

**STRUCTURE OF ANTENNAL SENSILLA OF THE
PARASITOID, *HYPOSOTER EBENINUS* (GRAV.)
(HYMENOPTERA: ICHNEUMONIDAE)**

HAMDY E.M. HANAFY

*Department of Plant Protection, Faculty of Agriculture, Ain Shams
University, Shoubra El-Kheima, Cairo, Egypt*

(Received 8-5-2007)

INTRODUCTION

It is well known that the antennae in insects play a major role in host findings (Dethier, 1963). Limited reports exist specifying sensilla involved in perception of stimuli responsible for host insect finding.

Females of the parasitoids, *Anabrolepis mavurai* were reported to examine the host by antennal drumming (Dutt and Devaiah, 1989). Females of the parasitoids, *Prionomitus miratus* identify nonparasitized fifth-instar nymphs of *Psylla pyri* by antenation (Mirkarimi, 1995). Female of the parasitoid *Dinarmus basalis* detected their hosts, *Callosobruchus chinensis* by the use of their antennae (Islam, 1997). Gravid females of the parasitoid, *Ormia ochracea* rely on their sense of hearing to detect and localize their hosts the field cricket of the genus *Gryllus* (Robert and Willi, 2000).

Generally, in order to understand host selection by insects, it was necessary to study types and the external morphology of sensory receptor system in the parasitoids.

The purpose of this study was to identify, classify and describe the different sense organs distribution on the antenna of both males and females of the parasitoid, *Hyposoter ebeninus* (Hymenoptera: Ichneumonidae).

MATERIAL AND METHODS

Pieris rapae larvae of all instars were collected from cabbage plants located at the field of Faculty of Agriculture, Ain Shams University, at Shalakan, Qalyobia Governorate. These larvae are known to be host to the parasitoid *Hyposoter ebeninus*. Collected larvae were transferred to the laboratory and maintained in glass

jars and fed on fresh cabbage leaves. These larvae were investigated for parasitism by the parasitoid *H. ebeninus*.

Upon the emergence of the parasitoid, *H. ebeninus* (Grav.) adults from infested *P. rapae* larvae they were carefully collected and sexed. They were decapitated and heads placed separately and prepared for Scanning Electron Microscopy (SEM).

The specimens were fixed in 2.5% glutaraldehyde for 24 h at 4°C. Post-fixation was in 1% osmium tetroxide for 1 h at room temperature according to Harly and Ferguson (1990). The specimens were then dehydrated in ascending concentrations of acetone until dried to the critical point and finally sputter coated with gold. The examination, measurements and photographing were done through a Jeol Scanning Electron Microscope (JSM-T₃₃₀ A) equipped with image recording and processing system (Semafore).

RESULTS AND DISCUSSION

Morphology, distribution and location of various types of sensilla on the antennae

The antenna of the parasitoid, *Hyposoter ebeninus* (Grav.) adult consists of a barrel-shaped scapus, a short pedicellus and a filiform flagellum of 29 segments (Fig. 1. A & B). The length of the antenna was longer in male than in female insects. The average length and width of the antennal flagellum segments was about 152 & 100.4 µm in male and 67.7 & 86.4µm in female. This data was calculated from the mean of 5 samples of each sex as shown in Table (1).

A considerable number of different types are evident on the various antennal segments which according to their position on the antennal segments could be presented as follows:

I. Scapus

The scapus appears as a small segment carried on a small tubercle. The various evident sensilla located on this segment are:

a) Mechanosensilla

Three distinct types of bristles or spines with sharp tips known as sensilla trichodea were evident and according to their size were classified as small, medium or large. These mechanosensilla were the largest and the most conspicuous, they appear slender, with sharp taper and smooth walls. The same was described and

classified as mechanoreceptors by McIver (1975). Various types of sensilla trichodea and sensilla styloconica were identified on antennae of *Exorista sorbillans* (Jyothi *et al* 1993).

