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ANTENNAL SENSILLA OF *Trichogramma evanescens* WESTWOOD (HYMENORTERA: TRICHOGRAMMATIDAE)

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ABSTRACT

The sense organs on antenna of the egg parasitoid Trichogramma evanescens (Hymenoptera: Trichogrammtidae) were investigated using a scanning electron microscope. The antennal sensilla showed strong sexual dimorphism as their number and types differed in female and male insects. The antenna of the female displayed 14 types of sensilla: basiconic capitata peg (types 1 and 2), campaniform, chaetica (types 1-3), coeloconic, falcate, placoid (types 1 and 2), styloconic and trichoid (types 1-3). The male antenna exhibited 12 types of sensilla which were: basiconic capitata peg (types 1 and 2), campaniform, chaetica (types 1-3), coeloconic, placoid (types 1 and 2) and trichoid (types 3 -5).

The falcate and styloconic sensilla were only observed on the female antenna, meanwhile, trichoid sensilla types 4 and 5 were only detected on the male antenna. Variation in the structure and distribution of antennal sensilla in both sexes are discussed, and also their function suggested. The survey could be used as a key for identification of Trichogramma spp.

Keywords: *Trichogramma evanescens*; Antennae; Sensilla; Scanning electron microscopy

INTRODUCTION

Trichogramma spp. are extremely tiny wasps (ca. 0.5 mm in length and 8 µg in weight) that are used worldwide to control lepidopteran insect pests (Nagarkatti and Nagaraja, 1977; Wajnberg and Hassan, 1994). In Egypt *Trichogramma evanescens* Westwood attacks many lepidopteran pests that attack various crops such as maize, sorghum, rice, wheat, sugarcane, cotton, tomato, cabbage and fruit trees (Nasr *et al*. 1995; Hegazi *et al*. 2004; Sakr *et al*. 2007; Sherif *et al.* 2008; Tohamy, 2008).

Antennae of parasitic Hymenoptera are involved in habitat searching, host location, host examination, host recognition, host acceptance, host discrimination, mating behavior and oviposition, (Weseloh, 1972; Dahms, 1984; Bin and Vinson, 1986; Vinson *et al.* 1986; Isidoro *et al*. 1996; Meyhöfer *et al.* 1997).When a suitable host egg is encountered, the female *Trichogramma* examines the egg by antennal drumming, drills into it with her ovipositor and lays one or more egg within the host egg, depending on its size. Antennae of male parasitic Hymenoptera are involved in courtship behavior (Isidoro and Bin, 1985). Antennal sexual dimorphism is expressed in size, shape, segment number and sensilla types (Navasero and Elzen, 1991).

In a previous study on recognition and searching behavior process of two parasitoids of *Trichogramma* spp. on eggs of *Cydia pomonella* L., it was found that insects used chemicals for orientation to host eggs (Sakr, 2006). It is therefore necessarily to follow up this study by surveying the sense organs on antennae of both male and female *T. evanescens* as this parasitoid is most active and wide spread in Egypt.

MATERIAL AND METHODS

Rearing of Trichogramma evanescens:

Trichogramma evanescens wasps were reared on eggs of the Angoumois grain moth *Sitotroga cerealella* Oliver in an environmental cabinet set at 27±1 °C, 16L: 8D photoperiod and 60 to 70 % relative humidity. The strain was kept in glass tubes (23 cm long and 2 cm in diameter) closed with muslin. Two tubes for strain were confined in plastic containers (18 x 13 x 6 cm). One half of the container was darkened by black paper to keep the adults parasitoids away from the lid. About 3,000 adult *T. evanescens* per tube were supplied with ca. 10,000 host eggs. After three to four days, when the eggs started to turn black, the tubes were placed in another environmental cabinet at 18±1 °C to slow down their development. Two days later, following death of adults, the egg-cards were removed from the cabinet, reduced to one third and placed into a new tube. When the adult wasps started to emerge, they were supplied with a new egg-card and transferred to the warmer cabinet.

Scanning electron microscopy (SEM)

Upon emergence of *T. evanescens* adults they were carefully collected and sexed and placed separately and prepared for Scanning Electron Microscopy (SEM) viewing. Ten specimens of each sex 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 Fergusen (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-T_{330} A) equipped with image recording and processing system (Semafore).

