

SURVEY OF SCALE INSECTS, MEALY BUGS AND ASSOCIATED NATURAL ENEMIES ON MULBERRY TREES IN THE NILE DELTA

HENDAWY, A. S., I. A. I. SAAD and REHAB H. TAHA

Plant Protection Research Institute, ARC, Dokki, Giza, Egypt

(Manuscript received 14 July 2013)

Abstract

Sampling of two mulberry tree species namely *Morus alba* L. and *M. nigra* L. was conducted from January 2011 to December 2012 to determine the arthropod pests attacking the trees, and their associated natural enemies at Delta region. Two arthropod classes were recorded during the present study (Insecta and Arachnida). Scale insects (*Asterolecanium pustulans* (Ckll.), *Ceroplastes rusci* L., *Coccus hesperidum* L., *Saissetia oleae* (Bern.), *Pseudaulacaspis pentagona* (Targ.-Tozz.), *Hemiberlesia lataniae* Signoret) and mealy bugs (*Icerya aegyptiaca* (Dough), *Icerya purchasi* Maskell, *Icerya seychellarum* (Westw.), *Ferrisia virgata* (Ckll.), *Planococcus citri* (Risso), *Maconellicoccus hirsutus* (Green)) were surveyed as major insect pests. The minor ones were accounted for 24 species (including insects and mites). The parasitoids associated with scale insects and mealy bugs were arranged in five families, *Aphytis* spp., *Encarsia citrina* (Crawford), *Anagyrus kamali* Moursi, *Metaphycus* sp., *Allotropa mecrida* (Walker), *Scutellista caerulea* (Fonscolombe) the most occurring. As for predators, 31 insect species and 9 spiders were found associated with the two pest categories. The predatory mites were identified as two species, which regulate the spider mites. Population fluctuations of mulberry mealy bug, *Maconellicoccus hirsutus* (Green) were found related to the population fluctuation of *Nephus bipunctatus*.

INTRODUCTION

Mulberry, *Morus alba* L. (Moraceae) is a widespread and important fruit tree. It is also used for silkworm feed, and a source of woods in many parts of the world including Egypt. In temperate and sub-tropical climates, mulberries are deciduous, under tropical upland conditions they are in leaf throughout the year (FAO, 2002, and Govindaiah, *et al.*, 2005).

Sericulture is the most important commercial use for white mulberry. Qualitative and quantitative leaves can only ensures quality cocoon and quality silk (Govindaiah, *et al.*, 2005). *Morus alba* is attacked by many pests (Sanchez, 2000 and Rama and Kumar 2007). The mulberry *M. alba* and *M. nigra* are cultivated in Egypt around the roads, houses and farms, many local trees scattered all over the Egyptian country

side. The mulberry trees have not any protection, pruning and fertilizer treatments. Many mites, insect pests cause a problem on shoots and leaves. Incidence of these pests in around the Egyptian area is unknown.

As the authors aware, no studies were conducted on insect pests of mulberry trees in Egypt. However, Hosny *et al.*(1976), in a text book, mentioned that mulberry trees as a wood tree are attacked by some insect pests, the Egyptian mealy bug, *Icerya aegyptiaca* (Douglas), the pink hibiscus mealy bug, *Maconellicoccus hirsutus* (Green), the fig wax scale *Ceroplastes rusci* (L.), the pit-making scale, *Asterolecanium pustulans* (Ckll.), the Egyptian cotton leafworm, *Spodoptera littoralis* (Boisd.), the large brown longhorn beetle *Macrotoma palmata* (F.) and the longhorned beetle, *Rhaesus serricollis* (Motschulsky). Attia, (2012) recorded striped mealy bug, *Ferrisia virgata* (Cockerell) on *Morus alba* in Cairo and Giza Governorates parasitized by *Blepyrus insularis*.

