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Influence of the Infestation by Varroa Mite *Varroa destructor* on Some Antennal Sense Organs of the Worker and Drone Honey Bees *Apis mellifera* L

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Abstract: Scanning electron microscope (S.E.M.) was used to investigate some sensilla organs of honey bee workers and drones antennae infested with varroa mites. Mean numbers and surface area of Sensilla placodea and mean number and length of Sensilla Trichodea type A & B for samples of healthy, heavily infested and deformed newly emerged workers and drones with varroa mites were conducted by S.E.M. Mean number and mean surface area of sensilla placodea on flagellomeres no. 6,8,10 of the examined bee antennae increased significantly with the infestation by varroa mites especially in the deformed newly emerged honey bee workers and drones compared with the healthy ones. There were reducing significant in the average no. of sensilla trichodea type A and B of antennae among the infested and healthy newly emerged honey bee workers particularly in the deformed worker bees. Significant lowers of mean length, width and mean surface area of antennal flagellomer were found in the heavily infested and deformed worker and drone bees than the healthy ones.

INTRODUCTION

Ectoparasitic mite *Varroa destructor* is the most serious pest of managed honey bees *Apis mellifera* L., world wide[4].

The infestation with *Varroa destructor* causes the death and losses several colonies of honey bees in Egypt and other countries of the world[8,1]. Varroa mite is an obligate ectoparasite that produced in capped cells and feeds by sucking the haemolymph from larval and pupal bees inside the cells and adult bees[3,4]. Sucking the haemolymph from immature and adult honey bees, introducing viral pathogen that cause deformities and poor bee healthy[11]. Deformed worker bees resulted of infestation by varroa mite showed atrophied with little number of their lobules in the hypopharyngeal glands and more shrinkage of mandibular glands[20]. The antennae are the important sensory organs of worker and drone honey bees. Flagellum of antennae covered with small innervated hairs and other minute sensory structures of several kinds. The antennae are responsive particularly to stimuli, touch and odor[9]. Gupta[10] studied the antennal sensilla organs of the adult workers of *Apis florea* F. by using Scanning Electron Microscope and detected some types of sensilla placodea, basiconica, trichodea, ampullacea, coeloconica and campaniformia. Abd El- Wahab[2] found that the tolerant worker bees of different races and hybrids of honey bees (Carniolian Manzala, Egyptian race, Carniolian and Italian hybrids) to varroa mite infestation recorded higher number of sensilla organs on the antennae than the non-tolerant ones.

The aim of this work is to study effect of the infestation by varroa mites on some sensilla organs of the antennal worker and drone honey bees by using Scanning Electron microscope.

MATERIALS AND METHODS

Experiments were conducted during autumn 2004, heavily infested three colonies of carniolian hybrid honey bees were subjected for this study. Another three healthy colonies were used as control. In the heavily infested colonies the mean percentage of infested worker and drone bees by varroa mites was 20% according to the method of De Jong *et al*[8]. These colonies did not receive any chemical control against varroa infestation during the experimental period.

Samples of newly emerged honey bee workers and drones infested with 7 females mites/ bee (heavily infested) as well as infested deformed bees (more than 7 mites/ bee) and samples of healthy worker bee (as control) were collected randomly for the antennal Scanning Electron Microscopy. The antennae were removed from the bee, dried to critical point using Co2 as the transition

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fluid. Then the antenna specimen was mounted and coated with gold[11].

The different samples of antennae were examined in Joel JXA 840 A SEM in the National Research Centre, Dokki, Cairo, Egypt.

The sensilla placodea, sensilla trichodea type A & B and sensilla basiconica of the flagellomeres no. 6, 8 and 10 were counted and the mean length of sensilla trichodea and sensilla basiconica were measured (µm). The mean surface area of sensilla placodea was measured (µm²/organ) according to the following formula of Maurizio[15], [12], placodea surface area = II x ab / 2 (II = 3.14, a = maximum length; b = maximum width). The length, width and surface area (mm²) of all antennal flagellomer were determined for each examined antenna of infested honey bee workers (10 segments) and drones (11 segments).

Analysis of variance (ANOVA) was carried out for the obtained data according to the method of Waller and Duncan[18].

