Egypt. J. Plant Prot. Res. Inst. (2022), 5 (1): 116–122

Egyptian Journal of Plant
Protection Research Institute
www.ejppri.eg.net

Morphological forms of varroa mites (Acari and Varroidae) in Egypt and Lebanon by means of scanning electron microscope

Amany, Saad M. Abou-Lila[1] ; Taksira, D.M.[1] ; Hebat Allah, S. Elsayh [1] and Sawires, S.G.[2]

[1]*Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.*
[2] *Department of Natural Products, National Center for Radiation Research and Technology, Atomic Energy Authority, Cairo, Egypt.*

ARTICLE INFO
Article History
Received: 16 / 2/2022
Accepted: 31/ 3 /2022

Keywords

Varroa destructor, Apis mellifera, scanning electron microscope, morphology, Egypt and Lebanon.

Abstract:

In the present study, adult females were collected from infested *Apis mellifera* Linnaeus (Hymenoptera: Apidae) in Lebanon and Egypt which are represented in three different regions: Giza, Behera, and Beni Suef were examined by scanning electron microscope (SEM). The *Varroa destructor* Anderson and Trueman (Acari and Varroidae) has a remarkably different morphology between the two sexes. *V. destructor* was analyzed and studied with SEM response was the chewing off of modified appendages from the mite destroying the terminal segment used for attachment. Both the ventral and dorsal sides of the mite were scanned. Only varroa females cause the depriving parasitic action on bees. The adult female is reddish-brown with an elliptical shape and it is on average 1.1 mm long and 1.5 mm wide. It has four pairs of legs that enable the mite to move very quickly inside the hive.

Introduction

The varroa life cycle is tightly linked to that of a honeybee. Varroa mites *Varroa destructor* Anderson and Trueman (Mesostigmata and Varroidae) are a significant threat to bees. A varroa infestation weakens the immunity of honey bees and spreads disease. Varroa can only reproduce in a honey bee colony. Mites attach to the body of a bee and weaken it by sucking haemolymph (The bee equivalent of blood). This spreads viruses, including deformed wing virus sacbrood virus, and acute paralysis virus. Varroa destructor is an external parasitic mite that attacks honey bees [*Apis cerana* Fabricius and *Apis mellifera* Linnaeus (Hymenoptera: Apidae)].

Varroa mite life cycle has two stages. During the phoretic stage (5-11 days), mites ride on adult workers or drones, at the same time feeding on blood (hemolymph) from bees, usually from the inter-segmental membrane on the abdomen. Mites change hosts (hop from one bee to another) often and this contributes to the transmission of various viruses. *Varroa destructor* (Anderson and Trueman), is amongst the world's most serious and dangerous pests of European honey bees, *A. mellifera*. However, Anderson and Trueman (2000) stated that varroa mite (*V. destructor*) was most responsible for damage in bee colonies whereas, *Varroa jacobsoni* Oudemans (Acari and Varroidae) resulted less harmful to honeybees (James and Nalen, 2014).

It is believed that *A.cerana* is rarely affected and has a maximum level of natural defense against varroa mites. When *A. mellifera* colonies were introduced, Asian people begin to accept how dangerous these mites could be. As evidence suggested that these mites may take 50 to 100 years when Varroa's host shifts to another host and did the genus Varroa includes in excess of 18 genetically different strains of mites (Cobey, 2001). It is considered that *V. destructor* and *V. jacobsoni* are closely related and both parasitize the Asian honey bee (*A. cerana*) (Zhang, 2000 and Delaplane, 2001). Hence in 1904 Oudemans described that *V. jacobsoni*, is not the same species that also attacks *A. mellifera*. Anderson and Trueman (2000) corrected previous confusion and mislabeled the literature prior to 2000, recognizing *V. destructor* as a separate species. Accurate estimates of the effect of varroa on the apiculture industry are hard to find, but it is safe to colonies of honeybees worldwide, resulting in an economic loss of billions of dollars.

