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Survey of the pseudococcid mealybugs (Hemiptera:Pseudococcidae) infesting dragon fruit and their natural enemies in some new reclaimed lands, Egypt

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Abstract:

The present work was conducted on three dragon fruit varieties in private farms at three localities, new reclaimed lands, Ain Ghosin (Ismailiya Governorate), New Nubariya (Beheira Governorate) and Berqash district (Giza Governorate). The study was conducted to survey mealybug species and their associated natural enemies on the dragon fruit trees; it considered a new kind of fruit in the Egyptian environment. The obtained results revealed four pseudococcid species, *Phenacoccus solenopsis* Tinsle, *Ferrisia virgata* (Ckll.), *Planococcus citri* (Risso) and *Maconellicoccus hirsutus* (Green) (Hemiptera:Pseudococcidae). Associated parasitoids were *Aenasius arizonensis* (Giraut), family: Encyrtidae and *Chartocerus dactylopii* (Ashmead), family: Signiphoridae on *Ph. solenopsis*; *Coccidoxenoides peregrinus* (Timberlake) and *Leptomastix abnormis* (Giraut) on *P. citri*, family: Encyrtidae; *Anagyrus kamali* Moursi and *Leptomastix dactylopii* Howard, family: Encyrtidae on *M. hirsutus* and *Blepyrus insularis* (Cameron) family: Encyrtidae on *F. virgata* Also, Associated predators, two predators, *Dicrodiplosis manihoti* Harris and *Diadiplosis donaldi* Harris on *Ph. solenopsis* and *P. citri*, family: Cecidomiidae, respectively. Also, one predator *Cryptolaemus montrouzieri* Mulsant, family: Coccinellidae. About susceptibility of three varieties of dragon fruit had differences with the infestation of the four mealybug species were recorded.

Introduction

Dragon fruit or pitaya, (*Hylocereus* spp. and *Selenicereus* spp.) is a new tropical fruit tree (Caryophyllales: Cactaceae). The first time to plant in Egypt was at the European countryside region 58 kilometer of desert Alexandria road, and then increasing gradually year by year in newly reclaimed lands in Egypt. The crop manifested susceptibility was attacked by insects and diseases. It is a lack of information to understand them.

Mealybugs (Hemiptera: Pseudococcidae) are major pests that infest a wide range of fruit trees, shrubs and ornamental plants worldwide (Ben-Dov *et al.*, 2010). The mealybug nymphs and adult females can be extremely polyphagous and feed by piercing and sucking plant sap. This feeding behavior often causes considerable economic losses to agriculture through direct damage to infested crops (Golino *et al.*, 2002 and Miller *et al.*, 2002).

The pseudococcids excrete large quantities of honeydew that ensure leave, stems and fruits, resulting in further crop damage and the growth of sooty moulds and bunch rots (Godfrey *et al.*, 2003). Mealybug control is made difficult because characterized by the presence of a white, waxy secretion covering the whole body that serves as a barrier to insecticide penetration. Repeated chemical treatments also affect natural enemies of mealybugs negatively (Walton and Pringle, 1999).

The objective of this study was to inventory, for the first time, the mealybug fauna and its natural enemies in a dragon fruit plantation in newly reclaimed land in Egypt.

**Materials and methods**

Survey of mealybug species on dragon fruit varieties cultivated in three new reclaimed lands, Ain Ghosin (Ismailiya Governorate), New Nubariya (Beheira Governorate) and Berqash district (Giza Governorate) (Figure 1) were carried out for one complete year from March 2020 to February 2021. Three private dragon fruit orchards are cultivated with different varieties of dragon fruit trees were chosen for sampling purposes.

The study was conducted on three varieties i.e. Pitaya blanca or white-fleshed pitaya, *Hylocereus undatus*. Pitaya roja, or red-fleshed pitaya, *Hylocereus costaricensis* and

yellow pitaya *Hylocereus megalanthus*. These trees were about 5-7 years old and about 2 meters in height, the distance between trees about 4 meters and heavily infested with mealybugs. These orchards were reserved for the normal agricultural practices without any insecticidal applications before and during sampling processes.

