

SURVEY OF SCALE INSECTS AND MEALYBUGS INFESTING SOME AVOCADO CULTIVARS AND THEIR ASSOCIATED NATURAL ENEMIES IN EGYPT

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Abstract

The present work was conducted for one year (January - December, 2013) on six avocado cultivars cultivated in new reclaimed lands at Borg El Arab (Alexandria Governorate), El Bostan (Beheira Governorate), El Sadat (Menofiya Governorate) and Sarapium (Ismailiya Governorate). The study was conducted to survey the scale insect and mealybug species and their associated natural enemies as well as the degree of infestation on avocado trees. The obtained results revealed eight species of scale insects and Mealybugs. Two cochineal species [*Coccus hesperidum* L. and *Pulvinaria psidii* (Mask.)], Four diaspidid species [*Hemiberlesia lataniae* (Sign.), *Aulacaspis tubercularis* (Newst.), *Aonidiella aurantii* (Mask.) and *Aspidiotus nerii* Bouche] and Two Pseudococcid species [*Pseudococcus longispinus* (Targ.-Tozz.) and *Ferrisia virgata* (Ckll.)]. Associated parasitoids were *Coccophagus scutellaris* on *C. hesperidum*, *Aphytis lepidosaphes*, *Habrolepis aspidioti* and *Marietta leopardina* on *H. lataniae*, *Encarsia citrina* and *Habrolepis diaspidi* on *A. tubercularis* and *Anagyrus* spp. on *P. longispinus*. Also, associated predators were *Rodalia cardinalis* on *C. hesperidum* and two coccinellid predators (*Cryptolaemus montrouzieri* and *Scymnus syriacus*) on *P. longispinus*. *H. lataniae* was the most abundant (56.8%) followed by *F. virgata* (42.5%), *A. tubercularis* (39.8%), *P. longispinus* (31.7%), *C. hesperidum* (26.6%), *P. psidii* (15%), *A. aurantii* (15%) and *A. nerii* (14.3%). Hass cultivar proved the highest infestation rate in the four localities followed by Boothy and Waldim cultivars. Fuerte, Gwen and Lula cultivars had the lowest infestation rate.

INTRODUCTION

Avocado, *Persea americana* Mill (family Lauraceae) is evergreen trees and native to Central and South America, it grown in most tropical and subtropical areas. Avocado fruits are a rich source in vitamins and minerals. The fruits mature on the tree and ripen off of the tree in a few days when stored at room temperature.

Avocado trees are attacked with many scale insect and mealybug species worldwide as Colombia (Foldi and Watson, 2001, Gil *et al.*, 2007, Kondo, 2010 and

Kondo *et al.*, 2012), USA (Rugman-Jones *et al.*, 2009), Chile (Navea and Vargas, 2012), Mexico (Lazaro-Castellanos *et al.*, 2012) and Israel (Swirski & Wysoki, 1995).

Scale insects and mealybugs causing considerable reduction in quantity and quality of avocados crop. *Hemiberlesia lataniae* (Signorte) infested up to 34% of the fruits during 1991-92 in New Zealand (Blank *et al.*, 1994). However, scale insects, *Abgrallaspis aguacatae* and *Hemiberlesia lataniae* were occasional pests of Hass cultivar in Mexico but they can cause problems during the production and packing of the fruits (Hernandez-Rivero *et al.*, 2013).

In Egypt, many avocado cultivars have been cultivated in new reclaimed lands in Borg El Arab (Alexandria Governorate), El Bostan (Beheira Governorate), El Sadat (Menofiya Governorate) and Sarapium (Ismailiya Governorate) and up to date no official records for avocado pests in Egypt for scale insect and mealybug species is available. The present work was conducted to survey the scale insect and mealybug species on avocado cultivars as well as their associated natural enemies and degree of infestation with the scale pests.

MATERIALS AND METHODS

Survey of scale insects and mealybugs on avocado cultivars cultivated in new reclaimed lands were carried out for one complete year (January - December, 2013) in Borg El-Arab (Alexandria Governorate), El-Bostan (Beheira Governorate), El-Sadat (Menofiya Governorate) and Sarapium (Ismailiya Governorate). Monthly samples (20 leaves, 4 twigs /20 cm long) and 4 avocado fruits) were collected randomly from avocado trees. The study was conducted on six cultivars *i.e.* Hass, Lula, Fuerte, Boothy, Gwen and Waldim as follows: El-Bostan (Boothy, Fuerte, Hass and Waldim), El Sadat (Boothy, Fuerte, Hass and Lula), Borg El Arab (Gwen, Lula and Waldim) and Sarapium (Gwen, Hass and Waldim). Collected samples were transferred to laboratory in paper bags for inspection. The scale insects and mealybugs were identified and sorted to different stages. After examined the leaves and twigs of avocado cultivars per each sample, some specimens from each scale species were confined in glass jars and kept in the laboratory for securing any emerging parasitoids. The surveyed scale insect and mealybug species and their natural enemies were identified in the Scale Insects and Mealybugs Division, Plant Protection Research Institute, Agricultural Research Center.