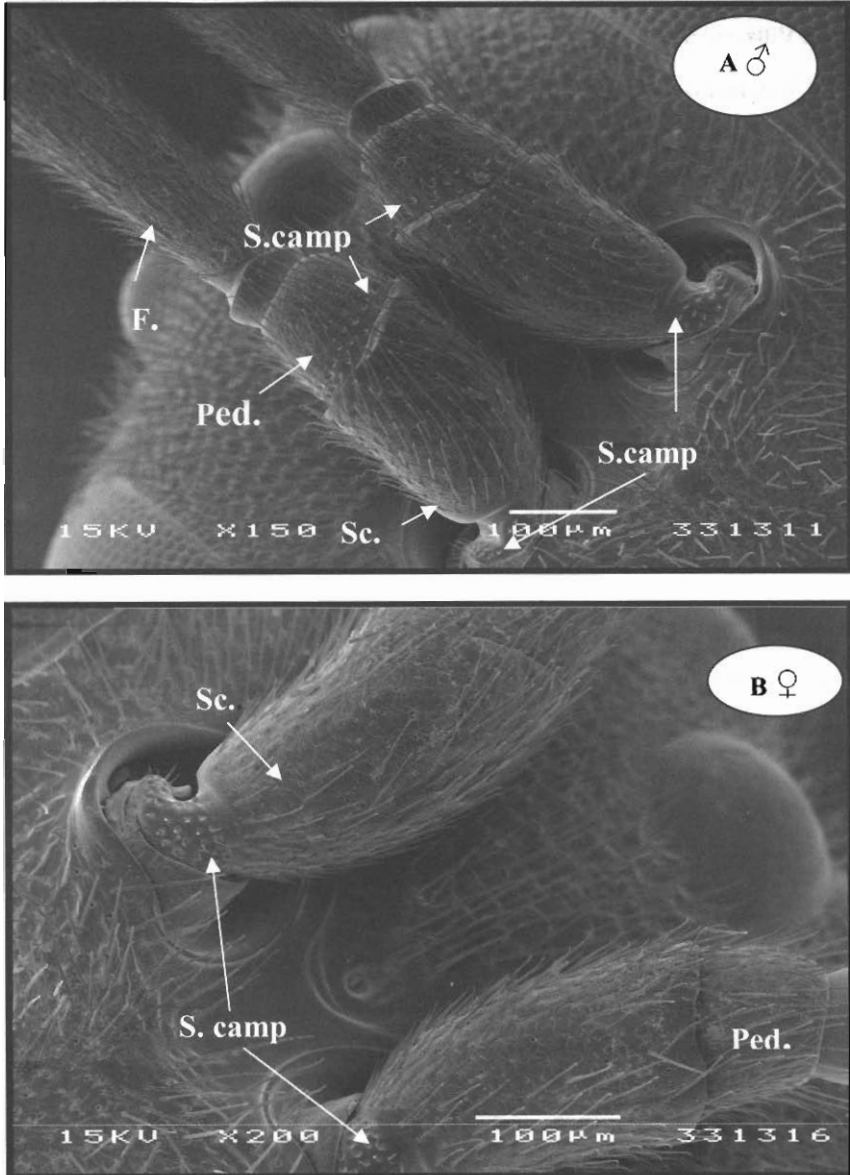


Fig. (1): SEM micrograph illustrating the antennae of *Hyposoter ebeninus* male (A) and female (B).

Sc: Scapus (2 segments); Ped: Pedicel (1 segment); F: Flagellum (29 segments); Scamp: Sensilla campaniformia.

Sensilla campaniformia appeared in groups and were more numerous at the base of scapus segment in females than in the males (Fig. 1). Similar mechanosensilla were described in many hymenopterous parasitoids (Bin *et al.* 1989 and Villa and Mineo, 1990).

b) Chemosensilla

1. Few scattered organs of sensilla coeloconica (S.co) appeared as a small Peg laying inside an oval shaped depression with a raised and rounded edge (Fig. 2 A & B). These organs were found on the scapus and were abundant on the antenna of females and absent on the scapus of males.

2. A few scattered organs of sensilla placodea (S.pl) appeared as plates of dome shaped on the scapus of female but were not detected on the male scapus.

These organs were described and proved to have an olfactory function in many parasitoids of hymenopterous insects, *e.g.* *Trybliographa rapae* and *Opius concolor*, Butterfield and Anderson (1994); Gokhman & Krutov (1996) and Barbarossa *et al* (1998).

3. Very few sensilla ampullicica (S.amp) were evident, they appeared as very small or minute pegs or immersed cones deeply sunken inside a pore. This chemosensilla appeared only on the antenna of the female insect (Fig. 2 A & B). The same description of such a chemosensilla was previously found and described in most hymenopterous insects and proved to have a great function in scent detection *e.g.* *Odontomachus ruginodis* Callahan (1975).

