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PRESENCE OF COCCOID INSECTS ON *FICUS NITIDA* AND THE EFFECT OF THREE SPECIES OF THEM ON THE ANATOMICAL STRUCTIRE OF INFESTED SEEDLINGS

BY

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ABSTRACT

This study revealed that twenty coccoid species (presenting 12 genera and three families) infest *Ficus nitida* in Egypt. Four of them were recorded for the first time (i.e. *Saissetia oleae* (Olivier), *Aonidiella citriana* (Corquillett), *Aonidiella aurantii* (Maskell), and *Icerya seychellarum* (Westwood)).

Rostralis length of three coccoids, *Saissetia coffeae* (Walker) was measured as 996.25 µ, *Aonidiella orientalis* (Newstead) 285.00 µ, and *Icerya purchasi* Maskell 2095.75 µ.

Transverse sections of *S. coffeae* infested stems exhibited an increase in the diameter of the whole section, thickness of vascular cylinder (specially phloem tissue) and diameter of pith. Thickness of both cortex and xylem tissue were decreased compared with the non infested ones. Infestation by *I. purchasi* showed a decrease in the diameter of whole section due to decreasing in pith diameter and thickness of cortex, while thickness of conductive tissues (i.e. xylem and phloem) was increased.

The infestation by *A. orientalis* and *I. purchasi* decreased the size of leaf midrib (thickness and width), midvein (length and width) and thickness of ground tissue. The size of midvein was decreased as a result of the decrease in thickness of both xylem and phloem tissues. Thickness of infested Leaf blade was decreased due to the decrease in thickness of mesophyll tissues and multiepidermis. The infestation by *I. purchasi* led to disappearance of scelerenchyma cells above the vascular bundle, while thickness of phloem tissue was increased.

Key Words: Homoptera, Coccoidea, *Ficus nitida*, Anatomy

INTRODUCTION

Ficus nitida Thumb (Family Moraceae), is a tree, originated in Northern Australia and Malaya. It has a horticultural value as a beautiful tree if planted

solitary or as a hedge. It is easy to shape and could be a part of symmetrically designed gardens. These trees can be used in industrial or polluted areas, where it is tolerant to smokes and dust pollutants.

Scale insects of superfamily Coccoidea are considered as an important group attacking ornamental plants in different parts of the world. Hamon and Williams (1984) reported that Coccoidea the largest one in order Homoptera. It includes 1000 species in approximately 100 genera distributed worldwide. Over 147 of coccoid species have been recorded in Egypt on different hosts. They belong to 132 genera and 13 families (Ezzat and Nada 1986, Mohammed and Nada 1991 and Ghabbour and Mohammad 1996).

Eighteen coccoid species belong to 14 genera presenting four families have been recorded to infest *F. nitidae* in Egypt (Hall 1923, Fullaway 1933, Tawfik 1967, Salama 1970, Assem 1982, 1990, and Serag 1998).

Coccoidea mouth parts are piercing-sucking. The mouth parts of *I. purchasi* Mask, *Parlatoria blanchardi* Targioni-Tozzetti (Homoptera: Diaspididae), and *I. aegyptiaca* have been described by Johnston (1912), Stickney (1934) and Ezz (1965), respectively. The essential feature of the mouth parts of coccoids that the mandibles and maxillae are turned to four thread like stylets, come together to form a sucking tube, which called the rostralis.

Dutt *et al.* (1951) gave preliminary observation on the histological changes occurred to Rosalie plants due to infestation with *Moconelliecoccus hirsutus* (Green) (Homoptera: Pseudococcidae). Entwistle and Longworth (1963) studied the feeding behavior of three mealybug species *Planococcoides milensis*, *Phenacoccus madeirenisis* and *Ferrisia virgata* (Homoptera: Pseudococcidae) on cacao seedlings.

Amin *et al.* (1994) described histological changes in the tissues of leaf and stem of grapevine due to infestation with *M. hirsutus*. Mohamed (1999) studied effect of infestation with *Saissetia oleae* (Olivier) and *Hemiberlesia latania* (Signoret) (Homoptera: Coccidae and Diaspididae) on anatomical characters of olive leaf and stem.