Degree of infestation with the scale insect and mealybug species was determined according to equation recorded by Facylate (1971):

$$\text{Degree of infestation} = (n / N) \times 100$$

Where:

n = Number of infested samples.

N = Total number of samples.

The surveyed scales were classified to three categories according to their percent of infestation as follows:

- Heavy infestation when percentages more than 50%.
- Medium infestation when percentages between 25 -50%.
- Low infestation when percentages between 1 -25%.

RESULTS AND DISCUSSION

Surveyed scale insect and mealybugs

The obtained results (Table 1) revealed 8 species of scale insect and mealybugs on avocado cultivars at four localities (Borg El-Arab, El-Bostan, El-Sadat and Sarapium). The Surveyed species belonging to three families as follows:

Table 1. Scale insect and mealybug species recorded on different parts of avocado cultivars at four localities in the new reclaimed lands (January - December, 2013).

Family	Common name	Scientific name
Coccidae	Soft brown scale	<i>Coccus hesperidum</i> L.
	Green shield scale	<i>Pulvinaria psidii</i> Mask.
Diaspididae	Latania scale	<i>Hemiberlesia lataniae</i> (Sign.)
	White mango scale	<i>Aulacaspis tubercularis</i> (Newst.)
	California red scale	<i>Aonidiella aurantii</i> (Mask.)
	Oleander scale	<i>Aspidiotus nerii</i> Bouche.
Pseudococcidae	Long-tailed mealybug	<i>Pseudococcus longispinus</i> (Targ. -Tozz.)
	Striped mealybug	<i>Ferrisia virgata</i> (Ckll.)

Family: Coccidae

Two coccid species were recorded at the four localities i.e. the soft brown scale, *Coccus hesperidum* L and green shield scale, *Pulvinaria psidii* (Mask.). These species suck the plant sap of leaves and secreted a large amount of honeydew which encourages the growth of sooty mould fungus. In addition, the infested trees became dirty black appearance which affected on photosynthesis and respiration processes. Swirski and Wysoki (1995) recorded the pyriform scale, *Protopulvinaria pyriformis* (Ckll.) on avocado trees in Israel. Kondo (2010) recorded a new soft scale insect, *Bombacoccus aguacatae* Kondo from the branches and twigs of avocado cultivated in Colombia South America.

Family: Diaspididae

Four diaspidid species were recorded on different parts of avocado cultivars at the four localities. They were Lataniae scale, *H. lataniae*, white mango scale, *A. tubercularis*, California red scale, *A. aurantii* and Oleander scale, *A. nerii*. The recorded species occurs on leaves, twigs and fruits and causes colored spots on the leaves and fruits of avocado cultivars. The infested leaves will be drop prematurely not only due to feeding on plant sap but also due to toxicity of saliva of some species as the white mango scale, *A. tubercularis* (Pena *et al.*, 1997), Heavy infested avocado trees appear unhealthy and grow poorly

In USA, Rugman-Jones *et al.* (2009) found six diaspidid species infesting avocado fruits (Hass cultivar) in California they were *Abgrallaspis aguacatae* Evans, Watson & Miller, *H. lataniae*, *Hemiberlesia* sp. near *lataniae*, *Hemiberlesia. rapax* (Comstock), *Acutaspis albopicta* (Ckll.), and *Pinnaspis strachani* (Cooley) besides two another additional species, *Diaspis miranda* (Ckll.) and *Diaspis* sp. near *Miranda*. Navea and Vargas (2012) revealed that *Hemiberlesia lataniae* becomes a major pest of avocado in Chile and reached high populations in the fruits because of limited natural control.

Lazaro-Castellanos *et al.* (2012) reported three armored scales (*H. lataniae*, *A. aguacatae* and *H. rapax*) infesting avocado leaves, branches and fruits in Mexico. They reported *Encarsia citrina* to parasitize these armored scale species and had better potential in management of armored scales and present most of the year. However, Hernandez-Rivero *et al.* (2013) showed that, the armored scales (*A. aguacatae* and *H. lataniae*) were occasional pests of Hass cultivar in Mexico but they can cause problems during the production and packing of the fruits.