Mulberry mealy bug, *Maconellicoccus hirsutus* (Hemiptera: Pseudococcidae) infestation of white and black mulberry causes malformation of terminal buds and appearance of small curly leaves on the shoots and top apical. *M. hirsutus* is a serious polyphagous pest feeding voraciously on mulberry leaves (Manjunath *et al.*, 2006, Mala *et al.*, 2007). The pest has been found on 215 genera of plants. Its wide host range favors rapid and complicated effective control. A heavy black sooty mold sometimes develops on infested leaves and stems as a result of the mealy bug heavy secretion was described by Alleyne, (2004). *M. hirsutus* was considered an economic pest in many of the tropical and semi tropical regions of the world (CABI/EPPO, 2004). Many Egyptian studies have addressed the natural enemies of scale insects and mealy bugs (Hendawy 1999, Abd-Rabou and Hendawy 2000, Mousa *et al* 2001, Hendawy *et al* 2002, Abd-Rabou and Hendawy 2005). The current study aimed to survey the local pests attacking the mulberry trees and their natural enemies in Delta Region of Egypt.

MATERIAL AND METHODS

Surveys were carried out at Delta region (Kafr El-Sheikh and Gharbia governorats) from January 2011 to December 2012 on mulberry trees, *Morus alba* L. and *M. nigra* L. to determine the arthropods attacking these trees and their natural enemies. The trees aged 3 -10 years old and scattered in plantations of annual crops (rice, maize, cotton, soybean, bean, clover, sugar beet, flax and wheat), around citrus and table grape orchards, water canals and roads. The considered trees were not treated with any of insecticides throughout the experimental period because most of trees are close to irrigation canals and rural roads.

Sampling of arthropods:**Parasitoids:**

Monthly samples (January 1st, 2011 up to December 30th, 2012) were taken from mulberry trees at Sakha and Kotoor areas. At each location, five mulberry trees were assigned, throughout the experimental period, for sampling. When sampling, 20 leaves and 4 branches (shoots) were picked up from a tree. Each tree was sampled from the four cardinal directions, east, west, north and south, as five leaves and one branch per direction. Thus, at each sampling date, 100 leaves and 20 branches were obtained from a location. The collected leaves and shoots were introduced into paper bags, and transferred to the insect laboratory, Sakha Agricultural Research Station for examinations.

Leaves having parasitoid insects only were separated from other insect infestations. Then, they were introduced into wooden boxes (50 x20 x 20 cm.) to collect the emerging parasitoids. A glass tube was inserted into a round hole of the box. An electric lamp (60w.) was placed in front of the box to attract emerging parasitoids, and enter the glass tube. Emerging parasitoids were identified and monitored and collected continuously by substituting the tubes having the parasitoids by new ones. Also, mulberry leaves were replaced by new ones having alive insects every two weeks.

Predators :

The insect pests, insect predators and spiders associated with mulberry insects were surveyed. Monthly samples were taken from the same five trees assigned for sampling insect pests, and at the same day. When sampling, the arthropods of four branches per tree were excluded by introducing the branch into a white cloth bag (50 cm long). Then, the branch was strongly beaten to drop the occurring arthropods inside the cloth bag. This procedure was conducted for the four branches of a tree. Thus, the arthropods were collected from 20 branches/ location/ sample. The cloth bag was thoroughly closed, transferred to the laboratory at Sakha Agricultural Research Station and kept in the refrigerator to anesthetize the confined arthropods. Fifteen minutes later, the bag was taken out from the refrigerator and emptied to examine and count the insect pests and natural enemies. Afterwards, specimens were kept in insect wooden boxes or into glass vials with 70 % ethyl alcohol, and two drops of glycerin to keep the arthropod tissues soft, to be easily handled, and identified.

Examination and Identification:

Monthly, the 100 leaves and twenty five branches of mulberry of a location were examined, and numbers of arthropods were recorded using a binocular microscope. Specimens of mites, insect pests, predators and emerging parasitoids were separated and initially identified, then sent to the Systematic Research Department and Biological Control Research Department at Plant Protection Research Institute, Giza, Egypt for confirming the identification.