The present study was conducted to determine the presence of coccoid insects on *F. nitida* at different parts of Egypt. The study also included measuring the length of the rostralis of *Saissetia coffeae* (Walker) (Coccidae), *Aonidiella orientalis* (Newstead) (Diaspididae), and *Icerya purchasi* Maskell (Margarodidae), and the effect of infestation with these insects on leaf and stem histological characters of *F. nitida* seedling.

MATERIALS AND METHODS

Random samples included leaves and branches of *F. nitida* infested by different coccoids were collected from different locations (i.e. Alexandria, Cairo Qalyubia, El-Sharkia, Giza, El-Faiyum, and Beni-Suef, regions) for 18 months (

i.e. May 2002 to October 2003). Samples were examined and occurred insects were identified at the Plant Protection Research Institute and recorded per sample.

Specimens of *S. coffeae*, *A. orientalis*, and, *I. purchasi* were prepared as permanent preparations on glass microscope slides according to Brain's method (1915) to measure the length of their mouth parts.

An experiment was carried out (and repeated using four sets of seedlings of the same cultivar) to study the effect of infestation with the mentioned coeeoid species on *F. nitida* seedlings on anatomical structure of *F. nitida*. Plant material (i.e. seedling of 24 month of age) were used as 12 seedling of the same age, size and health were selected. Seedlings were free of any insect infestation and received no previous pesticide application. Seedlings were potted in plastic bags filled with clay and kept under same horticultural procedures. The 12 seedlings were assigned to 4 groups. Each group was artificially infested with one of the studied insects by attaching of infested plant inclouding one group free from infestation as a control.

Seedling were kept in screened boxes which allowed air ventilation, light and humidity exchange but prevented other insect infestation or parasitism to occur. At the end of grown season (i.e. following November) the evaluation procedures took place. The sixth leaf and the third seedling branch were picked up at same direction from each replicate in the experiment. Specimens were killed and fixed in F. A. A. (10 ml. Fmalin, 5 ml. Glacial acetic aced, 85 ml. Ethyl alcohol 70 %), dehydrated by normal butyl alcohol and embedded in paraffin wax (melting point 54 - 58 C°) then sections of 15 - 20 μ thick were cut. Crystal violet-erythrosin combination (Jackson, 1926) was used for staining. Stained sections were mounted in Canada balsam (Willey, 1971).

RESULTS AND DISCUSSION

This study revealed twenty coccoid species (presenting 12 genera and three families) presented in the following list:

Family: Coccidae:
Ceroplastes floridensis Comstock
Ceroplastes rusci (L)
Coccus elongates (Signoret)
Coccus hesperidum L
Porasaissetia nigra (Nietner)
pulvinaria psidii (Maskell)
Saissetia coffeae (Walker)
Saissetia oleae (Olivier)
Family: Diaspididae:
Aonidiella aurantii (Maskell)
Aonidiella citrina (Coquillett)
Aonidiella orientalis (Newstead)
Aspidiotus nerii Bouche
Chrysomphalus aonidum (L)

Chrysomphalus dictyospermi (Morgan).
Hemiberlesia latania (Signort).
Lindingaspis floridana Ferris.
Mycetaspis personata (Comstock).
Family: Margarodidae:
Icerya aegyptiaca (Douglas).
Icerya purchasi Maskell.
Icerya seychellarum (Westwood).

Four species (i.e. *S. oleae*, *A. citrian*, *A. aurantii*, and *I. seychellarum*) were recorded for the first time to infest *F. nitida* in Egypt. *M. hirsutus* and *Ferrisia virgata* (Cockerell) (family Pseudococcidae) were recorded earlier (by Tawfik 1967 and Assem 1982, respectively) on *F. nitida* but were not collected in this survey.