Varroa has caused lower honey production, which ultimately lowers the profit margin in beekeeping. Varroa also affected the feral (Wild) population of bees in many areas. Since feral colonies when become unmanageable for varroa and left unprotected. This ultimately results in the loss of feral colonies quickly as varroa continued to spread (Webster and Delaplane, 2001).

The aim of the present work was to study the morphology variation in *V. destructor* by the morphological characteristics of mites from Egypt and Lebanon using a scanning electron microscope during the summer and winter generations.

Materials and methods

Mites collected in the field should be preserved immediately in 70-95% ethyl alcohol this ensures the specimens are not damaged and, even if they are kept this way at room temperature, are good for morphological analyses for at least a few months, but often much longer. Should be stored in a cool environment, such as a fridge at 4°C (Human *et al*., 2013). The specimens were quickly dried and then mounted on specimen stubs with gold conducting paints. Samples were gold coated in a layer of approximately 300 A0 using a fine gold coating apparatus, an ion sputtering device (JEOL- JFC-1100 E). Preparations were examined in the JOEL-JSM-5400 scanning electron microscope (SEM) with an accelerating voltage of 30 kV.

Results and discussion

Data illustrated in Figures (1-4) showed the difference in adult females *V. destructor* were collected from infected *A. mellifera* in Lebanon and Egypt. In Egypt, three regions were selected.

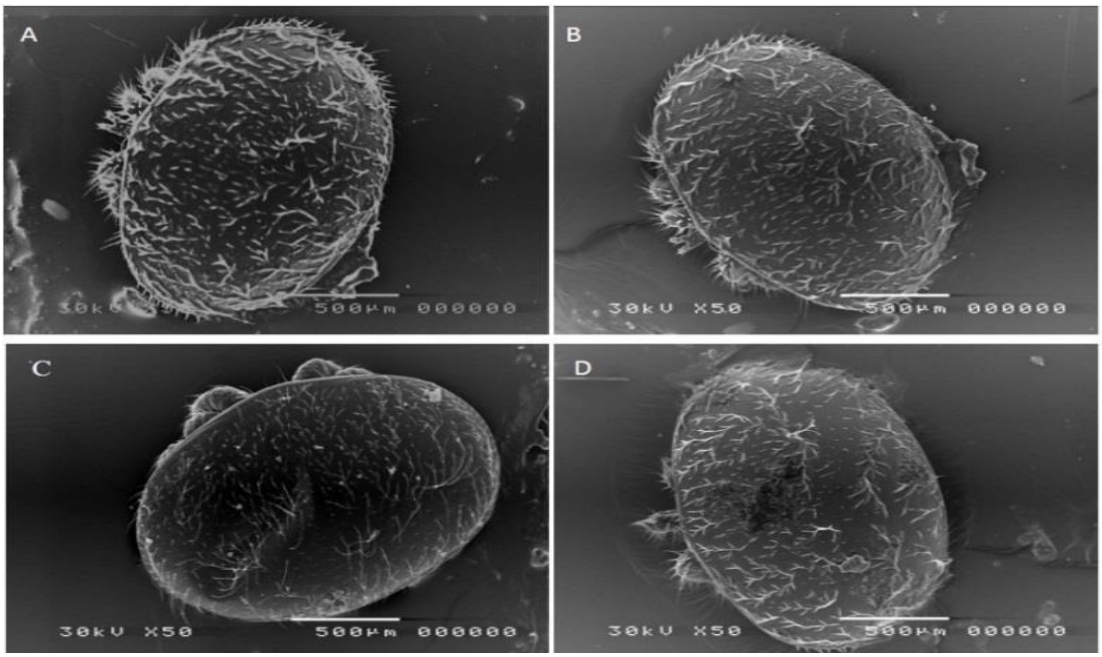

Figure (1): Scanning electron microscopy images of a dorsal view of an adult female *Varroa destructive* mite different type of between Lebanon (A) and Egypt represented in three different regions: Giza (D), Behera (C) and Beni Suef (B).