RESULTS AND DISCUSSIONS

Investigations by Scanning Electron Microscope (SEM) showed that the mean number and mean surface area of sensilla placodea on flagellomeres no. 6, 8, 10 of the examined bee antennae increased significantly with the infestation by varroa mites especially in the deformed newly emerged honey bee workers compared with the healthy ones Table (1) and Fig. (1). Also, heavily infested and deformed newly emerged drone bees shows higher significant differences of the mean number and mean surface area of sensilla placodea than the healthy drone bees Table (1) and Fig.(2). Concerning the data in table (1) drone bees recorded more counts of sensilla placodea than the worker bees.

As shown in Table (2) and Fig. (1) there were reducing significant in the average no. of sensilla trichodea type A and B of antennae among the infested and healthy newly emerged honey bee workers particularly in the deformed worker bees infested with varroa mites. Heavily infested and deformed drone bees recorded more counts of sensilla trichodea type A than the healthy ones, although sensilla trichodea type B shows only on the antennae of deformed drone bees (Table 2 and Fig.2).

Sensilla basiconica not recorded in all examined antennal flagellomeres of healthy and infested honey bee workers, but it showed only in the flagellomers of healthy and deformed drone bees Table (2) and Figs. (1&2).

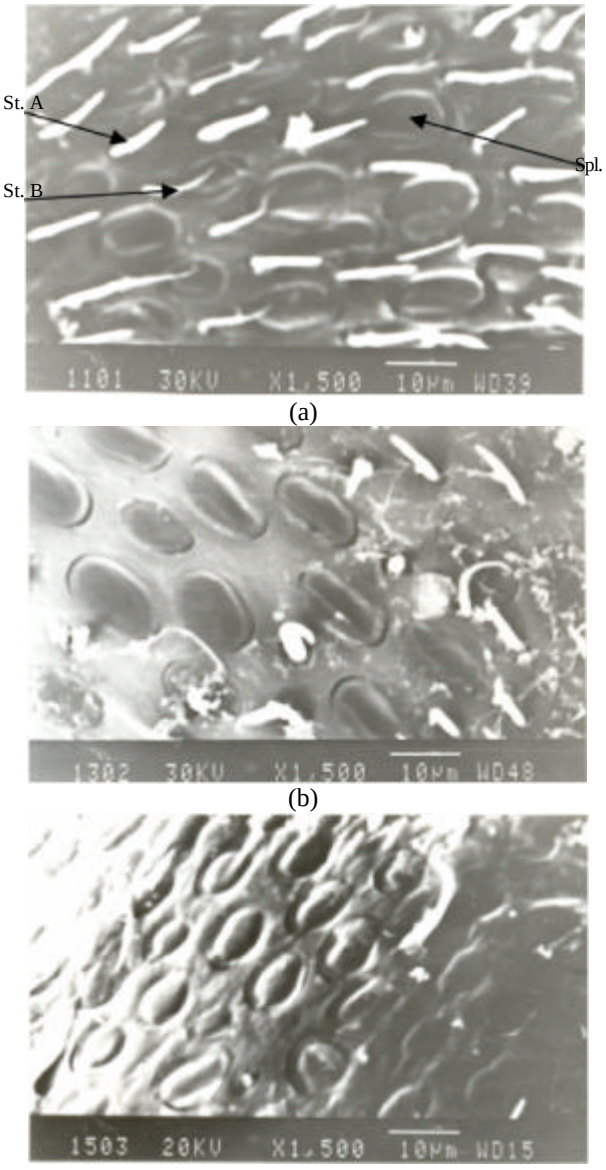


Fig. 1: Scanning electron microscope view of sensillsa organs on the antennae of healthy newly emerged honey bee workers (A); heavily infested honey bee workers (B) and deformed honey bee workers infested with varroa mites (C).

St. A: Sensilla trichodea type A
St. B: Sensilla trichodea type B
St. C: Sensilla placodea

Sensilla trichodea type A and B on the antennal flagellomeres of heavily infested and deformed worker bees recorded slightly lower length than the healthy ones Table (3).

Concerning the results in Table (2&3) and Fig. (2) heavily infested and deformed drone bees recorded more

Table 1: Mean number and mean surface area (µm²) of Sensilla Placodea organs on antennae of worker and drone honey bees infested by varroa mites.