Relationship between *Maconellicoccus hirsutus* and its predator, *Nephus bipunctatus*

During observations in Kafr-El Sheikh governorate, larvae and adults of *Nephus bipunctatus* (Kugelann) were found feeding voraciously on all stages of the *M. hirsutus*. Seasonal distribution of *M. hirsutus* and adult of *N. bipunctatus* was recorded on white mulberry from May to October, 2011. Randomly 10 shoots (20 cm. length) were taken from 5 mulberry trees in four direction, Kept in paper and polyethylene bags and transferred to laboratory to count the population of mulberry mealy bug (MMB) and its predator.

RESULTS AND DISCUSSION

Arthropod pests inhabiting mulberry trees were surveyed on mulberry trees at Kafr El-Sheikh and Gharbia Governorates (Table 1).

Three mite species belonging to two families, Tenuipalpidae (one species) and two species were related to Tetranychidae. These species were detected from May - June or from May - September, according to the mite species. The surveyed arthropods were categorized regardless of the governorates. Thus, the listed insect pests, parasitoids and predators, were presented occurring in both locations. Twenty one insect species, belonging to thirteen families and five orders, were surveyed. Two species are related to order Thysanoptera by two families and two species (April-May). Order Hemiptera have two families and three species, *Nezara viridula* was detected from May to October. Homoptera is represented by four species and three families. Lepidoptera and Coleoptera are represented by six species for each. Lepidoptera have three families, Noctuidae (4 species), Phycitidae and Lyonetiidae one species for each. Coleoptera is represented by three families, Scarabaeidae (2 species), Cerambycidae (3 species) and Scolytidae (one species).

Table 1. Occurrence of minor arthropod pests attacking mulberry trees at Delta region from January 2011 to December 2012

Order/ Family	Species	Period of occurrence
Acarina		
Tenuipalpidae	<i>Brevipalpus</i> sp.	May- June
Tetranychidae	<i>Panonychus ulmi</i> (Koch)	May- June
	<i>Tetranychus urticae</i> Koch	May-Sept.
Insecta		
Thysanoptera		
Phlaeothripidae	<i>Haplothrips</i> sp.	April- May
Thripidae	<i>Thrips tabaci</i> Lindman	April- May
Hemiptera		
Miridae	<i>Campylomma</i> sp.	May
Pentatomidae	<i>Agonoscelis pubescens</i> Thunb. <i>Nezara viridula</i> (L.)	May May-October
Homoptera		
Aleyrodidae	<i>Bemisia tabaci</i> (Genn.)	April- May
Aphidae	<i>Aphis gossypii</i> Glov. <i>Myzus persicae</i> (Sulz.)	June-August June-August
Cicadellidae	<i>Empoasca decipiens</i> Paoli	June-August
Lepidoptera		
Noctuidae	<i>Autographa gamma</i> (L.) <i>Trichoplusia ni</i> (Hbn.) <i>Spodoptera exigua</i> (Hbn.) <i>Spodoptera littoralis</i> (Boisd.)	May May April- September April- October
Phycitidae	<i>Cryptoblabes gnidiella</i> (Mill.)	April-May
Lyonetiidae	<i>Lyonetia clerkella</i> (L.)	May
Coleoptera		
Scarabaeidae	<i>Pachnoda fasciata</i> (F.) <i>Tropinota squalida</i> (Scop.)	March March –April
Cerambycidae	<i>Macrotoma palmata</i> (F.) <i>Rhaesus serricollis</i> (Motsch.) <i>Chlorophorus varius</i> (Muell.)	July on <i>M. alba</i> July on <i>M. alba</i> Jul., Aug. on <i>M. alba</i> & <i>M. nigra</i>
Scolytidae	<i>Scolytus rugulosus</i> (Muller)	Dead wood

Survey of scale insects and mealy bugs attacking mulberry trees:

Six species of scale insects were surveyed from mulberry trees. The scale insects are related to Asterolecaniidae, *Asterolecanium pustulans*, three Coccidae, *Ceroplastes rusci*, *Coccus hesperidum* and *Saissetia oleae*, and two Diaspididae, *Pseudaulacaspis pentagona* and *Hemiberlesia lataniae*. Three species of Pseudococcidae and three Margarodids, were surveyed at Kafr El-Sheikh and Gharbia Governorates (Table 2).