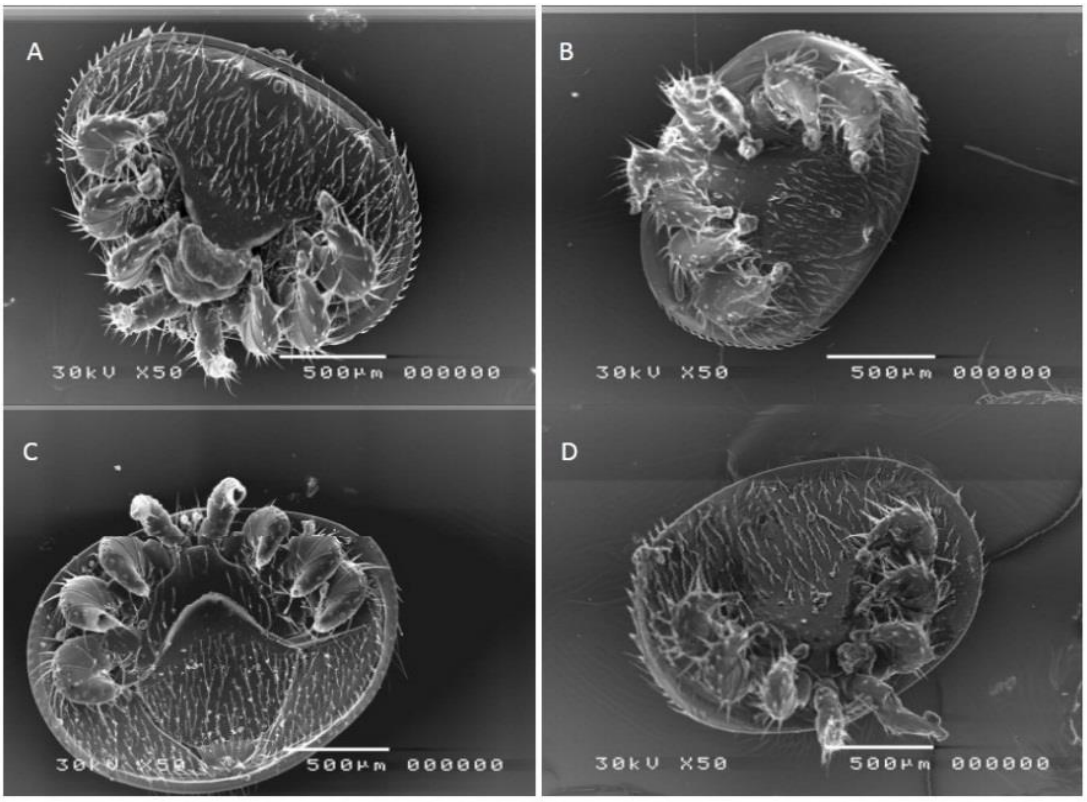

Figure (2): Scanning electron micrographs of ventral shields of *Varroa destructor*. (A) ventral shields, (B) sterna shield enlarged, (C) genital shield, (D) endopodal shield, Arrows indicate specific areas of the shields. SP=sternal plate, GP=genital plate, P=endopodal plate, MP=metapodal plate, NP=anal plate, St=sternal setae, Est=endopodal setae, an1-3=anal setae.