Population of three coccoid species reared on three groups of *F. nitida* seedling reached the following leveles at the end of the experiment:

S. coffeae was reached 22 insects/branch sample, *A. orientalis* reached 17 and 28 insects/leaf on lower and upper surfaces respectively. It was difficult to be detected *A. orientalis* on branches. *I. purchasi* reached 12 insects/leaf on lower surface leaves and 9 insects/branch.

The masseur of rostralis length (which is the mandibles and maxillae turned to four thread like stylets, came together to form a sucking tube called the rostralis) of three species of coccoid were 996.25 $\mu \pm 29.26$ for *S. coffeae*, 285.00 $\mu \pm 7.76$ for *A. orientalis* and 2095.75 $\mu \pm 99.48$ for *I. purchasi*.

The highest population represented by *A. orientalis*, while the longest mouth parts occurred in case of *I. purchasi*.
The effect of infestation on stem structure:

I- Effect of *S. coffeae*.

Transverse sections of infested stems by *S. coffeae* revealed an increase in the diameter of the whole section, thickness of vascular cylinder (specially phloem tissue) and diameter of pith (Table 1 and Fig.1). On the other hand, thickness of both cortex and xylem tissue decreased as compared with the non infested seedlings.

It could be concluded that infestation with *S. coffeae* on *F. nitida* stem enhanced the diameter of the stem due to increasing the thickness of phloem tissue (which distributes sap) and diameter of pith (area of cells which store the materials food) to resisting the infestation

These results are in accordance with the findings of Yadava (1966) who observed the mode of feeding of the pink mealybug, *Saccharicoccus sacchari* (Cockerell) (Homoptera: Pseudococcidae) on sugar cane. The mealybug's stylet penetrates through tissues inter cellularely avoiding the vascular cylinder and terminating in the parenchyma cells in its stylet sheath formed.

Table (1): Means of different anatomical parameters of *F. nitida* stem infested with *S. coffeae* and *I. purchasi*

Parameters (in micron)	Control	*S. caffeae*	*I. purchasi*
Diameter of whole section	2266.25	2371.25	2143.75
Thickness of cortex	240.63	175.00	183.75
Thickness of vascular cylinder	1697.50	1881.25	1583.75
- Thickness of xylem	148.75	122.50	161.88
- Thickness of phloem	91.88	105.00	135.63
- Diameter of pith	1277.50	1338.75	1093.75

II-Effect of *I. purchasi*:

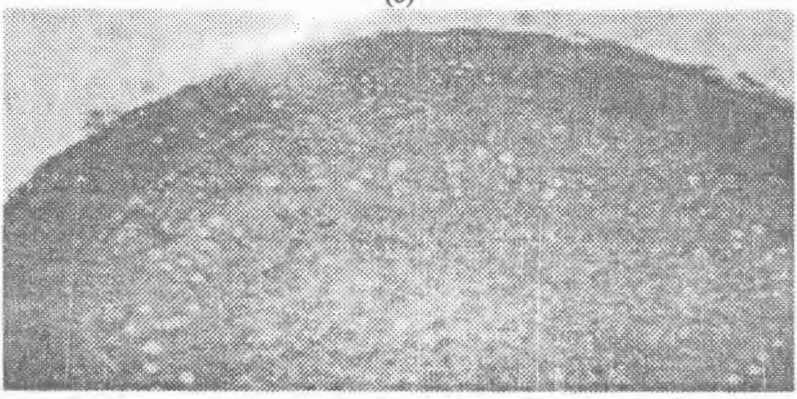
Transverse sections made in stems of infested *F. nitida* seedlings showed different modifications in the primary structure (Table 1 and Fig.1). The diameter of the whole section decreased from 2266.25μ for uninfested stem to 2143.75μ for infested one. This reduction was accompanied by decrease in thickness of cortical layers and diameter of pith. Thickness of the vascular cylinder decreased from1697.50μ to 1583.75μ due to infestation. This decrease was mainly due to the decrease in the diameter of pith only, while the thickness of xylem and phloem tissues were increased as compared with uninfested seedlings.

