risso). The three coccinellid predators, *Hyperaspis vinciguerrae*, *Scymnus syriacus* and *Nephus hiekei* were recorded as associated with *P. Solenopsis*, while the five predators; *Hyperaspis vinciguerrae*, *Scymnus syriacus* and *Nephus hiekei* (Coccinellidae), *Sympherobius amicus* (Hemerobiidae) and *Dicrodiplosis manihoti* (Cecidomyiidae) were recorded as associated with *F. virgate*. On the other hand, one coccinellid predator, *Scymnus syriacus* was recorded as associated with *Maconellicoccus hirsutus* while the coccinellid predator, *Nephus hiekei* was recorded as associated with *Planococcus citri*.

Keywords: Survey; mealybugs; Parasitoids; Predators.

1. Introduction

Mealybug is the common name of insects belonging to Pseudococcidae, a family consisting of unarmored scale insects found in moist and warm climates. They are considered pests as they suck plant juices of greenhouse plants, house hold garden plants and subtropical trees (Jahn *et al.*, 2003). The mealybug species are widespread throughout the world. It has been found on a relatively wide variety of host plants such as mango, grapevines, citrus, apple and ornamentals (Keraba, 2011). Feeding caused by mealybugs reduces plant vigour and the released honeydew encourages the formation of a black sooty mold that interferes with photosynthesis and affects fruit quality (Gullan and Martin, 2003).

Control of mealybugs commonly relies on the use of insecticides, but mealybugs can exhibit high levels of resistance. In addition, their control is made difficult because of their localization in protected sites under the bark, where pesticide penetration is difficult (Geiger and Daane, 2001). Further, mealybugs are often characterized by the presence of a white, waxy secretion covering the whole body that serves as a barrier to the penetration of insecticides (Copland *et al*., 1985). Repeated chemical treatments also affect natural enemies of mealybugs negatively (Walton and Pringle, 1999). Biological control offers a possible alternative method to suppress mealybug populations.

In Egypt, several investigators have studied

***Corresponding author: Ghada S. Mohamed**
Email: d.ghada1@yahoo.com
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mealybug species, parasitoids and their associated predators (El-Serfi, *et al*., 2004; Attia, 2012). Many species of coccinellids attack mealybugs, however, their immature stages are subjected to be parasitized by a variety of hymenopterous parasitoids, especially those belong to the chalcidoid families; Encyrtidae, Eulophidae, Eupelmidae, and Pteromalidae (Anis and Hayat, 1998).

The present study aimed to conduct a field survey of mealybug and its natural enemies at Qena Governorate, Egypt, and to study the role of predators and parasitoids in suppressing the population of mealybugs.

2. Materials and methods

Survey of mealybug species on different host plants in Qena Governorate was carried out for two successive years 2022 – 2023. The survey was carried out on the ornamental host plants, *Hibiscus rosa-sinensis*, *Lantana camara*, *Catharanthus roseus*, *Euphorbia trigona*, *Portulaca grandiflora*, *Hibiscus sabdariffa*, *Nerium oleander*, *Leucaena leucocephala*. Fruit host plants, *Musa acuminate*, *Psidium guajava*, *Mangifera indica*, *Punica granatum*, *Annona sp*., *Vitis vinifera*, *Citrus x Limon*. Vegetables host plants, *Abelmoschus esculentus*, *Corchorus olitorius*, and *Solanum melongena*. Grass host plants, *Convolvulus arvensis*, *Conyza discoridis*. Field crops host plants, *Sesamum indicum.* Samples were cut from each host plant, which were transported to the Lab. in polyethylene bags. which were examined under a stereomicroscope to determine the mealybug species that infest each host plant and each species was kept separately in carton cylindrical boxes (15 cm long and 15 cm in diameter) covered with fine muslin cloth until all parasitoids and Predators had emerged. The types of mealybugs that were surveyed and their natural enemies were identified in the Scale Insects and Mealybugs Division, Plant Protection Research Institute, Agricultural Research Center, Giza – Egypt

3. Results and discussion

3.1. Mealybug species

The obtained results in Table (1) revealed five species of mealybug species in different localities at Qena Governorate. Four pseudococcid species were recorded on several host plant varieties: the cotton mealybug, *P. solenopsis*, the striped mealybug, *F. virgata*, the citrus mealybug, *P. citri*, and the hibiscus mealybug, *M. hirsutus*. Also, one Monophlebidae species, *Icerya purchasi* Maskell Was recorded in citrus trees

In the present study, a total of Twenty-two host plants belonging to nineteen families included field crops, vegetables, ornamentals, weeds, and fruits. Economic damage was observed on okra, sesame, mulukhiyah, basil, roselle, eggplant, Guava, Banana, mango, Pomegranate, grape vine and Lemon.