Treatment	Flagellomers of Sensilla						Average number of Sensilla placodea (µm)	Average surface area of sensilla placodea (µm²)
	Flagellomer no. 6		Flagellomer no. 8		Flagellomer no. 10			
	Mean No. of Sensilla placoda	Mean surface area of Sensilla placodea	Mean No. of Sensilla placoda	Mean surface area of Sensilla placodea	Mean No. of Sensilla placoda	Mean surface area of Sensilla placodea		
Healthy workers (Control)	13	202.6 ±13.85	13	178.13 ±8.55	15	180.97 ±12.06	13.66 a	187.23 ±11.48a
Heavy infested workers	12	237.64 ±12.98	10	232.59 ±7.60	9	179.16 ±7.43	10.33 a	216.45 ±9.33 a
Deformed workers	24	130.31 ±6.86	18	111.63 ±6.74	21	121.87 ±5.82	21 b	121.27 ±6.47 b
L.S.D.							6.2	37.28
Healthy drones (Control)	40	127.10 ±2.82	41	117.34 ±1.88	36	129.38 ±1.74	39 a	124.60 ±2.14 a
Heavy infested drones	45	81.39 ±4.27	46	67.13 ±3.10	51	89.32 ±3.13	47.33 a	79.28 ± 3.5 b
Deformed drones	57	77.42 ±1.75	72	73.88 ±1.75	62	74.24 ±1.99	63.66 b	75.18 ±1.83 b
L.S.D.							8.93	13.01

Table 2: Mean number of sensilla trichodea and sensilla basiconica of honey bee workers and drones infested by varroa mites.

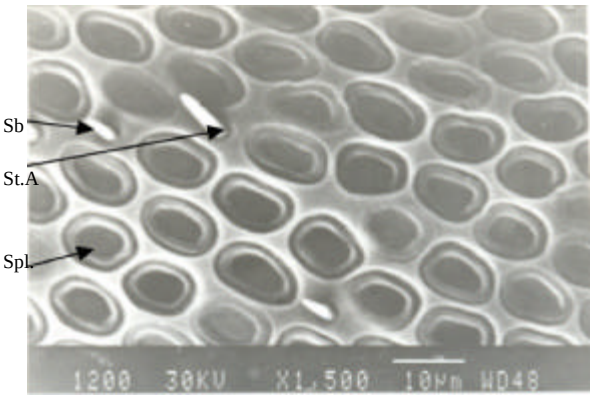
Treatment	Segment of sensilla									Average No. of sensilla		
	Segment 6			Segment 8			Segment 10			Sensilla trichodea		Sensilla basiconica
	Mean No. of Sensilla trichodea		Mean No. of Sensilla basiconica	Mean No. of Sensilla trichodea		Mean No. of Sensilla basiconica	Mean No. of Sensilla trichodea		Mean No. of Sensilla basiconica	Type A	Type B	
	Type A	Type B		Type A	Type B		Type A	Type B				
Healthy workers (Control)	15	6	0.0	18	7	0.0	21	7	0.0	18	6.66	0.0
Heavy infested workers	8	2	0.0	6	3	0.0	10	4	0.0	8	3	0.0
Deformed workers	4	2	0.0	5	2	0.0	6	3	0.0	5	2.33	0.0
Healthy drones (Control)	2	0.0	0.0	0.0	0.0	2	2	0.0	2	1.33	0.0	1.33
Heavy infested drones	3	0.0	0.0	9	0.0	0.0	2	0.0	0.0	4.66	0.0	0.0
Deformed drones	5	2	0.0	0.0	0.0	2	4	0.0	2	3	0.66	1.33

Table 3: Mean length of sensilla trichodea and sensilla basiconica (um) of honey bee workers and drones infested by varroa mites.