It could be concluded that the infestation by *I. purchasi* produced stems with higher amount of conductive tissues to compensate the sap loss.

The modifications in the structure of seedling stem recorded in the present work due to infestation with insects are in agreement with the findings of some previous investigations. Entwistle and Longworth (1963) studied the feeding behavior of three mealybug species on cacao seedlings. They observed that the stylist of *Planococcoides milensis* and *F. virgata* ended in the phloem of the stem and passed throughout the cortex intracellular; while the stylet of *Phenacoccus madeirenisis* (Homoptera: Pseudococcidae) did not ended in the phloem of the same host plant. Liphschitz and Mendel (1989) Indicated that the histological examination of infested plant sections revealed that artificial infestation of seven pine species stems injury reached the cambium; traumatic resin ducts, parenchyma cells instead of tracheids, and curved tracheids were formed. Mechanical lesions caused by needle punctures resulted in production of parenchyma cells instead of tracheids in all pine species investigated. Press and Whittaker (1993) Indicated that adaptations to phytophagy are discussed with respect to gaining access to xylem tissue and the nutrition of sap feeders.

(a)

(b)



(c)

Fig. (1) : Transverse section of *F. nitidae* as affected by infestation with scale insects. (X40)
a: Non-infested b: infested by *S. coffeae* c: infested by *I. Purhasi*

The effect of infestation on Leaf structure:

I-Effect of *A. orientalis* :

It is clear from Table (2) and Fig. (2) that the infestation by *A. orientalis* decreased the size of midrib(thickness and width), midvascular bundle (length and width) and thickness of ground tissue.

The size of midvein was decreased due to infestation by *A. orientalis*, as a result of the decrease in thickness of both xylem and phloem tissues.

Thickness of infested Leaf blade was decreased due to the decrease in thickness of palisade and spongy tissues and multiepidermis towards upper and lower surface.

In this connection, Albrigo *et al.* (1983) found that the feeding by *Panonychus citri* (Acari: Tetranychidae) on the upper surface of citrus leaves resulted in the removal of the cytoplasm.

Table (2): Means of different anatomical parameters of *F. nitida* leaf infested with *A. orientalis* and *I. Purhasi.*

Parameters (in micron)	Control	*A. orientalis*	*I. purchasi*
Thickness of midrib	1076.5	402.5	945.0
Width of midrib	1400.0	350.0	1312.5
Dimension of midvein:			
- Length	595.0	175.0	525.0
- Width	787.5	210.0	682.5
- Xylem thickness	102.0	54.0	66.0
- Phloem thickness	72.0	30.0	102.0
Number of vessels	132.0	31.0	105.0
Sclerenchyma	24.0	24.0	---
Thickness of ground tissue	108.0	30.0	90.0
Thickness of blade	342.0	240.0	300.0
Thickness of palisade tissue	90.0	42.0	36.0
Thickness of spongy tissue	180.0	132.0	180.0
Multiepidermis			
- Upper	90.0	60.0	90.0
- Lower	30.0	24.0	24.0

II-Effect of *I. purchasi* :

It is clear from Table (2) and Fig. (2), that the infestation by *I. purchasi* led to lessening the thickness of midrib compared with the uninfested seedlings, this caused by the decrease of the size of midvein and thickness of ground tissue.