Abbreviations used in the text, tables and figures of this paper are:

C	= Club
An1	= Anellus1
An2	= Anellus2
Fn1	= Funicle 1
Fn2	= Funicle 2
Fn3	= Funicle 3
P	= Pedicel
R	= Radicle
Sc	= Scape
BCPS1	= BasiconicCapitate Peg Sensilla, type 1
BCPS2	= BasiconicCapitate Peg Sensilla, type 2
CaS	= Campaniform Sensilla
ChS 1	= Chaetica Sensilla, type 1
ChS 2	= Chaetica Sensilla, type 2
ChS 3	= Chaetica Sensilla, type 3
CoS	= Coeloconic sensilla
FS	= Falcate sensilla
PS 1	= Placoid sensilla, type 1
PS 2	= Placoid sensilla, type 2
StS	= Styloconic Sensilla
TS 1	= Trichoid Sensilla 1
TS 2	= Trichoid Sensilla 2
TS 3	= Trichoid Sensilla 3
TS 4	= Trichoid Sensilla 4
TS 5	= Trichoid Sensilla 5

RESULTS

Terminology

The literature on morphology of insect antennae is somewhat inconsistent and confusing with different names and terminologies assigned to sensilla types despite similarity in form and distribution. The nomenclature reported by Chapman (1998), Isidoro *et al*. (1996), Amornsak *et al*. (1998), Pettersson *et al*. (2001), Ryan (2002), Bleeker *et al.* (2004) and Onagbola *et al*. (2008) were as much as possible followed.

General description of antennae of T. evanescens

The antennae are strongly sexually dimorphic in *T. evanescens*, eight distinguishable segments compose the female antenna and nine segments in male antenna. Each antenna consists of an elongate scape with basal radical, pedicel and flagellum. The flagellum is differentiated into basal anelli (ring segments), funicel and apical club, which are all apparent especially in the female antenna.

The length of the antenna is longer in male than in the female insects, as the mean total antennal length was about 231.38 ± 0.6 µm and 205.82 ± 0.9 µm, respectively, as calculated from the mean of 10 individuals from each sex as shown in Table 1.

Table 1: Average length ± SE (µm) of antennal segments in female and male *T. evanescens*

Antennal segments	Female	Male
Radical	8.3 ± 0.21	7.6 ± 0.19
Scape	67.2 ± 0.35	50.0 ± 0.31
Total	75.5 ± 0.31	57.6 ± 0.24
Pedicel	31.6 ±0.45	33.5 ± 0.25
Anellus 1	2.7 ± 0.09	2.5 ± 0.12
Anellus 2	6.4 ± 0.12	7.2 ± 0.14
Funicel 1	7.4 ± 0.22	16.4 ± 0.26
Funicel 2	10.3 ± 0.12	17.8 ± 0.18
Funicel 3	--	24.9 ± 0.14
Club	71.95 ± 0.72	71.33 ± 0.19
Mean total length of antenna	205.8 ± 0.9	231.4 ± 0.56

The female antennal surface has a corrugated cuticular wall possessing several types of sensilla. The flagellum consists of 2 anellar segments, 2 funicular segments and a club of one segment (Figs. 1A and 2A). The first anellus (An1) is a small cylindrical ring-like structure. The second anellus (An2) is triangular in profile. The funicular segments are cylindrical. The first funicle segment (Fn1) is shorter than the second (Fn2). The apical or club segment is broadest at the midpoint, slightly tapered, curved apically, blunt flattend on the dorsal surface and curved on the ventral surface (Fig. 1A). The club is covered with numerous types of antennal sensilla on the ventral surface.

The surface of the male antennal scape and pedicel segments are similar to that of the female antenna, but the surface of the club is more irregularly corrugated and covered with numerous relatively long sensilla.

Fig.1 A) Adult female *T. evanescens* antenna showing different segments. (X 500)
B) Adult male *T. evanescens* antennae (X 500)

The male antenna is composed of 2 anellar segments, 3 funicular segments and a club of one segment (Fig. 1B). The first anellus (An1) is distinct thin segment and cylindrical ring-like structure. The second anellus (An2) is triangular in profile and fused with the first funicle segment. The funicular segments are cylindrical, the second funicle (Fn2) is shorter than the first (Fn1) and third (Fn3). The club form an elongate tube like structure. The club is slightly curved with a blunt apex, a deep line or corrugated wall is evident on the dorsolateral surface and indicates segment boundaries (Fig. 1B).