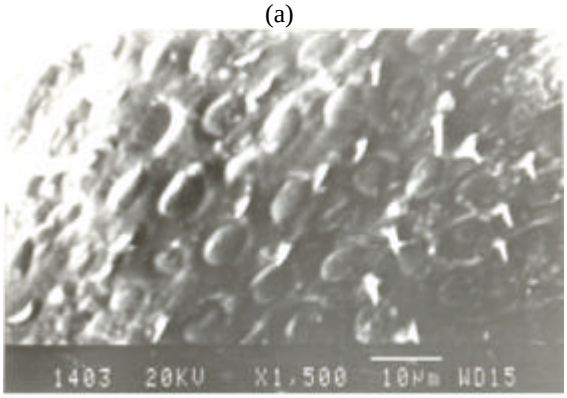
Treatment	Segment of sensilla									Average length of sensilla		
	Segment 6			Segment 8			Segment 10			Sensilla trichodea		Sensilla basiconica
	Mean length of Sensilla trichodea		Mean length of Sensilla basiconica	Mean length of Sensilla trichodea		Mean length of Sensilla basiconica	Mean length of Sensilla trichodea		Mean length of Sensilla basiconica	Type A	Type B	
	Type A	Type B		Type A	Type B		Type A	Type B				
Healthy workers (Control)	12.26 ±0.34	10.33 ±0.28	0.0	11.33 ±0.26	10.47 ±0.34	0.0	11.20 ±0.2	10.80 ±0.28	0.0	11.59 ±0.46	10.53 ±0.3	0.0
Heavy infested workers	10.49 ±0.45	10.16 ±0.79	0.0	9.71 ±0.26	10.55 ±1.12	0.0	10.76 ±0.78	10.58 ±0.71	0.0	10.32 ±0.49	10.43 ±0.87	0.0
Deformed workers	15.12 ±2.2	12.5 ±0.43	0.0	8.79 ±0.57	7.66 ±0.33	0.0	7.94 ±0.49	7.44 ±0.28	0.0	10.61 ±1.08	9.2 ±0.34	0.0
Healthy drones (Control)	7.16 ±0.16	0.0	0.0	0.0	0.0	5.72 ±0.27	6.16 ±0.16	0.0	5.16 ±0.16	4.44 ±0.10	0.0	3.62 ±0.14
Heavy infested drones	6.88 ±0.58	0.0	0.0	4.88 ±0.36	0.0	0.0	10.27 ±0.05	0.0	0.0	7.34 ±0.33	0.0	0.0

Table 3: Continued.

Deformed drones	11.66 ±0.43	13.95 ±0.04	0.0	0.0	0.0	4.05 ±0.04	6.66 ±0.27	0.0	4.16 ±0.16	6.10 ±0.23	4.95 ±0.01	2.73 ±0.06



(a)



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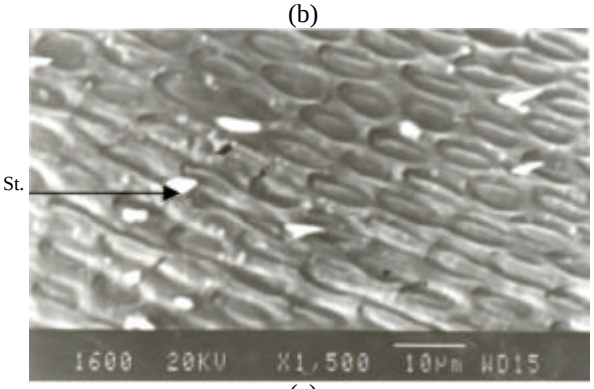


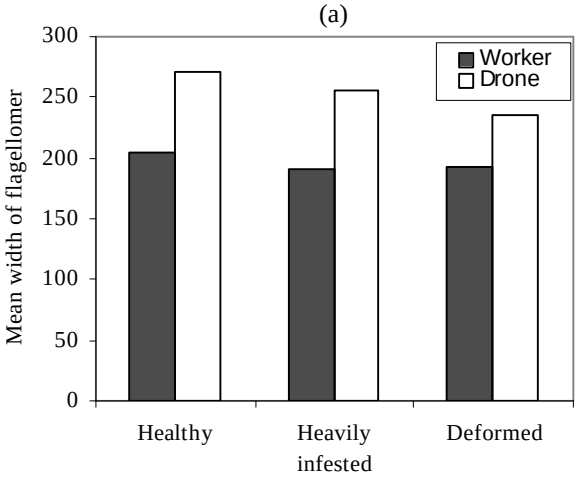
(c)

Fig. 2: Scanning electron microscope view of sensillsa organs on the antennae of healthy newly emerged honey bee drones (A); heavily infested honey bee drones (B) and deformed honey bee drones infested with varroa mites (C).