They suck the plant sap and secrete honeydew which leads to the growth of sooty mold. The black fungus coats most of the plant parts interfering with photosynthesis. In this respect, Mohamed (2021) recorded that *P. solenopsis* Tinsley for the first time on the okra plant at Qena Governorate, Egypt, and its population changes from one season to another also (Sartiami *et al.*, 2016) reported that *P. solenopsis* and *F. virgata* are pests on dragon fruit trees in Indonesia. *P. citri* and *M. hirsutus* are pests of grapes and may be transferred from vineyards very close to dragon fruit plantation (Youssef *et al.,* 2021).

Weeds were considered host plants infested with severe species of mealybug, so control of weeds is an important process to control the population of mealybug. In this concern, Abd- Rabou (2010) recorded *P. solenopsis* as a new pest in Egypt on the ornamental plant, *Hibiscus rosa sinensis* and (Samah *et al*., 2015) recorded it as a new pest on tomato plants in Egypt while this paper recorded a lot of newly host plants for the cotton mealybug.

Table 1. Surveyed of mealybug species recorded on different localities at Qena Governorate, Egypt during two successive years 2022 – 2023.

Family	Common name	Scientific name	Host plant	Family of plants	Location
Pseudococcidae	Cotton mealybug	*Phenacoccus solenopsis* Tinsley	*Abelmoschus esculentus*	Malvaceae	Qena
			Sesamum indicum	Pedaliaceae	Nagaa Hammadi
			Corchorus olitorius	Malvaceae	Qift
			Lantana camara	Verbenaceae	Qena
			Ocimum basilicum	Lamiaceae	Dishna
			Hibiscus sabdariffa	Malvaceae	AL waqf
			Solanum melongena	Solanaceae	Naqada
			Hibiscus rosa-sinensis	Malvaceae	Qena
			Portulaca grandiflora	Portulacaceae	Dishna
			Psidium guajava	Myrtaceae	Dendera
			Catharanthus roseus	Apocynaceae	Qena
			Euphorbia trigona	Euphorbiaceae	Qena
			Convolvulus arvensis	Convolvulaceae	Abu Tisht
			Conyza discoridis	Compositae	Al jabalw
	Striped mealybug	Ferrisia virgata (Ckll.)	*Nerium oleander*	Apocynaceae	Qena
			Leucaena leucocephala	Fabaceae	Naqada
			Musa acuminata	Musaceae	Al Qinawiyyah
			Psidium guajava	Myrtaceae	Abu Tisht
			Mangifera indica	Anacardiaceae	Al Qinawiyyah
	Hibiscus mealybug	*Maconellicoccus hirsutus* (Green)	*Punica granatum*	Lythraceae	Al Jabalw
			Hibiscus rosa-sinensis	Malvaceae	Qena
			Abelmoschus esculentus	Malvaceae	Qift
	Citrus mealybug	*Planococcus citri* (Risso)	*Annona sp.*	Annonaceae	Qena
			Vitis vinifera	Vitaceae	Nagaa Hammadi
Monophlebidae	Cottony cushion scale	*Icerya purchasi* Maskell	*Citrus x Limon*	Rutaceae	Al Qinawiyyah

3.2. Natural enemies

The samples of mealybugs collected from different districts in Qena Governorate from 2022 to 2023 under the survey program consisted mostly of adult females and immature instars along with various species of natural enemies i.e., parasitoids, and predators.

Results in Table (2) revealed the parasitoids associated with surveyed two mealybug species at different localities as follows*:* The cotton mealybug, *P. Solenopsis* was associated with encyrtid primary parasitoid, *Aenasius arizonesis* (Giraut), and encyrtid hyperparasitoid *Prochiloneurus aegyptiacus* whereas, the striped

mealybug, *F. virgata* was associated with two encyrtids primary parasitoid**,** *Blepyrus insularis* (Cameron), and *Acerophagus sp*. and the Signiphorid hyperparasitoid, *Chartocerus subaenus*. No parasitoids were recorded associated with the two mealybug species; *Maconellicoccus hirsutus* (Green) and *Planococcus citri* (Risso).