Antennal sensilla types

A considerable number of different types of sensilla are evident on the various antennal segments, according to their position, size, shape and cuticular attachment 14 and 12 types of sensilla appear on the female and male antenna, respectively. These sensilla are: basiconic capitate peg sensilla (BCPS) in two types, campaniform sensilla (CaS), chaetica sensilla (ChS types 1-3), coeloconic sensilla (CoS), falcate sensilla (FS), placoid sensilla (PS) in two types, styloconic sensilla (StS) and trichoid sensilla (TS, types 1-5). The club segment contains the greatest number and range of sensilla types. The types, number and distribution of the antennal sensilla of the adult female and male are given in Table 2.

FEMALE ANTENNAL SENSILLA

Eight groups of antennal sensilla were recognized and classified to 1٤ sensilla types: basiconic capitate peg sensilla (types 1 and 2), campaniform sensillum, chaetica sensilla (types 1-3), coeloconic sensillum, falcate sensillum, placoid sensilla (types 1 and 2), one styloconic sensillum and trichoid sensilla (types1-3).

Basiconic capitate peg sensilla (BCPS)

The two type of basiconic capitate peg sensilla (BCPS1 and 2) are distinguished by their external structure shape. BCPS are bulb-like structures, each set into a shallow cuticular depression.

With higher magnification the BCPS1 were shown to possess an indistinct stalk with a tapered blunt apex and appears more slender than BCPS2, which possesses a much more rounded capitate peg on a distinct stalk. An obvious ring of wrinkled cuticle surrounds the stalk, which is set in a distinct cuticular depression (Figs. 2 A & B). Another BCPS1 lies on the ventral region of the club near the apex, it is about 1.93 ± 0.05 µm long and occurs between members of the first row of falcate sensilla (Fig. 2 C), the shallow depression is 2.6 ± 0.31 µm in diameter.

Five BCPS2 occur on *T. evanescens* female antenna of which three are detected on the club dorsum in a triangle shape, one on each of the medial portion of the second funicle and dorsal surface of the first funicle. The BCPS2 is 3.12 ± 0.1 µm long and the shallow depression is 2.9 ± 0.24 µm in diameter (Fig. 2 B).

Campaniform sensilla (CaS)

Campaniform sensilla are convex discs-like structures arising from the cuticle. The basal region is composed of wrinkled cuticle and the distal sensilla surface is smooth. CaS are 1.2 ± 0.1 µm in diameter. Four CaS occur on the distal area of the pedicel segment (Fig. 3). Two of these sensilla are located on the lateral surface and lie close together. A third CaS occurs on the ventral surface of the pedicel and the fourth CaS occurs on the medial surface.

Chaetica sensilla (ChS)

Three types of chaetica sensilla (ChS types 1,2 and 3) occur on *T. evanescens* antennae. These organs are classified according to their cuticular surface, structure and basal socket.

Chaetica sensilla type 1 is distributed on all female antennal segments except the second anellus. ChS1 vary in length between 11.7 -

27.0 µm, with the longest sensillum on the first funicle (27.0 ± 0.75 µm long). Length and basal socket characteristics vary according to location, but shaft morphology is similar. ChS1 are elongated, pointed or slightly curved and surface walls show longitudinal ridges. ChS1 on the club normally have a small conical basal socket with shaft slender and straight or slightly curved (Figs. 2 A & 4 A). ChS1 on funicle, anellus, pedicel and scape show deep insertion into the socket, appear thicker and are more pointed.

Fig. 2A). Female antenna showing sense organs on club segment (X 1000)
B). Higher magnification of club segment with (BCPS2) & (PS 1& 2) (X 5000)
C). Higher magnification for BCPS1& StS on the apex of the club (X 4000)

Chaetica sensilla, type 2 is set in a socket, has a smooth shaft and few grooves on the cuticular surface (Fig. 2 A). Four ChS2 occur along the venteral surface of the scape. The sensillum length is 11.71 ± 0.24 µm.

Chaetica sensilla, type 3 occurs at two locations: on the basal portion of the pedicel and on the radical (Fig. 4 B). Each sensillum is a triangular peg- like structure with smooth cuticle and blunt apex. ChS3 is relatively short, measuring 1.45±0.2 µm long with 1.11±0.1 µm basal width. ChS3 is set in a socket. Fourteen ChS3 occur on the radical arranged in groups: 4 sensilla in 2 groups on the ventral and dorsal surfaces and 3 sensilla in two groups on the lateral and medial surfaces. Six ChS3 occur on the basal part of the pedicel: a group of 4 sensilla on the lateral surface and a group of 2 sensilla on the dorsal region.