II. Pedicel

The pedicellus segment appears as a short segment equal in length in both sexes. This segment carried the following sense organs:

Mechanosensilla

Two types were evident; sensilla trichodea in three sizes (small, medium and large) and were depicted on the pedicle of both sexes. Furthermore, a few sensilla campaniformia were distributed between the trichoid sensilla at the base of the pedicellus segment on the antenna of males (Fig. 1.A).

III. Flagellum

The flagellum consists of 29 slender segments which were invaded with a considerable variety of sensilla. The antenna of female insects carried a large

number and more types of sense organs in comparison to the same segments of males (Fig. 3 A & B).

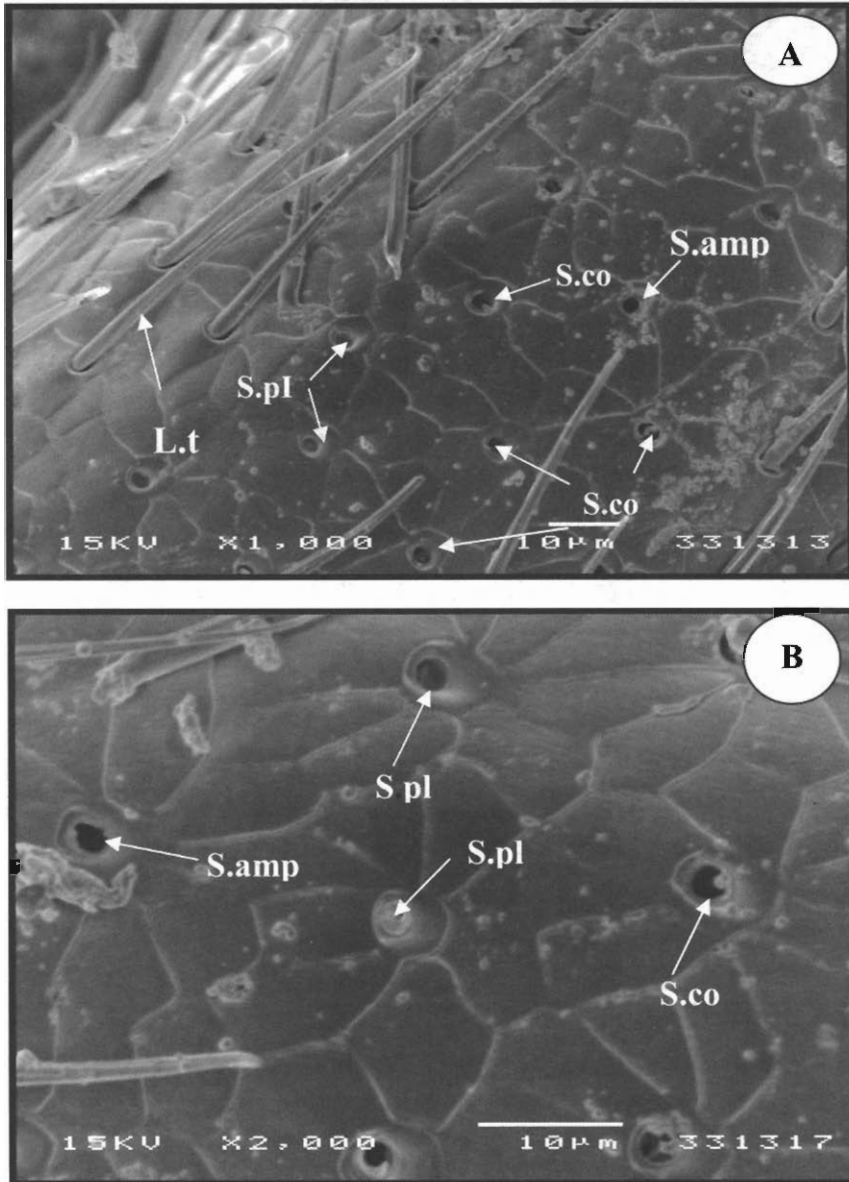


Fig. (2): (A) SEM micrograph illustrating the chemosensilla of the scapus of the female parasitoid. (B) Higher magnification
 S.amp: Sensilla ampullicica; S.pl: Sensilla placodea; S.co: Sensilla coeloconica