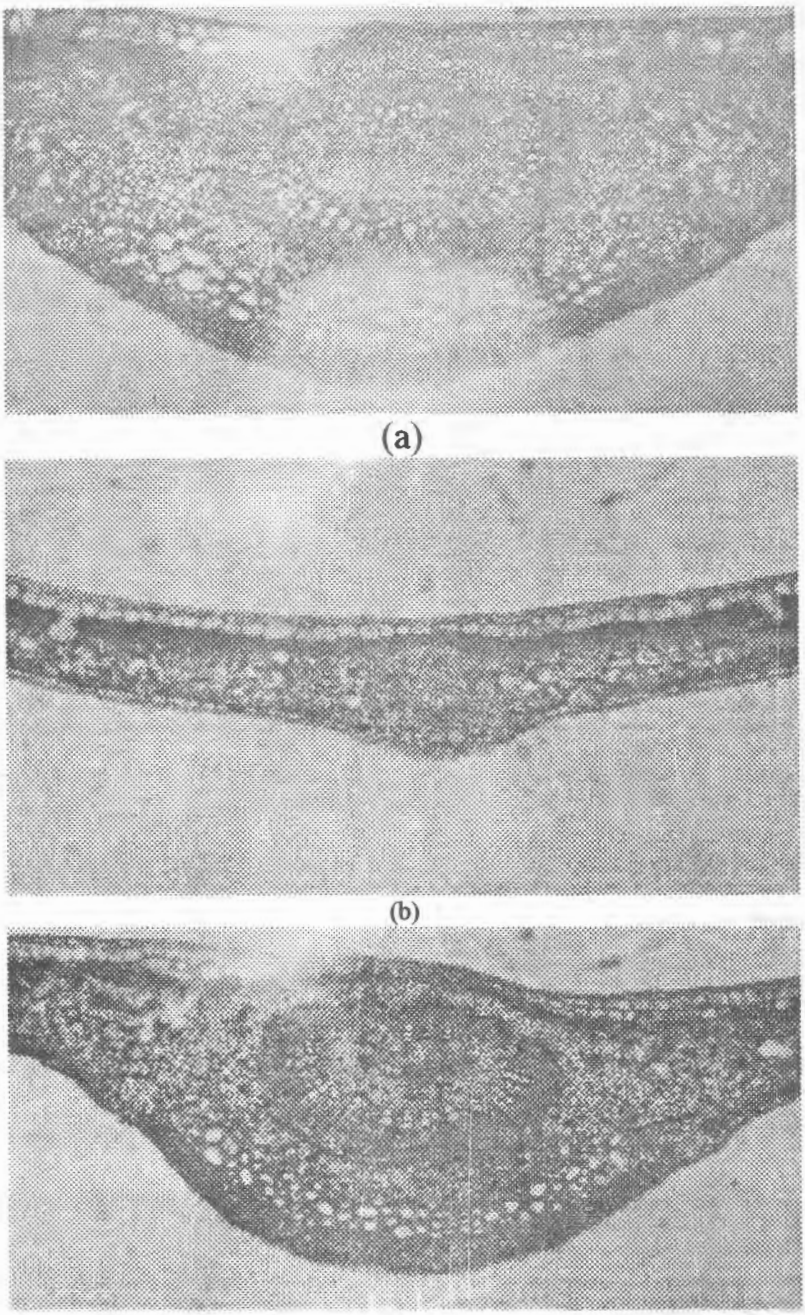


Fig. (2): Transverse section of *F. nitidae* leaf midrib as affected by infestation with scale insects. (X40)
a: Non-infested b: infested by *A. orientalis* c: infested by *I. purhasi*

The disappearance of scelerenchyma cells above the vascular bundle in the midrib is an inevitable result of infestation, which happens through cortex cellularely heading to phloem.

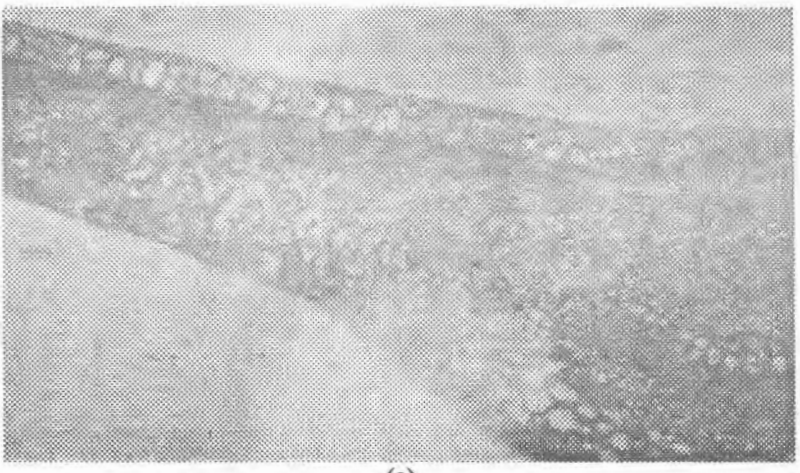
These results clarify that phloem thickness increased in case of infestation by *I. purchasi* over uninfested. This increase may be because of the more activation of vascular cambium and of the change of most regenerated cells into phloem rather than xylem, to compensate the injury resulted by the infestation, the area for distributing prepared sap in leaf expands through phloem tissue as well.