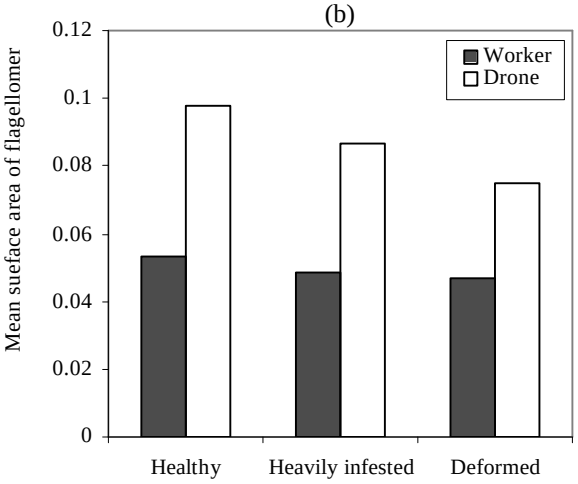
St. A: Sensilla trichodea type A
Sb: Sensilla basiconica
St. B: Sensilla trichodea type B
SpL: Sensilla placodea

no. of sensilla trichodea type A and B than the healthy ones. Also, drone bees showed lower mean length of

(a)



(b)



(c)

Fig. 3: The effect of infestation by varroa mite on the A) mean length, B) mean width, C) mean surface area of antennal flagellomer of worker and drone honey bees.

Table 4: Mean length, width and surface area of flagellomeres in all flagellum antenna of wrker and drone bees infested by varroa mites.

Treatment	Mean length of flagellomer µm	Mean width of flagellomer µm	Mean surface area of flagellomer mm²
Healthy worker (control)	267.27 a	204.2 a	0.0533 a
Heavily infested workers	255.31 b	191.23 b	0.0486 b
Deformed workers	243.47 c	192.43 b	0.0468 b
L.S.D.	6.708	5.6123	0.0020
Healthy drones (control)	340.02 a	270.56 a	0.0979 a
Heavily infested drones	333.62 a	255.30 b	0.0868 b
Deformed drones	315.12 c	234.64 c	0.0749 c
L.S.D.	15.356	8.2036	0.0050

sensilla basiconica than the healthy ones.

Data represented in Table (4) indicates that the effects of the infestation by varroa mites on the mean length, width and mean area of all antennal flagellomers on each examined antenna of worker and drone honey bees. Significant lowers of mean length, width and mean surface area of antennal flagellomer were found in the heavily infested and deformed worker and drone bees than the healthy ones. Also, drone bees recorded higher length, width and area of the tested antennal flagellomers than the worker bees Fig.(3).

It could be concluded that Scanning Electron Microscope of the deformed infested hone bee colonies with varroa mites showed highly counted mean number of Sensilla placodea on the antennal flagellomeres no 6,8 and 10 of honey bee workers and drones. Heavily infested and deformed worker bees showed lower mean number of Sensilla trichodea type A and B than the healthy ones, in contrast that drone bees recorded higher mean number of Sensilla trichodea type A and B than the healthy ones. Infestations by varroa mites caused highly lower of mean length, width and area of flagellomer in antenna than the healthy ones. The obtained results indicted that the infestation by varroa mites (7 female mites or more) caused highly malformations to sensilla organs of antennae of worker and drone honey bees that may be effect on the biological activities of worker bees inside the hive as well as on the drone bees in matting virgin queens. The previous studies concluded that infested honey bee workers by varroa mites exhibit reductions of haemolymph volume, total protein, protein concentration, weight at emergence and longevity[8,19,16,13]. De Jong *et al*[8] and Marcangeli *et al*[14] found that heavily infested colonies with varroa mites 6% of worker bees showed deformation in the form of wing damage and had some leg malformations. De Jong[6] and Daly *et al*[5] recorded that worker bees infested with up 5mites had exoskeletons that were normal in microscopic detail, but exhibited morphometric changes associated with increased mite infestation. It was assumed that these characteristics were caused by the loss of haemolymph, rather than injuries directly related to mite feeding sited. They also suggested that the damage to the wings and legs of worker bee is an external manifestation of loss of haemolymph pressure to fully expand the wings and legs during development.

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