Scale insects and mealy bugs were previously surveyed from the Egyptian mulberry trees, *Icerya aegyptiaca*, *Maconellicoccus hirsutus*, *Ceroplastes rusci*, *Asterolecanium pustulans* (Hosny *et al*, 1976), *Ferrisia virgata* (Attia 2012).

Table 2. Scale insects and mealy bugs attacking mulberry trees at Delta region from January 2011 to December 2012

Family	Species	Period of occurrence
Asterolecaniidae	<i>Asterolecanium pustulans</i> (Ckll.)	January-December
Coccidae	<i>Ceroplastes rusci</i> L. <i>Coccus hesperidum</i> L. <i>Saissetia oleae</i> (Bern.)	June-August June-August June-August
Diaspididae	<i>Pseudaulacaspis pentagona</i> (Targ.-Tozz.) <i>Hemiberlesia lataniae</i> Signoret	January-December May - October
Margarodidae	<i>Icerya aegyptiaca</i> (Dough) <i>Icerya purchasi</i> Maskell <i>Icerya seychellarum</i> (Westw.)	May – October May – October May - October
Pseudococcidae	<i>Ferrisia virgata</i> (Ckll.) <i>Planococcus citri</i> (Risso) <i>Maconellicoccus hirsutus</i> (Green)	May – October May – October May - October

Survey of parasitoids:

Seventeen species of super family Chalcidoidea belonging to five families and ten genera were collected during the period of study (January, 2011 till December, 2012) associated with mulberry armored, soft scales and mealy bugs. The obtained results in Table (3) show the parasitoid species and their hosts.

Table 3. Hymenopterous parasitoids attacking mulberry scale insects and mealy bugs in Delta region from January 2011 to December 2012

Family	Parasitoid	Host species
Aphelinidae	<i>Aphytis</i> spp.	<i>Pseudaulacaspis pentagona</i> <i>Hemiberlesia lataniae</i>
	<i>Encarsia citrina</i> (Crawford)	<i>Pseudaulacaspis pentagona</i> <i>Hemiberlesia lataniae</i>
	<i>Coccophagus scutellaris</i> (Dalman)	<i>Coccus hesperidum</i>
	<i>Marietta leopardina</i> Motschulsky*	<i>Aphytis</i> spp.
Encyrtidae	<i>Anagyrus kamali</i> Moursi	<i>Maconellicoccus hirsutus</i>
	<i>Anagyrus seudococci</i> (Girault)	<i>Maconellicoccus hirsutus</i>
	<i>Blepyrus insularis</i> (Cameron)	<i>Ferrisia virgata</i>
	<i>Clausenia josefi</i> (Rosen)	<i>Maconellicoccus hirsutus</i>
	<i>Coccidoxenoides peregrines</i> (Timberlake)	<i>Planococcus citri</i>
	<i>Gyranusoidea</i> sp.	<i>Maconellicoccus hirsutus</i>
	<i>Leptomastidea abnormis</i> (Girault)	<i>Planococcus citri</i>
	<i>Leptomastix dactylopii</i> Howard	<i>Maconellicoccus hirsutus</i>
	<i>Metaphycus</i> sp.	<i>Ceroplastes floridensis</i> <i>Saissetia oleae</i>
<i>Microterys</i> sp.	<i>Coccus hesperidum</i>	
Signiphoridae	<i>Chartocerus</i> sp. *	<i>Leptomastidea abnormis</i>
Platygastridae	<i>Allotropa mecrida</i> (Walker)	<i>Maconellicoccus hirsutus</i>
Pteromalidae	<i>Scutellista caerulea</i> (Fonscolombe)	<i>Ceroplastes rusci</i> <i>Saissetia oleae</i>

* hyperparasitoid

Survey of predaceous insects:

Thirty one insect predators, belonging to six orders and 11 families were surveyed from mulberry trees. Most of surveyed species are belonging to coleopteran, mainly Coccinellidae. The important predators are *Chilocorus bipustulatus* L., *Exochomus flavipes* Thunb., *Hyperaspis* sp., *Nephus includens* (Kirsch), *Nephus bipunctatus* (Kugelann), *Pharoscymnus* sp., *Rhizobius litura* F., *Rodolia cardinalis* (Mulsant), *Pullus syriacus* Mulsant, *Cybocephalus* sp. as they prey upon scale insects and mealy bugs. Family Coccinellidae was represented by 16 predatory species surveyed in the current study (Table 4). This family was often detected by several Egyptian authors when surveyed the scale insects and mealy bugs predators in fruit trees, e.g. Priesner. and Hosny, 1940 and Hendawy 1999. In addition, two neuropterous species, *Conwentzia psociformis* (Curtis), *Chrysoperla carnea* Steph. prey upon the same insect pests.

Table 4. Predatory insects inhabiting mulberry trees at Delta region from January 2011 to December 2012

Order/ Family	Species	Prey
Thysanoptera Aeolothripidae	<i>Aeolothrips</i> sp.	Thrips, Mites
Hemiptera Anthocoridae	<i>Orius laevigatus</i> (Fieber) <i>Orius albidipennis</i> (Reuter)	Aphids, scale insects, mealy bugs, thrips, mites
Reduviidae	<i>Coranus</i> sp. (F.)	Moth
Coleoptera Coccinellidae	<i>Chilocorus bipustulatus</i> L. <i>Coccinella undecimpunctata</i> L. <i>Cydonia vicina</i> Isis Cr. <i>Cydonia vicina nilotica</i> Muls. <i>Cydonia vicina subsignata</i> Pic <i>Exochomus flavipes</i> Thunb. <i>Hippodamia convergens</i> G.-M. <i>Hyperaspis</i> sp. <i>Nephus includens</i> (Kirsch) <i>Nephus bipunctatus</i> (Kugelann) <i>Pharoscyrnus</i> sp. <i>Stethorus gilvifrons</i> Mulsant <i>Rhizobius litura</i> F. <i>Rodolia cardinalis</i> (Mulsant) <i>Scymnus interruptus</i> (Goeze) <i>Pullus syriacus</i> Mulsant	scale insects Aphids Aphids Aphids Aphids Aphids, Mealy bugs Aphids Aphids, Mealy bugs Mealy bugs Aphids, mealy bugs Mealy bugs Mites Aphids, <i>Icerya</i> spp. Aphids Aphids, Mealy bugs
Carabidae	<i>Bembidion</i> sp.* <i>Tachys</i> sp.*	Aphids
Cybocephalidae	<i>Cybocephalus</i> sp.	scale insects
Staphylinidae	<i>Paederus alfieri</i> Koch. <i>Philonthus</i> spp.	Aphids Aphids
Diptera Syrphidae	<i>Eupeodes corollae</i> (F.) <i>Paragus compeditus</i> (Wied.) <i>Sphaerophoria rueppelli</i> (Wied.)	Aphids Aphids Aphids
Neuroptera Coniopterygidae Chrysopidae	<i>Conwentzia psociformis</i> (Curtis) <i>Chrysoperla carnea</i> Steph.	Mites, mealy bugs Aphids, scale insects, mealy bugs, thrips, mites
Orthoptera Mantidae	<i>Mantis religiosa</i> L.	aphids, fruit flies, flies, moths

* Around tree trunks

Survey of predaceous mites:

Two predacious mites, belonging to family Phytoseiidae, and nine species, belonging to eight families of spiders, Araneidae, Dictynidae, Miturigidae, Lycosidae, Pholcidae Salticidae, Theridiidae and Thomisidae , were surveyed (Table 5).