Family: Pseudococcidae

Two Pseudococcid species were recorded on the fruit of avocado trees, the long-tailed mealybug, *P. longispinus* and the striped mealybug, *F. virgata*. They sucking the plant sap and secreting honeydew which leads to growth of sooty mould. The black fungus coats the upper surface of leaves interfering with photosynthesis. In this respect, Swirski and Wysoki (1995) reported that, the long-tailed mealybug, *P. longispinus* is a pest on avocado trees in Israel.

Natural enemies associated with avocado scales

Results in Table (2) revealed the parasitoids and predators associated with surveyed scale insect and mealybug species on avocado cultivars at four localities as follows:

Coccid pests: The soft brown scale, *C. hesperidum* associated with one aphelinid parasitoid, *C. scutellaris* and green shield scale, *P. psidii* associated with one coccinellid predator, *R. cardinalis*.

Diaspidid pests: The latania scale, *H. lataniae* associated with three aphelinid parasitoids (i.e. *A. lepidosaphes*, *H. aspidioti* and *M. leopardina*) whereas the white mango scale *A. tubercularis* was associated with the Aphelinid parasitoid, *E. citrina* and the encyrtid parasitoid, *H. diaspidi*. California red scale *A. aurantii* associated with the aphelinid parasitoid, *A. maculicornis* and the oleander scale *A. nerii* was associated with the encyrtid parasitoid, *H. aspidioti*.

Pseudococcid pests: The long-tailed mealybug, *P. longispinus* was associated with encyrtid parasitoids, *Anagyrus* spp. whereas the striped mealybug, *F. virgata* has two coccinellid predators *C. montrouzieri* and *S. syriacus*.

Abundant of scale insect and mealybug species on avocado trees

The abundant of scale insect and mealybug species on avocado trees in the four localities were noticeably varied (Fig. 1). The highest abundant scale on avocado trees in the four localities was *H. lataniae* as 56.8% followed by *F. virgata* and *A. tubercularis* (42.5% and 39.8%, respectively). *P. longispinus* and *C. hesperidum* came in the 4th order and presented by 31.7% and 26.6%. *P. psidii*, *A. aurantii* and *A. nerii* had lower percentages of all collected species in the four localities, they came in the last order and presented by 15%, 15% and 14.3% respectively.

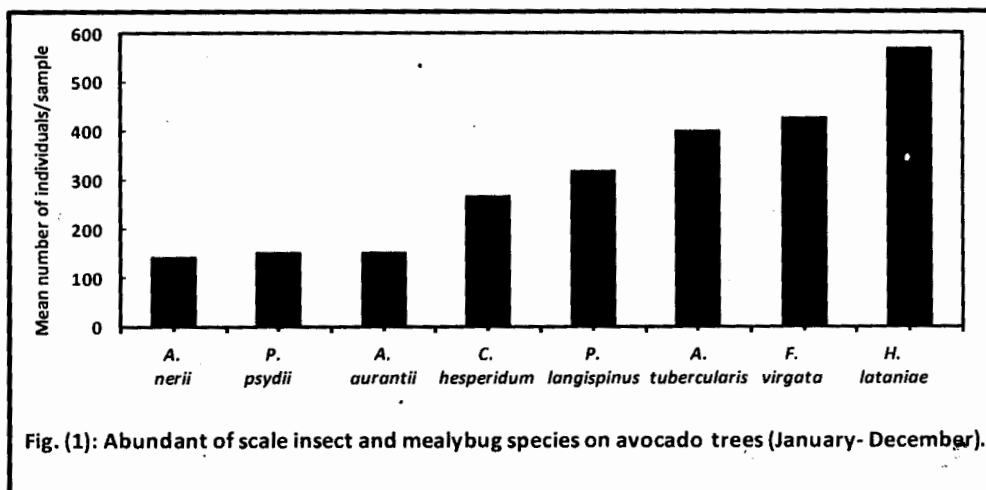
Table 2. Natural enemies associated with scale insects and mealybugs recorded on avocado cultivars at four localities in the new reclaimed lands (January-December, 2013).