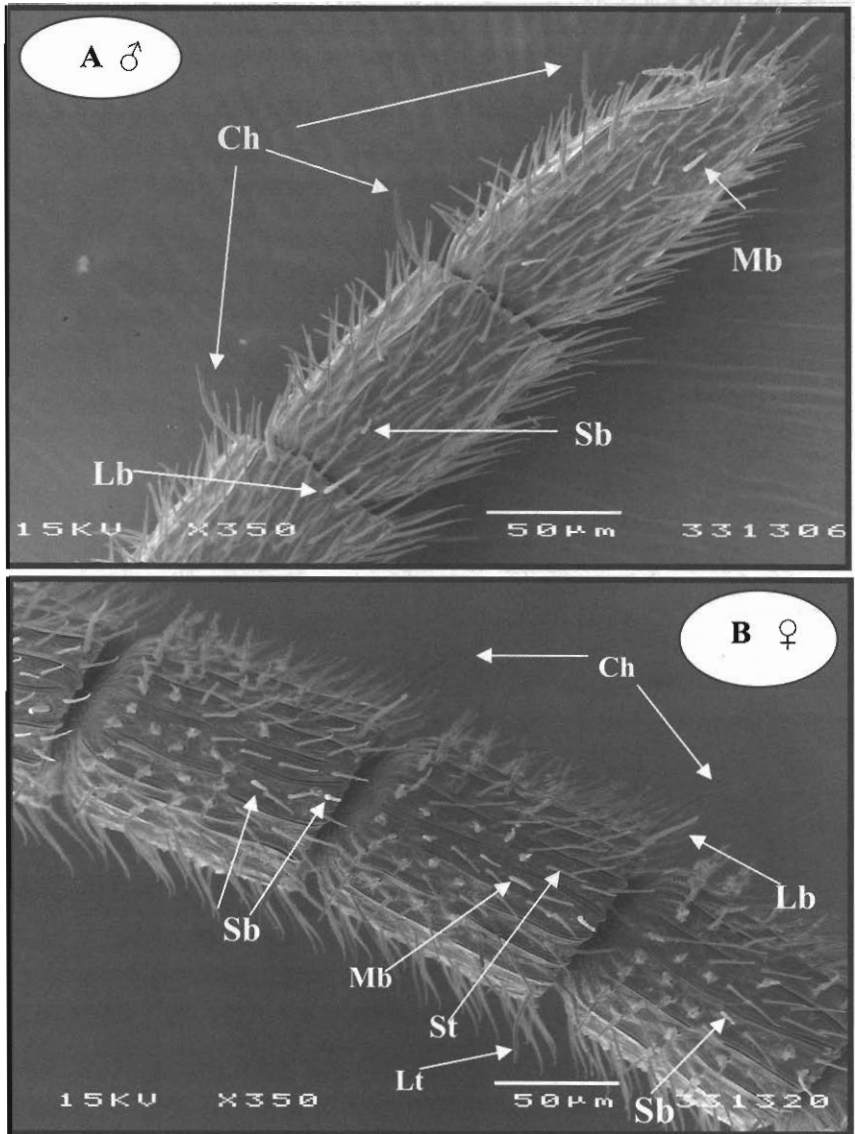


Fig. (3): SEM micrographs illustrating the flageller segment of the antennae of *Hyposoter ebeninus* male (A) and female (B).

Ch: Sensilla chaetica

Sb: small basiconica

Mb: medium basiconica

Lb: Large basiconica

St: small trichodea

Lt: Large trichodea

a) Mechanosensilla

Mechanosensilla included tactile hairs or sensilla trichodea of three sizes that were widely distributed and covering most of the segment surfaces especially the apical segments. Sensilla chaetica which were the longest hairs, the shaft of the hair

was slightly tapered or curved with a thick smooth wall and were found along all the flagellum segments in both sexes. A few hairs of sensilla chaetica of the long type appeared as slightly curved bristles or spines rather than the typical bristles were concentrated on the tip of the apical flagellum segments. This type of sensilla was the largest and the most conspicuous among all hair shape sensilla (Fig. 4 A & B).