Table 5 . Predacious mites and spiders collected on mulberry trees at delta region from January 2011 to December 2012

Family/Common name	Species	Period of occurrence
Acarina Phytoseiidae	<i>Amblyseius</i> sp. <i>Typhlodromus</i> sp	May- July May-Sept.
Araneae		
Araneidae weaver	<i>Cyrtophora citricola</i> Forskål	July.
Dictynidae Mesh web weaver	<i>Dictyna</i> sp.	Jun., Jul.
Miturigidae Long-legged sac spider	<i>Chiracanthium</i> sp.	May, Jun., July
Lycosidae Wolf spider	<i>Pardosa</i> spp.*	May, June, July
Pholcidae Daddylonglegs spiders	<i>Pholcus phalangioides</i> (Fuesslin)**	Aug-Oct.
Salticidae Jumping spider	<i>Plexippus paykulli</i> Audouin ** <i>Thyene imperialis</i> (Rossi)	May-Sept. May-Sept.
Theridiidae Comb-footed spider	<i>Theridion</i> sp.	June, July
Thomisidae Crab spider	<i>Thomisius</i> sp.***	March

* Around tree trunks ** Beside the houses *** on flowers

Periodical observations were recorded on the populations of mulberry mealy bug, *M. hirsutus* and its coccinellid predator, *N. bipunctatus* on mulberry shoots in mulberry trees from May to October, 2011. The mealy bug population raised during the period from June to September with the peak incidence of the pest observed

during second fortnight of June. During May to October, activity of other natural enemies could not be seen in the mulberry trees with the coccinellid predator, *N. bipunctatus* being the dominant predator feeding on the of mealy bug ovisacs. During September and October, presence of coccinellids like *Nephus includens* Kirsch and *Pullus syriacus* Marseul. could be noticed in the mulberry trees and the population of *N. bipunctatus* was declining (Table 6).

Table 6. Population fluctuations of the mulberry mealy bug, *Maconellicoccus hirsutus* and adult of coccinellid predator *Nephus bipunctatus* in mulberry tree at Kafr El- Sheikh Governorate (from May to October, 2011)

Date of collection	Population / Shoot 20 cm	
	<i>M. hirsutus</i>	<i>N. bipunctatus</i>
25 th May	2.46 ± 56.86	2.00 ± 1.00
20 th June	50.60 ± 23.79	1.30 ± 0.57
25 th July	34.33 ± 5.03	2.00 ± 0.75
20 th August	24.22 ± 2.44	1.5 ± 0.55
25 th September	16.33 ± 4.50	0.66 ± 0.57
20 th October	8.00 ± 4.36	0.33 ± 0.58

The values are mean ± SD of 10 shoots(top apical)

REFERENCES

1. Abd-Rabou, S. and A.S. Hendawy. 2000. Parasitoids attacking the parlatoria date scale, *Parlatoria blanchardi* (Targioni-Tozzetti) (Homoptera : Diaspididae in Egypt. J. Agric. Mansoura Univ.,25(12):8217-8222.
2. Abd-Rabou, S. and A.S. Hendawy. 2005 . Updating nomination of parasitoids of pink hibiscus mealy bug, *Maconellicoccus hirsutus* (Green), (Homoptera : Pseudococcidae) in Egypt. Egypt. J. Agric. Res. 83 (3),1135-1139.
3. Alleyne J.C. 2004. Controlling a dangerous pest-pink hibiscus mealy bug. Newsletter of the University of Florida - IFAS Extension -Pinellas County Extension, 38(4):2-3.
4. Attia, A. R. 2012. Hymenptrous parasitoids as a bioagents for controlling mealy bugs (Hemiptera: Pseudococcidae) in Egypt. Egypt. Acad. J. Biolog. Sci., 5(3): 183 -192
5. CABI/EPPO. 2004. *Maconellicoccus hirsutus*, distribution map of plant pests, pp. Map 100. CAB International, Wallingford (GB).