Regular monthly excursions were carried out for sampling purposes throughout one complete year. Monthly sampling, 3 tender green stems about 20-30 cm. long from each variety were randomly collected from each locality. These samples were kept in a special plastic box and transferred to the laboratory for inspection. The monthly samples from the three localities were examined with aid of a stereoscopic microscope. After examining the stems and fruits of dragon fruit varieties per each variety and some specimens from each mealybug species were confined in big glass jars and kept in the laboratory for securing any emerging parasitoids.

The surveyed mealybug species and their natural enemies were identified in the Scale Insects and Mealybugs Division, Plant Protection Research Institute, Agricultural Research Center, Giza – Egypt by the key of pseudococcids Zeinat and Youssef (2017) and the key of parasitoids by Güleç *et al.* (2007) and Hayat (1970).



Figure (1): Localities of three orchards of dragon fruit and its coordinate.

## Results and discussion

### 1. Survey of mealybugs:

The obtained results Table (1) revealed four species of mealybug species on dragon fruit varieties at three

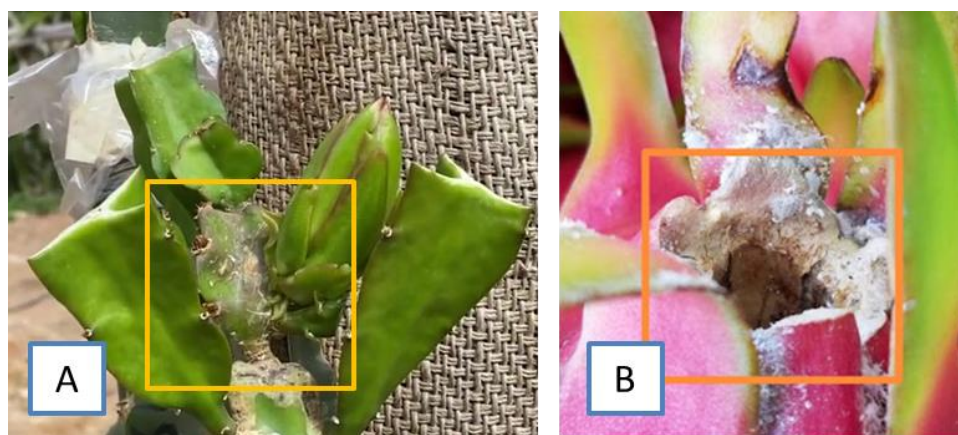
**Table (1): The mealybug species which recorded on stems and fruits of dragon fruit varieties from three localities in the new reclaimed lands from March, 2020 to February, 2021.**

Family	Common name	Scientific name
Pseudococcidae	Cotton mealybug	<i>Phenacoccus solenopsis</i> Tinsley.
	Striped mealybug	<i>Ferrisia virgata</i> (Ckll.)
	Citrus mealybug	<i>Planococcus citri</i> (Risso)
	Hibiscus mealybug	<i>Maconellicoccus hirsutus</i> (Green)

Four pseudococcid species were recorded on the stem and the fruits of the three different varieties of dragon fruit trees (Figure 2 A and B), the cotton mealybug, *P. solenopsis*, the striped mealybug, *F. virgata*, the citrus mealybug, *P. citri* and the hibiscus mealybug, *M. hirsutus*. They suck the plant sap and secrete honeydew which leads to the growth of sooty mould. The

localities (Ain Ghosin, Ismailiya; New Nubariya Beheira and Berqash district Giza Governorates). The surveyed species belonging to one family are as follows:

black fungus coats the most of plant parts interfering with photosynthesis. In this respect, Sartiami *et al.* (2016) reported that the, *Ph. 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 closed with dragon fruit plantation (Youssef, 1991).