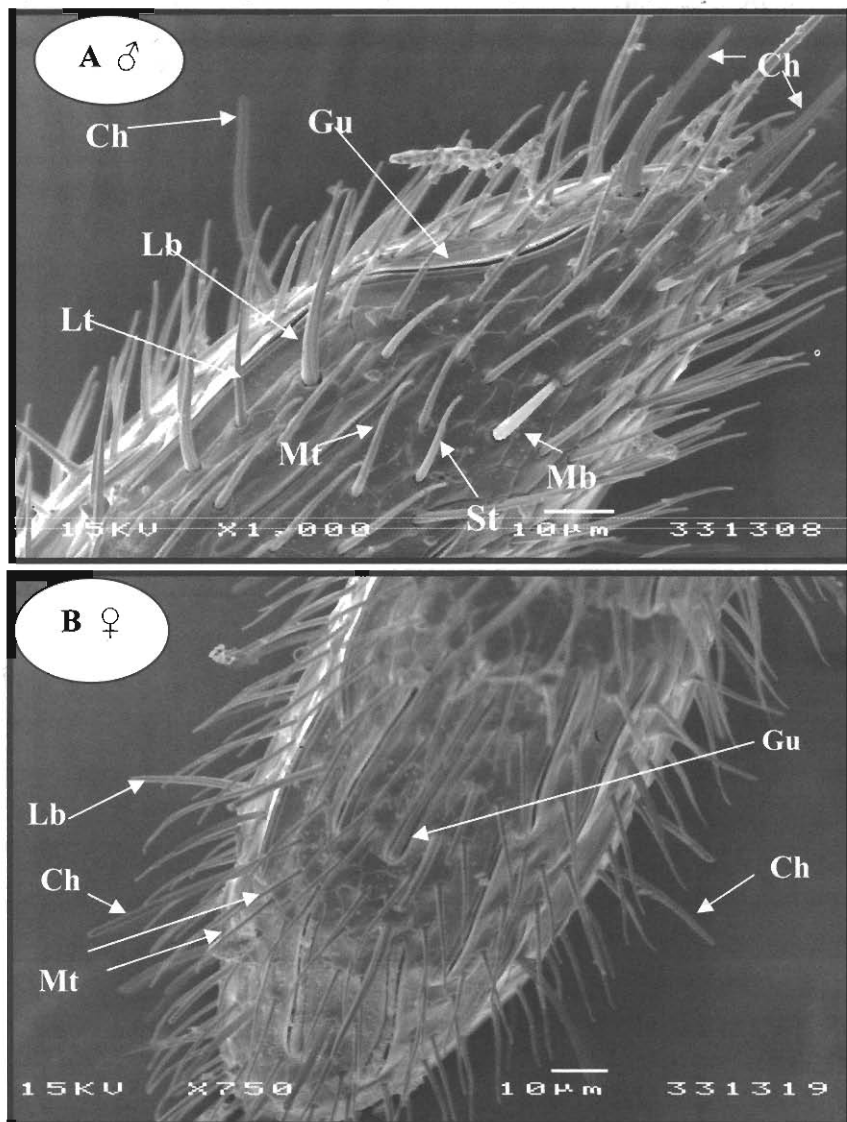


Fig.(4): Higher magnification of the flagellar apical segments male (A) and female (B).

Ch: Sensilla chaetica

Mb: medium basiconica

Lb: Large basiconica

St: small trichodea

Mt: medium trichodea

Lt: Large trichodea

Gu: Glandular unite

Mechanosensilla act as monitors for host finding and selection (Callahan, 1975 and Zacharuk, 1985). These organs were found and described in some parasitoids of hymenopterous insects of family Encyrtidae (Van-Baaren *et al.* 1996) and family Braconidae (Villa and Mineo, 1990).

b. Chemosensilla

Segments of the flagellum in both sexes are equipped with great variety of chemosensilla which included:

- 1- Three variant sizes of sensilla basiconica which could be distinguished as small basiconica (Sb), medium basiconica (Mb) and large basiconica (Lb), which were morphologically similar in shape, however, they varied in length (Fig. 4 A & B). These sensilla apical pores in the hair wall and were reported to have an olfactory, humidity receptor function in the hymenopterous insects as noted by Schneider and Steinbrecht (1968).
2. Multiporous chemosensilla or glandular unites associated canals were distributed on the medial and apical segments of the flagellum segments and were more richly distributed in female than male insects, (Figs. 3 and 5). These organs were found to provide a secretion which may prove the chemical interaction with scents of hosts. The same organs were described in some parasitoids of coleopteran insects (Skilbeck and Anderson, 1994).