As to leaf blade, decrease of blade thickness was recorded due to similar decrease in palisade tissue thickness; 90μ for non affected seedling and 36μ for affected seedling, worth mentioning here that thickness of spongy tissue is not affected (Fig.3).

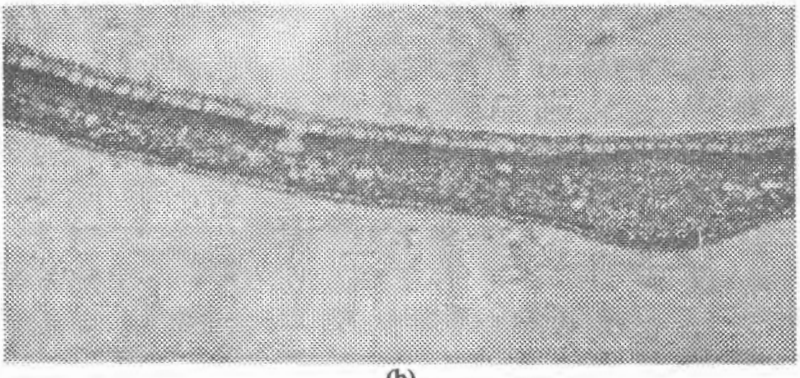
Severe infestation by *I. purchasi* on the lower surface of the leaf decreased the thickness of multiepidermis; such decrease is due to the *I. Purhasi's* sucking of its content, while that multiepidermis in upper surface is not affected (Fig.3).

In this connection, Ghose (1971) described the histological changes in ramie, *Bohemia nivea* and mulberry, *Morsus alba* due to infestation with *M. hirsutus*. He stated that cells were less lignified. Amin *et al.* (1994) described the damage caused to grapevine due to infestation with *M. hirsutus* throughout morphological and histological changes in artificially infested canes. The histological changes in the tissues of leaf and stem were also described from transverse sections. The abnormal growth in the infested canes may be due to the salivary toxic secretions secreted by different stages of the mealybug. Hanafi (1997) classified the different internal parts affected by infestation with yellow scale insect, *A. citrina* on five rose plant varieties belong to *R. hybrid* as:

1- Lightly infestation: phloem xylem
2- Moderately infestation: cortical region.
3- Heavily infestation: vascular cylinder and ground parenchyma.



(a)



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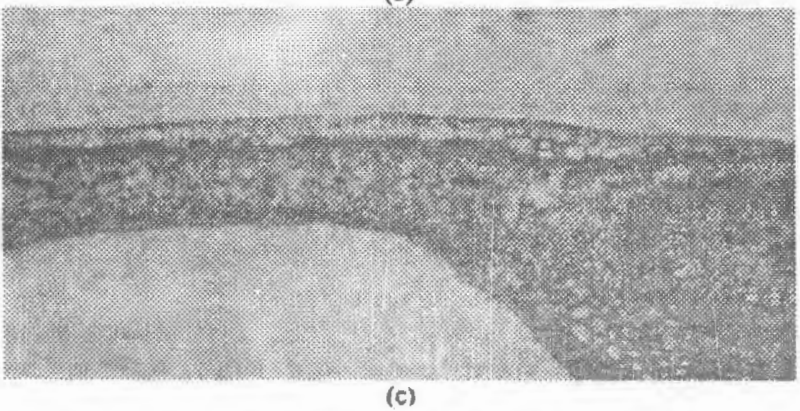

(c)

Fig. (3) : Transverse section of *F. nitidae* leaf blade as affected by infestation with scale insects. (X40)
a: Non-infested b: infested by *A. orientalis* c: infested by *I. purhasi*

REFERENCES

Albrigo, L.G.; Childers, C.C. and Syvertsen, J.P (1983): Structural damage to citrus leaves from spider mite feeding. Proc Int. Soc. Citriculture. 52:399-402.