**Figure (2): (A): Colony of mealybugs on stem, (B): Colony on fruit scales.**

### 2. Degree of infestation:

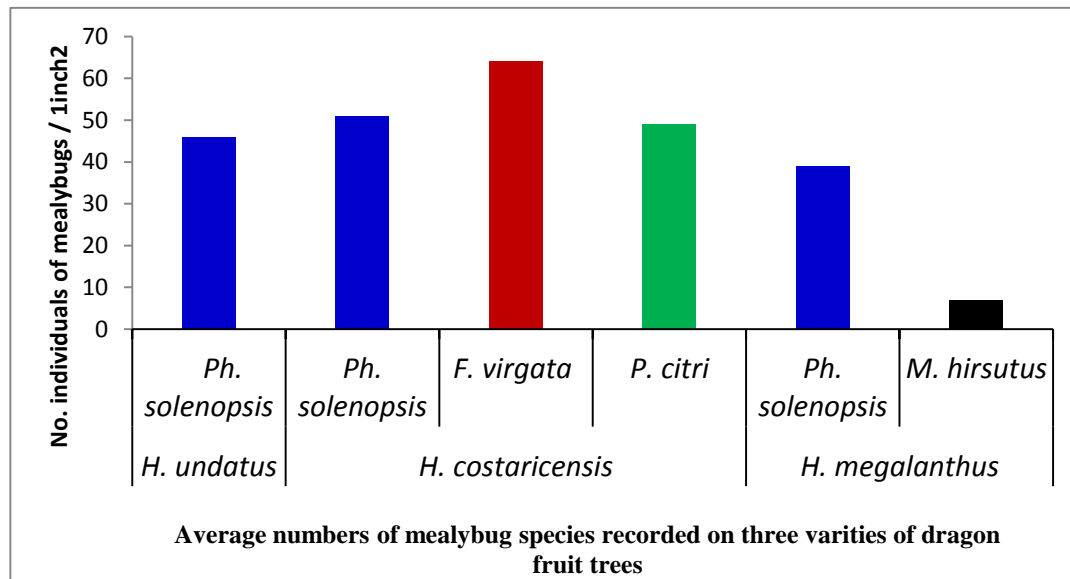
The degree of infestation with the four mealybug species which recorded on dragon fruit varieties was presented in Table (2) and illustrated in Figure (3). The obtained results showed different infestation with mealybug species on dragon fruit varieties at the three different localities. The red-fleshed pitaya, *H. costaricensis* had the heaviest infestation with three pseudococcids mealybugs, *Ph. solenopsis*, *F. virgata* and *P. citri*,

respectively. The followed by Yellow pitaya which is infested with *P. solenopsis* and *M. hirsutus*, respectively. The white-fleshed pitaya infested with only one mealybug species, *Ph. solenopsis* but a heavy infestation. On the other side, *Ph. solenopsis* has more population density on the three varieties of dragon fruit followed *F. virgata* on (Red-fleshed pitaya), *H. costaricensis*. The lowest density was *M. hirsutus* on Yellow pitaya, *H. megalanthus*.

**Table (2): The mealybug species which recorded on three varieties of dragon fruits and degrees of infestation.**

Dragon fruit varieties	Mealybug species recorded	Degree of infestation
<i>Hylocereus undatus</i> (White-fleshed pitaya)	<i>Phenacoccus solenopsis</i>	+++
<i>Hylocereus costaricensis</i> (Red-fleshed pitaya)	<i>Phenacoccus solenopsis</i>	+++
	<i>Ferrisia virgata</i>	+++
	<i>Planococcus citri</i>	++
<i>Hylocereus megalanthus</i> (Yellow pitaya)	<i>Phenacoccus solenopsis</i>	+++
	<i>Maconellicoccus hirsutus</i>	+

Note: (+): >10 individuals, (++): 11-25 individuals, (+++): < 25 /1 inch<sup>2</sup> According to Faclyate (1971)



**Figure (3): Average numbers of mealybug species were recorded on three dragon fruit varieties during March, 2020 to February, 2021 in three localities.**

**3. Natural enemies associated with mealybug species on dragon fruit trees:**

Results in Table (3) and Figure (4) revealed the parasitoids and predators associated with surveyed four mealybug species on dragon fruit varieties at three localities as follows:

- The cotton mealybug, *Ph. solenopsis* was associated with encyrtid parasitoid, *Aenasius arizonensis* (Giraut) and signiphorid, *Chartocerus dactylopii* (Ashmead) whereas, has one cecidomiid predator *Dicrodiplosis manihoti* Harris
- The citrus mealybug, *P. citri* was associated with two encyrtid parasitoids, *Coccidoxenoides peregrinus* (Timberlake) and *Leptomastix abnormis* (Giraut), also,

has one cecidomiid predator *Diadiplosis donaldi* (Harris) .

- The hibiscus mealybug, *M. hirsutus* was associated with two encyrtid parasitoids, *Anagyrus kamali* Moursi and *Leptomastix dactylopii* Howard.
- The striped mealybug, *F. virgata* was associated with encyrtid parasitoid, *Blepyrus insularis* (Cameron) and one coccinellid predator *Cryptolaemus montrouzieri* Mulsant.