Table 2. Parasitoids associated with mealybug species recorded at localities at Qena Governorate, Egypt during two successive years 2022 – 2023.

Mealybug species	Parasitoids with their families	
Phenacoccus solenopsis	***Aenasius arizonensis***	**Encyrtidae**
	Prochiloneurus aegyptiacus	**Encyrtidae**
***Ferrisia virgata* (Ckll.)**	**Acerophagus sp.**	**Encyrtidae**
	Blepyrus insularis	**Encyrtidae**
	Chartocerus subaenus	**Signiphoridae**

Results in Table (3) showed the predators associated with surveyed four mealybug species at different localities as follows**:** The cotton mealybug, *P. Solenopsis* was attacked by three coccinellid predators, *Scymnus syriacus*, *Hyperaspis vinciguerrae* and *Nephus hiekei* whereas, the striped mealybug, *F. virgata* was attacked with three coccinellid predators, *Scymnus syriacus* ,*Nephus hiekei*, and *Hyperaspis vinciguerrae*. They were attacked with Cecidomyiid predator, *Dicrodiplosis manihoti* and Hemerobiid predator, *Sympherobius amicus*. While the pink hibiscus mealybug, *M. hirsutus* attacked with one coccinellid predator, *Scymnus syriacus*. The citrus mealybug, *Planococcus citri* attacked with one coccinellid predator, *Nephus hiekei that* was recorded for the first time in this species of mealybug.

Table 3. predators associated with mealybug species recorded at localities at Qena Governorate, Egypt during two successive years 2022 – 2023.

Mealybug species	predators with their families		
***Phenacoccus solenopsis* Tinsley.**	***Scymnus syriacus***	**Coleoptera**	***Coccinellidae***
	Hyperaspis vinciguerrae	**Coleoptera**	***Coccinellidae***
	Nephus hiekei	***Coleoptera***	***Coccinellidae***
***Ferrisia virgata* (Ckll.)**	***Dicrodiplosis manihoti***	***Diptera***	**Cecidomyiidae**
	Sympherobius amicus	***Neuroptera***	**Hemerobiidae**
	Scymnus syriacus	**Coleoptera**	***Coccinellidae***
	Nephus hiekei	***Coleoptera***	***Coccinellidae***
	Hyperaspis vinciguerrae	**Coleoptera**	***Coccinellidae***
***Maconellicoccus hirsutus* (Green)**	***Scymnus syriacus***	**Coleoptera**	***Coccinellidae***
***Planococcus citri* (Risso)**	***Nephus hiekei***	***Coleoptera***	***Coccinellidae***

These results are in harmony with those obtained by many authors, including Ghada (2021), Mohamed *et al*. (2019), Attia *et al*. (2017), Aga *et al* (2016), Attia and Awadallah (2016 a and b), and Attia (2012) recorded the same parasitoids and predators on the above-mentioned mealybugs on the same host plants. Huseyn *et al*. (2023) mentioned that, *Nephus hekei* was recorded preying on the mealybug, *Plenacoccus ficus* on the host plant *ficus carica* and *phenacoccus solenopsis* on four host plants; *Solanum lycopersicum, Lantana camara, Amaranthus viridis, Mirabilis Jalapa.* IN this investigation, this predator was recorded for first time on the citrus mealybug, *Planococcus citri.*

4. Conclusion

the three coccinellid predators, *Hyperaspis vinciguerrae*, *Scymnus syriacus* and *Nephus hiekei* were recorded as associated with *P. Solenopsis*, while the five predators; *Hyperaspis vinciguerrae*, *Scymnus syriacus* and *Nephus hiekei* (Coccinellidae), *Sympherobius amicus* (Hemerobiidae) and *Dicrodiplosis manihoti* (Cecidomyiidae) were recorded as associated with *F. virgate*. On the other hand, one coccinellid predator, *Scymnus syriacus* was recorded as associated with *Maconellicoccus hirsutus* while the coccinellid predator, *Nephus hiekei* was recorded as associated with *Planococcus citri*.

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The authors disclosed no conflict of interest.

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