6. FAO. 2002. Mulberry for Animal production, FAO Animal Production and Health Paper 147 Rome. p. 331.
7. Govindaiah, V. P. Gupta, D. D. Sharma, S. Rajadurai and V. Nishita Naik 2005. A Text Book on Mulberry Crop Protection. Sampath, J. (ed.), Central Silk Board, Bangalore, India.
8. Hendawy, A.S.A. 1999. Studies of certain natural enemies of scale insects attacking guava trees at Kafr El-Sheikh Governorate. Ph. D. Thesis, Fac. Agric., Tanta Univ., 160 pp.
9. Hendawy, A. S, M. F. El-Mitwally and S.A. Abd Elsameh. 2002. *Coccophagus scutellaris* (Dalman) (Hymenoptera: Aphelinidae), a new record parasitoid attacking sugar-cane soft scale insect, *Pulvinaria Tenuivalvata* (Newstead) in Egypt. Egypt. J. Agric. Res. 80 (1): 222-224.
10. Hosny, M. M. , M. A. Assem and E. A. Nasr. 1976. Insect and animal agricultural pests.(2^{ed} edition, Dar El-Maarif, Egypt, p. 1076). (In Arabic).
11. Mala, V.R., K.S. Prasad, D. Manjunath, S. B. Dandin. 2007. Evaluation of germplasm genotypes of mulberry for reaction of sucking pests. Indian J. Sericulture. 46(1): 38-42.
12. Manjunath D., K. S. Prasad , D.K.S. Gowda. 2006. Ecological approach for the management of the mealy bug, *Maconellicoccus hirsutus* causing tukra in mulberry. Plant Archives. 6(2): 767-768.
13. Mousa, S.F, A.H. El-Heneidy, A.S. Hendawy, D. Adly, D. Gonzalez and S.V. Trjaptsyn. 2001. Pink hibiscus mealy bug , *Maconellicoccus hirsutus* (Green), Parasitoids in Egypt. 1- Preliminary record. Egypt.J. Biol. Pest Control Vol.11(2) ,195-196.
14. Priesner, A. and M. Hosny.1940. Notes on parasites and predators of Coccidae and Aleyrodidae in Egypt. Bull. Soc. Ent. Egypt, 24: 58-70.
15. Rama K. and K. V. Kumar. 2007. Impact of climatic conditions on the infestation of major pests of mulberry (*Morus* spp.) in Doon Valley.J. Entomol. Res. Society. 9(2): 17-30.
16. Sanchez M. D. 2000. Mulberry for Animal Production. FAO Animal Production and Health Paper 147. Rome, 331 pp.

حصر مفصليات الأرجل علي أشجار التوت في منطقة الدلتا مع الإشارة بوجه خاص إلى الحشرات القشرية والبق الدقيقي والأعداء الحيوية المرتبطة بها

أحمد سمير هندراوي ، إبراهيم عبد العظيم إبراهيم سعد ، رحاب حسني طه

معهد بحوث وقاية النباتات، مركز البحوث الزراعية ، دقى - مصر

في أول دراسة مصرية لحصر مفصليات الأرجل علي أشجار التوت (الأبيض و الأسود)
وأعداءها الحيوية المرتبطة بها في منطقة الدلتا، أجري الحصر من يناير ٢٠١١ حتي ديسمبر ٢٠١٢ .

خلال هذه الدراسة سجل صنفين من مفصليات الأرجل (الحشرات والعنكبوتيات).
كانت الحشرات القشرية و البق الدقيقي (١٢ نوعا) هي الآفات الرئيسية لأشجار التوت أما الآفات
الثانوية فتمثل ٢٤ نوعا من الحشرات والأكاروسات.

تم حصر ١٧ نوعا من الطفيليات المرتبطة بالحشرات القشرية والبق الدقيقي و كانت تتبع خمس
فصائل، والطفيليات الأكثر تواجدا هي :

Aphytis spp., *Encarsia citrina*, *Anagyrus kamali*, *Metaphycus* spp., *Allotropa*
mecrida, *Scutellista caerulea* .

كذا تم حصر ٣١ نوعاً من الحشرات المفترسة، و ٩ أنواع من العناكب الحقيقية المرتبطة بهذه
الآفات، كما تم التعرف على نوعين من الأكاروسات المفترسة.
كما تم دراسة تقلبات التعداد لبق التوت الدقيقي *Maconellicoccus hirsutus* ، و المفترس المرتبط
به *Nephus bipunctatus*