These results are in harmony with those obtained by many authors ,Abdul Rahman *et al.* (2010); Aga *et al.* (2016); Attia and Awadallah (2016 a and b), Attia and El Arnauty (2009) and Afifi *et al.* (2010) and Attia (2012) they recorded the same parasitoids and predators on the above mentioned mealybugs but different host plants.

Table (3): Natural enemies associated with mealybug species recorded on dragon fruit varieties at three localities in the new reclaimed lands (March,2020 -February, 2021).

Mealybug species	Parasitoids and predators with their families	
<i>Phenacoccus solenopsis</i>	<i>Aenasius arizonensis</i> (Giraut)	Hymenoptera – Encyrtidae
	<i>Chartocerus dactylopii</i> (Ashmead)	Hymenoptera- Signiphoridae
	<i>Dicrodiplosis manihoti</i> Harris	Diptera – Cecidomiidae
<i>Planococcus citri</i>	<i>Coccidoxenoides peregrinus</i> (Timberlake)	Hymenoptera -Encyrtidae
	<i>Leptomastidae abnormis</i> (Giraut)	
	<i>Diadiplosis donaldi</i> (Harris)	Diptera – Cecidomiidae
<i>Maconellicoccus hirsutus</i>	<i>Anagyrus kamali</i> Moursi	Hymenoptera- Encyrtidae
	<i>Leptomastix dactylopii</i> Howard	
<i>Ferrisia virgata</i>	<i>Blepyrus insularis</i> (Cameron)	Hymenoptera -Encyrtidae
	<i>Cryptolaemus montrouzieri</i>	Coleoptera -Coccinellidae

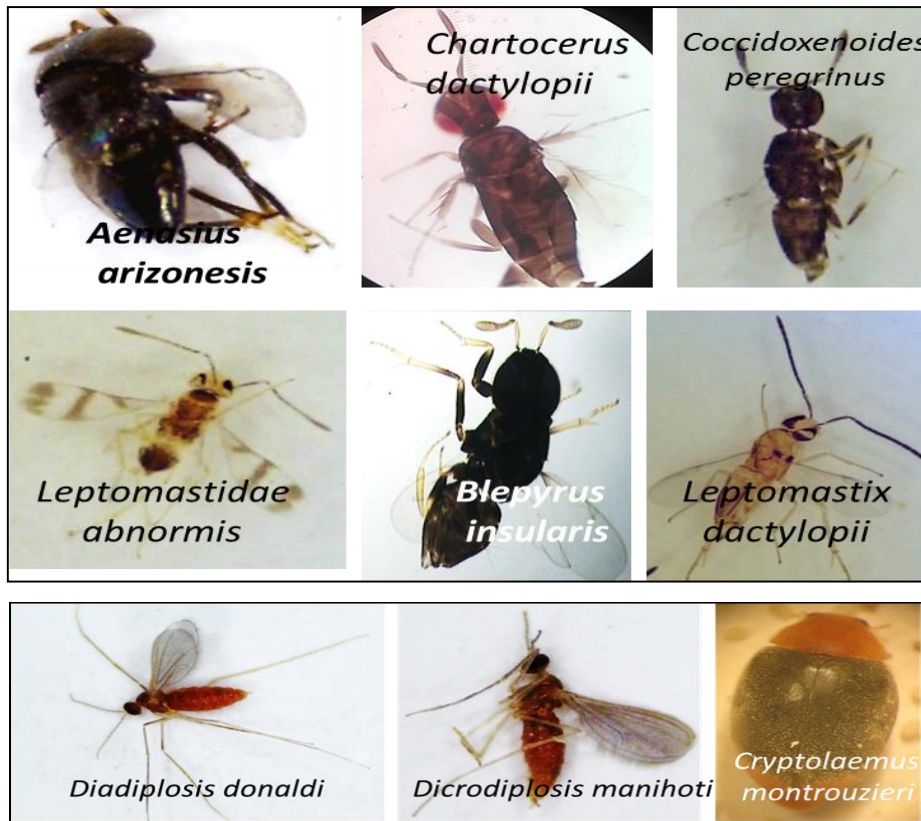


Figure (4): Parasitoids and predators associated with recorded four mealybug species on dragon fruit varieties.

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