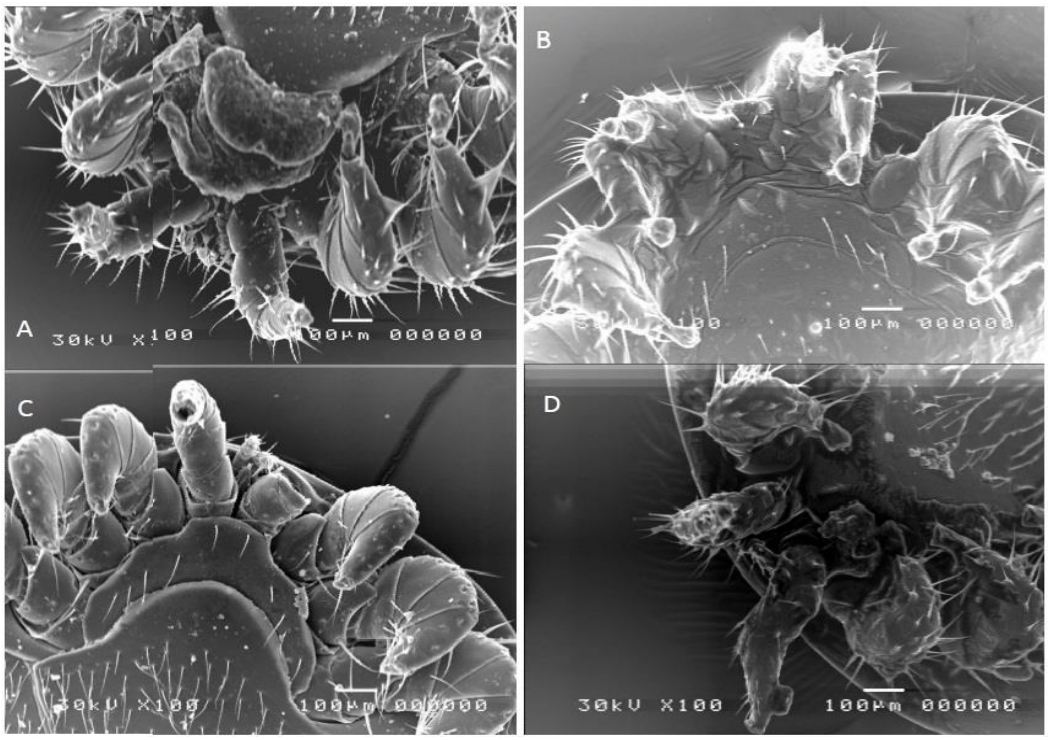

Figure (3): Scanning electron micrographs of legs of *Varroa destructor*. Legs were categorized by length as Leg I, Leg II, Leg III, and Leg IV. (A) Leg-I is 624.4µm long and rounded. The condylophore is 78.94µm long. (B) Leg-II is 584.3µm long and dorso-ventrally flat with a short condylophore. (C) Leg-III is 812.8µm long, completely flattened, with short tarsi and the condylophore is 100.68µm long. (D) Leg-IV is 970.3µm long, completely flattened, and the condylophore is 86.07µm long.