Insect pest	Associated parasitoids and predators with their families names and orders	
<i>Coccus hesperidum</i> L.	<i>Coccophagus scutellaris</i>	Aphelinidae - Hymenoptera
<i>Pulvinaria psidii</i> Mask.	<i>Rodalia cardinalis</i>	Coccinellidae - Coleoptera
<i>Hemiberlesia lataniae</i> (Sign.)	<i>Aphytis lepidosaphes</i>	Aphelinidae - Hymenoptera
	<i>Habrolepis aspidioti</i>	
	<i>Marietta leopardina</i>	
<i>Aulacaspis tubercularis</i> (Newst.)	<i>Encarsia citrina</i>	Aphelinidae - Hymenoptera
	<i>Habrolepis diaspidi</i>	Encyrtidae - Hymenoptera
<i>Aonidiella aurantii</i> (Mask.)	<i>Aphytis maculicornis</i>	Aphelinidae - Hymenoptera
<i>Aspidiotus nerii</i> Bouch.	<i>Habrolepis aspidioti</i>	Encyrtidae - Hymenoptera
<i>Pseudococcus longispinus</i> (Targ.-Tozz)	<i>Anagyrus</i> spp.	Encyrtidae - Hymenoptera
<i>Ferrisia virgata</i> (Ckll.)	<i>Cryptolaemus montrouzieri</i>	Coccinellidae - Coleoptera
	<i>Scymnus syriacus</i>	

Degree of infestation

Degree of infestation with scale insect and mealybug species on avocado cultivars was presented in Table (3) and illustrated in Fig. (2). The obtained results

showed different infestation with scale insect and mealybug species on avocado cultivars cultivated at Borg El-Arab (Alexandria Governorate). The Hass cultivar had the heaviest infestation with scale insect and mealybug species followed by Waldim cultivar with medium infestation whereas Fuerte, Gwen and Lula cultivars had lower infestation rate.



In El-Bostan locality at Beheira Governorate Hass cultivar showed heavy infestation with scale insect and mealybug species followed by Boothy and Waldim cultivars with medium infestation while Fuerte and Gwen cultivars have lower infestation with scale insect and mealybug species.

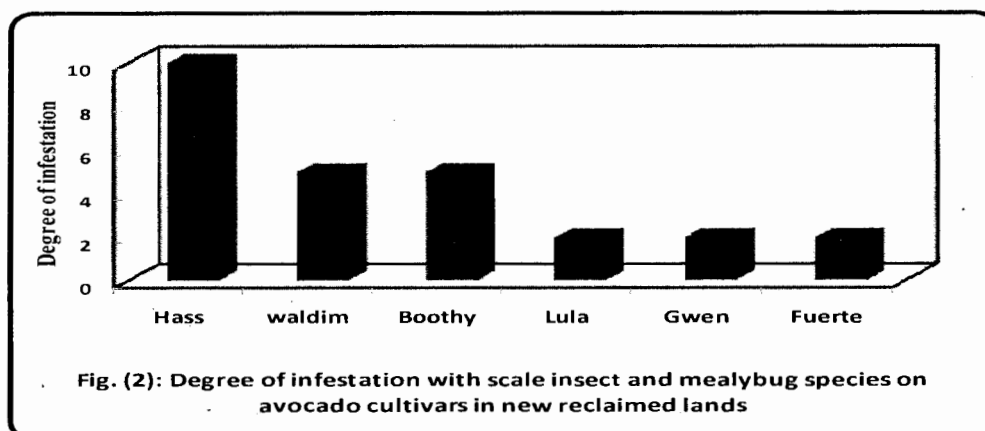
In El-Sadat locality at Menofiya Governorate Hass cultivar showed heavy infestation with scale insect and mealybug species followed by Boothy cultivar with medium infestation while Fuerte and Lula cultivars have lower infestation with scale insect and mealybug species.

In Sarapium locality at Ismailiya Governorate Hass cultivar showed heavy infestation by scale insect and mealybug species followed by Waldim cultivar with medium infestation while Fuerte and Gwen cultivars have lower infestation with scale insect and mealybug species.

Generally, Hass cultivar proved to be the highest infestation with scale insect and mealybug species in the four localities in the new reclaimed lands followed by Boothy and Waldim cultivars whereas Fuerte, Gwen and Lula cultivars were the lowest in this respect. Wysoki *et al.* (1977) graded the common avocado varieties grown in Israel in descending order of susceptibility to *Pseudococcus longispinus* as follows: Hass, Nabal, Fuerte and Ettinger cultivar.

Table 3. Degree of infestation with scale insect and mealybug species on different avocado cultivars cultivated in the different localities in the new reclaimed lands.