The present survey clarifies the different sense organ types and their distribution on the antenna of the parasitoid, *Hyposoter ebeninus*. This may form a base for further physiological type specific variations for correlating these structures with function in host detection and selection.

TABLE (I)

Total number, type, average size of antennal flagellum segments (μm) of the adult parasitoid, *H. ebeninus*

Flagellum	Total number	Type	Average length of a flagellum segment ($\mu\text{m} \pm \text{S.D}$)	Average width of a flagellum segment ($\mu\text{m} \pm \text{S.D}$)
Male	29	Filiform	152 \pm 3.3	100.4 \pm 0.5
Female	29	Filiform	67.7 \pm 0.8	86.4 \pm 0.8

TABLE (II)Types of sensilla on the antenna of the adult parasitoid, *H. ebeninus*

External shape of sensilla	Types	Average length (μm) \pm S.D	
		Male	Female
Sensilla trichodea	Small	16.5 \pm 0.8	14.7 \pm 0.5
	Medium	27.3 \pm 0.9	22.5 \pm 0.4
	Large	40.6 \pm 0.8	33.1 \pm 0.6
Sensilla basiconica	Small	11.7 \pm 0.7	8.1 \pm 0.7
	Medium	19.8 \pm 1.5	20.5 \pm 0.6
	Large	34.5 \pm 2.6	28.1 \pm 3.0
Sensilla chaetica	Large	31.4 \pm 0.7	36.5 \pm 0.8
Glandular unite	Large	47.6 \pm 0.6	42.5 \pm 0.5
Sensilla coeloconica	--	Absent	Present
Sensilla placodea	--	Absent	Present
Sensilla ampullicica	--	Absent	Present
sensilla campaniformia	--	Present	Present

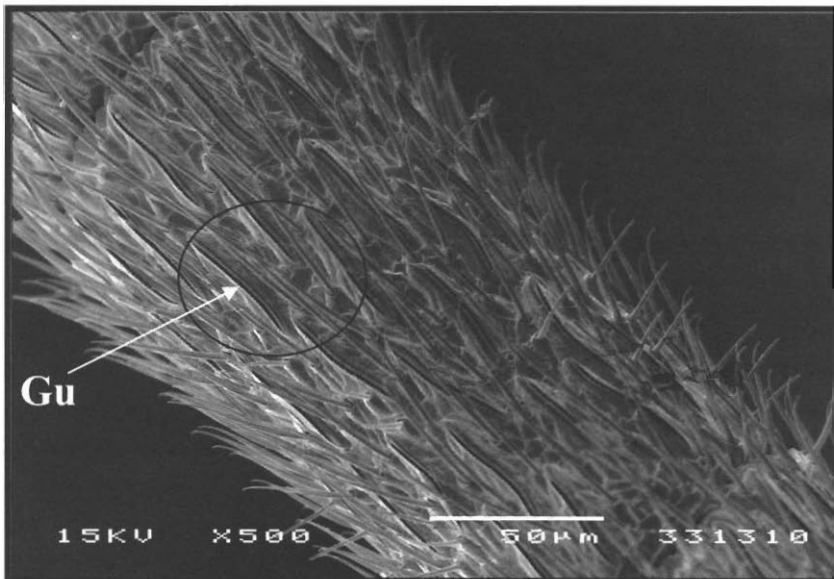


Fig. (5): Higher magnification of one of the middle flagellar segments of male shown the multiporus chemosensilla (glandular units associated canals "Gu").

SUMMARY

Study of the antenna of *Hyposoter ebeninus* revealed a considerable variety of sensilla located on the antennal segments of both sexes of this parasitoid. The filiform antenna was composed of a scapus, pedicle and 29 flagellum segments which were larger in size in females than in males.

The morphology and distribution of observed sensilla were determined and surveyed. The mechanosensilla appeared as three types of sensilla trichodea hairs on all segments. Groups of sensilla campaniformia were located on the scapus of both sexes; furthermore the scapus in females also was invaded with various surface pits characteristics of porous olfactory chemosensilla such as the grooved smooth pegs of sensilla coeloconica and ampullicica in addition to the pore plates. These forms were not detected in males. Three types of the sensilla basiconica (short, medium and large) were widely distributed on the flagellum segments of both sexes. The flagellum segments were highly equipped with the glandular units as associated canals especially on the apical segment in the female insect.

Comparative morphometry revealed sex specific differences in number of sense organs.

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