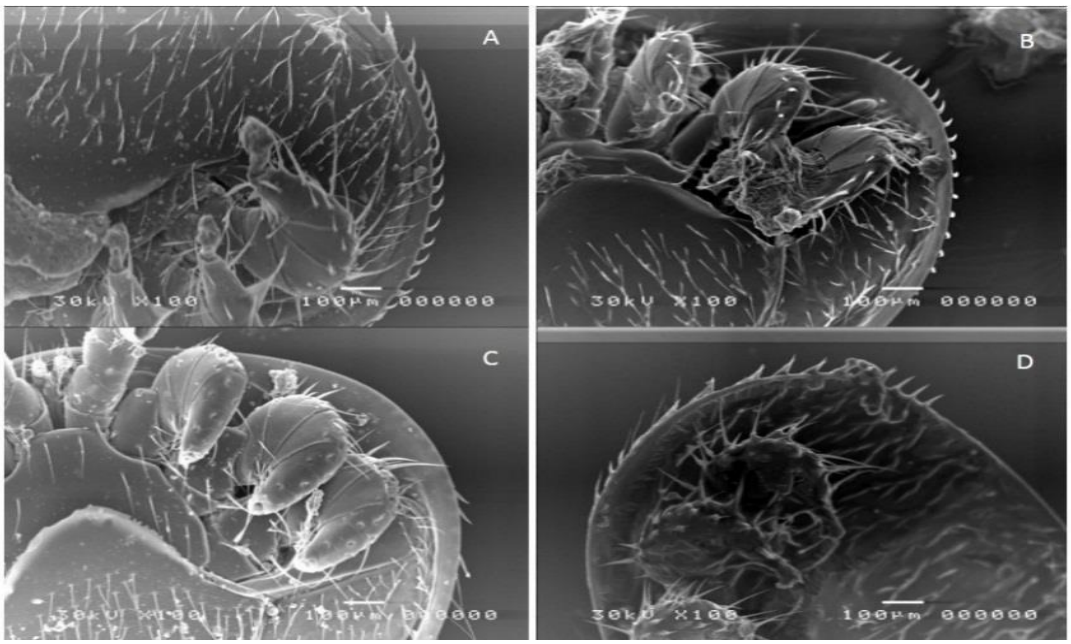

Figure (4): Scanning electron micrographs of different kinds of body setae of *Varroa destructor*. (A) Dorsal setae in different dorsal body parts, (B) Higher magnification images of mid-dorsal setae, (C) Higher magnification image of posterior setae, (D) Lateral setae, arrows indicate types of setae.

Table (1): difference in adult females *Varroa destructor* were collected from infected *Apis mellifera* in Lebanon and Egypt. In Egypt, three regions were selected.

Size and shape	Lebanon (A)	Beni Suef (B)	Behera (C)	Giza (D)
Body Lengths µm	1.88± µm	1.8± µm	1.8± µm	1.82± µm
Body Width µm	1.33± µm	1.2± µm	1.46± µm	1.29± µm
Morphological Character	Oblate	Semi oblate	Oblate spheroid	Semi oblate

Data illustrated in Figures (1-4) and Table (1) showed the difference in adult females *V. destructor* were collected from infested *A. mellifera* in Lebanon and Egypt which are represented in 3 regions (Gov.) for morphological forms the following:

-Figure (1) SEM images of dorsal view of an adult female *Varroa destructor* mite different types between Lebanon (A) and Egypt represented in three different regions: Beni Suef (B), Behera (C), and Giza (D).

-Figure (2) SEM of ventral shields of *Varroa destructor* mite (A) ventral shields, (B) sterna shield enlarged, (C) genital shield, and (D) endopodal shield. Arrows indicate specific areas of the shields and differences between plats and some morphological characteristics among regions.

-Figure (3) SEM of legs of *Varroa destructor* legs were categorized by length as leg 1, 2, 3, and leg 4.

A-leg-1 is 624.4 µm long and rounded. The condylophore is 78.94µm long.

B-leg-2 is 584.3µm long and dorso-ventrally flat with a short condylophore.

C-leg-3 is 812.8πm long, completely flattened, with short tarsi and the condylophore is 100.68 µm long.

D-leg-4 is 970.3µm long, completely flattened and the condylophore is 86.07 µm long.

-Figure (4) SEM of different kinds of body setae of *Varroa destructor*.

(A) Dorsal setae in different dorsal body parts.

(B) Higher magnification images of mid-dorsal setae.

(C) Higher magnification images of posterior setae.

(D) Lateral setae, arrows indicate types of setae.

Therefore, treatment thresholds have been developed for specific geographic climatic conditions adapted for specific honey bee breads (Locke, 2016). SEM micro graphs showed (Figure 1) dorsally serrated setae dorsally and entire simple setae ventrally. The most possible explanation is that the dorsal setae are probably used to interlock with the body hairs of bees during the phoretic period. The ventrally entire spinecent setae may help *Varroa destructor* to walk on brood cells and on bee's bodies. All these setae are reflexed posteriorly. Nuzzaci *et al.* (1992) described the presence of some specialized sensilla on mouth parts, suspected by ultrastructural evidence to be gustatory chemical sensilla and mecano sensilla.