Amin, A.H., Emam, A. and Youssef, A.S. (1994): Morphological and histological changes in grapevine due to the infestation with *Maconellicoccus hirsutus* (Green) (Homoptera: Pseudococcidae). International Symposium on Crop Protection, Facultier Landbouw en Toegepaste Biologisch Wetenschappen Univ. Gent Belgium

Assem, S.M (1982): Studies on certain coccid pests of ornamental plants in Egypt. M. Sc. Thesis, Fac. Agric. Ain Shams Univ., Egypt.

Assem, S.M (1990): Survey and ecological studies on some insects attacking certain ornamental plants. Ph.D. Thesis, Fac. Agric. Cairo Univ., Egypt.

Brain, K. (1915): Report on plant pathologist. Rep. Agric, Malto, pp. 14- 17. (Abstract in R. A. E. xt. Pp. 290 - 1931.

Dutt, V.; Mukherjee, P. K. and Sengupta, N. (1951): Preliminary observations on the incidence of *Phenococcus hirsutus* Green. and its effect on the growth of *Hibiscus*. Sabdariffal. Indian J. Agric. Sci., 21: 331-337.

Entwistle, P.F. and Longworth, J.F (1963): The relationship between cacao viruses and their vectors. The feeding behavior of three mealybug (Homo. Pseud.) species. Ann. Appl. Bio. 52: 387-391.

Ezz, A.I. (1965): Morphology and Biology of *Icerya aegyptiaca* (Douglass) (Homoptera: Margarodidae). Ph.D Thesis, Fac. Agric. Cairo Univ., Egypt.

Ezzat, J. M. and Nada, S. M. (1986): List of superfamily Coccoidea as Known to exist in Egypt. Boll. Lab. Ent. Agr Filippo Silvertri, 43: 85-90.

Fullaway, D.T. (1933): Division of Entomology. Hawaiian Forest Agriculturist. (C.F.R.E.) XXI. p.275.

Ghabbour, M.W. and Mohammad, Z.K. (1996): The Diaspidiae of Egypt (Coccoidae: Homoptera). J Egypt, Ger. Soc. Zool., Vol. 21(E), Entomology, 337- 369.

Ghose, S.K. (1971): Assessment of loss in yield of seeds of roselle Hibiscus sabdariffa var altissima due to the mealybug *Onellicoccus hirsutus* (Green), Pseudococcidae – Heimeptera. Indian J. Agric. Sci. 41: 360-362.

Hall, W.J. (1923): Further observations on the Coccidae of Egypt. Minist. Of Agric. Tech. And Sci. Service, 36 39-52.

Hamon, A.B. and Williams, M.L (1984) The soft scale insects of Florida (Homoptera Coccoidea:Coccidae) Florida Dept. Agric. & Consumer Serv Div. Plant Industry, p.194

Hanafi, H.A. (1997): Studies on some scale insects infesting some ornamental plants. Ph. D. Thesis, Fac. of Agic., Al-Azhar Univ., Egypt.

Jackson, G. (1926): Crystal Violet and erythrosine in plant anatomy. Stain Tech., 1: 33-34.

Johnston, C.E. (1912): The internal anatomy of *Icerya purchasi* Mask. Ann. Ent. Soc. Amer., V.II: 383 – 388.

Liphschitz, N. and Mendel, Z .(1989): Interactions between hosts and non-hosts of *Pinus* spp. and *Matsucoccus josephi*: anatomical responses of stem to infestation. New-Phytologist. 113: 135-142.

Mohamed, G.H. (1999): Studies on scale insects infesting olive trees. Ph. D. Thesis, Fac. of Agric. Al-Azhar Univ. Egypt.