Governorate	Locality	Avocado cultivar	Degree of infestation
Alexandria	Borg El- Arab	Hass	Heavy
		Waldim	Medium
		Fuerte	Low
		Gwen	Low
		Lula	Low
Beheira	El- Bostan	Hass	Heavy
		Boothy	Medium
		Waldim	Medium
		Fuerte	Low
		Gwen	Low
Menofiya	El- Sadat	Hass	Heavy
		Boothy	Medium
		Lula	Low
		Fuerte	Low
		Gwen	Low
Ismailiya	Sarapium	Hass	Heavy
		Waldim	Medium
		Fuerte	Low
		Gwen	Low



Foldi and Watson (2001) recorded *Laurencella colombiana* (Hemiptera: Margarodidae) as a new scale insect pest of avocado trees in Colombia and is becoming increasingly important at altitudes over 2000 meters above sea level, killing branches by excessive extraction of plant sap and reducing productivity by causing development of sooty mould on leaves and fruit. Recently, Kondo *et al.* (2012) reported the multicatrices fluted scale, *Crypticerya multicatrices*. Kondo and Unruh (Hemiptera: Monophlebidae) from the islands of San Andres and Providence of Colombia as a recent invasive species on avocado and numerous plants of economic importance.

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حصص الحشرات القشرية والبق الدقيقى والاعداء الحيوية المرتبطة بها على أصناف الأفوكادو فى مصر

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أجريت الدراسة الحالية لمدة عام (يناير - ديسمبر ٢٠١٣) على ستة أصناف أفوكادو منزرعة فى أراضى مستصلحة جديدة فى أربعة مناطق بأربعة محافظات (برج العرب بالإسكندرية والسادات بالمنوفية وسراييوم بالإسماعيلية ومنطقة البستان بمحافظة البحيرة) حيث تمثل هذه المناطق مراكز زراعة الأفوكادو فى مصر بغرض حصر الحشرات القشرية والبق الدقيقى والاعداء الحيوية المرتبطة بها (طفيليات ومفترسات) ودرجة الإصابة على أصناف الأفوكادو المختلفة فى مناطق الدراسة.

أتضح من نتائج الدراسة وجود ثمانية أنواع من الحشرات القشرية والبق الدقيقى تنتمى لثلاثة فصائل حشرية هى فصيلة الحشرات القشرية الرخوة وتضم الحشرة القشرية البنية الرخوة وحشرة البلفناريا، فصيلة الحشرات القشرية المسلحة وتضم حشرة اللاتنيا القشرية وحشرة المانجو القشرية البيضاء والحشرة القشرية الحمراء وحشرة النقلة القشرية وفصيلة البق الدقيقى الكاذب وتضم البق الدقيقى ذو الذنب الطويل وبق الفرجاتس الدقيقى.

ومن الدراسة وجد طفيل *Coccophagus scutellaris* مصاحبا للحشرة القشرية البنية الرخوة ، وثلاثة طفيليات (*Marietta leopardina* و *Habrolepis aspidioti* و *Aphytis lepidosaphes*) مصاحبة لحشرة اللاتنيا القشرية ، والطفيليان *Encarsia citrine* و *Habrolepis diaspidi* مصاحبان لحشرة المانجو القشرية البيضاء وأنواع من جنس الـ *Anagyrus spp.* مصاحبة للبق الدقيقى ذو الذنب الطويل ومن المفترسات وجد المفترس *Rodalia cardinalis* مصاحبا لحشرة البلفناريا والمفترسان *Cryptolaemus montrouzieri* و *Scymnus syriacus* مصاحبان لبق الفرجاتس الدقيقى.

و كانت حشرة اللاتنيا القشرية هى الحشرة السائدة على أصناف الأفوكادو (٥٦.٨%) ثم بق الفرجاتس الدقيقى (٤٢.٥%) وحشرة المانجو القشرية البيضاء (٣٩.٨%) والبق الدقيقى ذو الذنب الطويل (٣١.٧%) والحشرة القشرية البنية الرخوة (٢٦.٦%) وانخفضت كثيرا الإصابة بحشرة البلفناريا والحشرة القشرية الحمراء وحشرة النقلة القشرية (١٤.٣ - ١٥%) كما اختلفت درجة إصابة أصناف الأفوكادو بالحشرات القشرية والبق الدقيقى حيث كان الصنف هاس شديد الإصابة وكان الصنفين ولديم وبوسى متوسطى الإصابة بينما كانت الأصناف لولا وجوين وفويرت منخفضة الإصابة .