These are probably related to the feeding behavior of *Varroa* and not so much involved in orientation. Büchler,(2015) observed that *Varroa* tolerance in honey bee occurrence characters and breeding. The morphological plasticity suggests that K-type *Varroa destructor* also uses the marginal setae to grab the integument of the larvae during the feeding periods inside the sealed cell, and also uses to grab the adult bees during the hibernation times inside the tergits of winter bees, and the phoretic period. Davis and Camin (1976) have

demonstrated the primary role of marginal setae in *Dermanyssus prognephilus* Ewing (Acari: Dermanyssidae) mites, ectoparasites of birds are for attachment.

Generally: comment on that, find that the Varroa destructor in Egypt (Behera, Giza and Beni Suef) and Lebanon in size and some morphological differences between them and (fig1) SEM images of a dorsal view of an adult female *V. destructor* mite different type of between Lebanon (A) and Egypt represented in three different regions: Beni Suef (B), Behera (C) and Giza (D). Kuenen and Calderone (1998) stated that positive anemotaxis by Varroa mites: responses to bee odour plumes and single clean-air puffs. It is a study in agreement with the results of this research.

Shimanuki and Knox, (2000) showed that diagnosis of honey bee diseases of both brood and adult and using some chemicals for controlling diseases.

It is concluded that *V. destructor* is still the common species in both Egypt and Lebanon, despite the morphological differences.

References

Anderson, D. L. and Trueman, J.W.H. (2000): *Varroa jacobsoni* (Acari: Varroidae) is more than one species. Experimental and Applied Acarology, 24:165-189.

Büchler, R. (2015): Varroa tolerance in honey bees-occurrence, characters and breeding. Bee World, 75: 54–70.

Cobey, S. (2001): The Varroa species complex: Identifying Varroa destructor and new strategies of control. American Bee Journal, 141(3):194-196.

Davis, J.C. and Camin, J.H. (1976): Setae of the anterior tarsi of the martin mite,*Dermanyssus prognephilus* (Acari: Dermanyssidae).J. Kans. Entomol. Soc., 49:441–449.

Delaplane, K.S. (2001): *Varroa destructor*: revolution in the Making. Bee World, 82(4):157-159.

Human, H.; Brodschneider, R.; Dietemann, V.; Dively, G. *et al.* (2013): Miscellaneous standard methods for *Apis mellifera* research. Journal of Apicultural Research, 52 (4): 1-53. DOI: 10.3896/ IBRA.1.52.4.10.

James, D.E. and Nalen, C.M.Z. (2014): Varroa Mite, *Varroa destructor* Anderson and Trueman (Arachnida: Acari:Varroidae).Extension Assistant; Department of Entomology and Nematology, UF/IFAS Extension, Gainesville. FL 32611.

Kuenen, L. P. S. and Calderone, N. W. (1998): Positive anemotaxis by varroa mite: responses to bee odour plumes and single clean-air puffs. Physiol. Entomol., 23:255Y264.

Locke, B. (2016): Natural varroa mite-surviving *Apis mellifera* honeybee populations. Apidologie, 47(3): 467-482.

Nuzzaci, G.; de Lillo, E. and Porcelli, F. (1992): Functional morphology of mouthpart sensilla in females of *Varroa jacobsoni* Oudemans (Acari: Varroidae). Entomologica Bari, 27: 41-67.

Oudemans, A. C. (1904): Acarologische Aanteekeningen XII. Entomologische Bericheten Uitgegeven Door de Nederlandische Entomologische Vereeniging, 1: 18.

Shimanuki, H. and Knox, D.A. (2000): Diagnosis of Honey bee

Diseases. Agriculture Handbook No. AH690, pp.61.

Webster, T. C. and Delaplane, K.S. (2001): Mites of the Honey bee. Dadant and Sons, Inc., Hamilton, Illinois. pp. 280.

Zhang, Z.Q. (2000): Notes on *Varroa destructor* (Acari: Varriodae) parasitic on honey bees in New Zealand. Systematic and Appl. Acarol. Special Publications, 5 (S).