Mohammed, Z.K. and. Nada, S.M.A (1991): Observations on the Coccidae of Homoptera – Coccoidea - Coccidae). Fourth Arab Congress of Plant Protection Cairo 1-5 Dec. Pp 105-110.

Press, M.C. and Whittaker, J.B. (1993): Exploitation of the xylem stream by parasitic organisms. Biological-Sciences: 101-111.

Salama, H.S. (1970): Ecological studies on the scale insect, *Chrysomphalus dictyosperrni* (Morgan) in Egypt. Zeitschrift für Angewandte Entomolgie. 65 (4) 427-430.

Serag, A.M. (1998): Biological studies on certain scale insects in Egypt. M.Sc. Thesis, Fac. Sci. Benha Branch, Zag. Univ., Egypt. 170 pp.

Stickney, F. S. (1934): The external anatomy of the *Parlatoria* date scale, *Parlatoria blanchardi* Targioni -Tozzetti, with studies on the head skeleton and associated parts. Tech. Bull. No. 421, U.S. Dept. Agric. Washington, D.C.

Tawfik, M. F. S. (1967): Microfauna of leaf-rolls of *Ficus nitida.* Bull. Soc. Ent. Egypt, 51: 483 – 487.

Yadava, R.L. (1966): Feeding habit of the pink sugarcane mealbug, *Saccharicoccus sacchari* (Homoptera-Pseudococcidae). Indian J. Ent., 28: 106-108.

Willey, R.L. (1971): Microtechniques: A laboratory guide. McMillan Co. Pub., New York, 99.

تواجد حشرات فوق فصيلة كوكوئيديا على الفيكس نيتدا وتأثير ثلاثة أنواع منها على التركيب التشريحى للشتلات المصابة

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فى هذه الدراسة تم تسجيل ٢٠ نوع من حشرات فوق فصيلة كوكوئيديا على الفيكس نيتدا تتبع ١٢ جنس و ٣عائلات ، منها ٤ أنواع تم تسجيلها لأول مره فى مصر(حشرة البحر الأبيض المتوسط الرخوه ، الحشره القشريه الحمراء ، الحشره القشريه الصفراء ، بق السشيلارم الدقيقى.

تم دراسة تركيب أجزاء فم ٣ أنواع (الحشرة النصف كروية الرخوة ،الحشرة القشرية الشرقية والبق الدقيقى الأسترالى) لتقدير طول الرمح لكل منها حيث كان ٩٩٦,٢٥ ، ٢٨٥,٠٠ ٢٠٩٥,٧٥ ميكرون على التوالى.

تم دراسة تأثير الإصابة بهذه الحشرات على شتلات الفيكس ، حيث أظهرت القطاعات العرضية فى الساق المصابة بالحشرة النصف كروية الرخوة إلى زيادة فى قطر الساق وسمك الأسطوانة الوعائية (خاصة نسيج اللحاء) وقطر النخاع بينما نقص سمك كل من القشرة ونسيج الخشب مقارنة بالشتلات الغير مصابة .

أدت الإصابة بحشرة البق الدقيقى الأسترالى إلى نقص فى قطر الساق نتيجة لنقص فى قطر النخاع وسمك القشرة ، بينما راد سمك أنسجة التوصيل (الخشب واللحاء) .

أوضحت القطاعات العرضية فى اوراق شتلات الفيكس أن الإصابة بالحشرة القشرية الشرقية والبق الدقيقى الأسترالى أدت إلى نقص فى سمك العرق الوسطى والحزمة الوعائية (نتيجة لنقص كل من نسيج الخشب واللحاء) وسمك النسيج الأساسى.

قل سمك أنصال الأوراق نتيجة لنقص فى سمك نسيج الميزوفيل والبشرة المتضاعفة كما أدت الإصابة بالبق الدقيقى الى اختفاء الخلايا الأسكلرنشيمية أعلى الحزمة الوعائية وريادة سمك نسيج اللحاء.