Table 2: Types, number and distribution of sensilla on the antenna of female and male *T. evanescens*

Sensilla types	Measurments		No. of sense organs located on the antennal segments														
			Scape		Pedicel		Anellus 1		Anellus 2		Funicle 1		Funicle 2		Funicle 3	Apical Club	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	Male	F	M
BCPS1	1.9		--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
BCPS2	3.1		--	--	--	--	--	--	--	--	1	1	1	1	1	3	3
CaS	1.2		--	--	4	4	--	--	--	--	--	--	--	--	--	--	--
ChS 1	18.1		8	4	6	6	1	1		--	7	--	10	--	--	1	--
ChS 2	11.7		4	4	--	--	--	--	--	--	--	--	--	--	--	--	--
ChS 3	1.5		14	14	6	6	--	--	--	--	--	--	--	--	--	--	--
CoS	3.5		--	--	--	--	--	--	1	1	--	--	1	1	--	--	--
FS	11.7		--	--	--	--	--	--	--	--	--	--	--	--	--	25	--
PS1	34.7		--	--	--	--	--	--	--	--	--	--	--	--	--	2	2
PS2	31.5		--	--	--	--	--	--	--	--	--	--	--	--	--	2	2
StS	11.8		--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
TS1	27.0		--	--	--	--	--	--	--	--	--	--	--	--	--	10	--
TS2	11.0		--	--	--	--	--	--	--	--	--	--	--	--	--	104	--
TS3	4.3		4	4	--	--	--	--	--	--	--	--	--	--	--	--	--
TS4	59.4		--	--	--	--	--	--	--	--	--	7	--	6	6	--	20
TS5	35.5		--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Total			30	26	16	16	1	1	1	1	8	8	12	8	7	149	29

Coeloconic sensilla (CoS)

Two CoS are present on each female antenna. Both occur in the same position on the lateral surface of the second funicle and the second anellus. The former occurs next to BCPS 2. CoS vary in structure: they have the form of a pit organ or occur as a peg protruding from a pit organ (Fig. 5). More variation in structure is present on the funicle than anellus. CoS show variation of the apical shape of the funicle peg.

Falcate sensilla (FS)

FS are sickle-shaped and apically sharp when viewed from the lateral or dorsal surface. They have parallel slanting furrows on both flattened lateral surfaces (Fig. 6) and transverse grooves on the dorsal surface. The shaft projects from a circular basal depression (4.26 ± 0.07 µm diameter) with a thick edge. The sensillar field is aligned and directed distally. A group of 25 FS (11.65 ± 0.21 µm) are only observed on the venteral region of the club, arranged in 8 rows. FS are only found on the female antenna and have no terminal pores, however the tips appear dark (Fig. 6).

Fig. 3. Campaniform sensillum on the pedicle segment (X 2200)

Fig. 4 A). Higher magnification of the club segment with ChS1, StS, FS, PS1 and PS2 (X 4500)
B). Higher magnification of the radical segment with ChS3 (X 4000)

Fig. 5. CoS distributed on second anellus and second funicel segments (X 3500)

Fig. 6. FS and StS on the club segment (X 1000)

Fig. 7. Sense organs showing on club segment of female antenna, TS1 & 2, PS1 & 2, ChS1 and StS (X 1500

Placoid sensilla (PS)

Placoid sensilla are elongate plate-like sensory organs with corrugated shafts containing numerous pores. Each sensillum arises from an elevated cuticular rim and is tapered apically. Owing to a difference in the density of pores, we separate them into PS1 and PS2 (fig. 7). PS1 are longer and wider than PS2. Each PS1 is 34.7 ± 0.12 µm long and 2.47 ± 0.12 µm wide; PS2 is 31.5 ± 0.1 µm long and 2.1 ± 0.23 µm wide. Two PS1 and 2 PS2 are present on the female antenna, both types are situated along the longitudinal axis of the club. Two PS1 are located on the venterolatera and mid-dorsally on the club. A PS2 occurs on the dorsomedial and dorsolateral surface (Fig. 7) of the club and its tip ends distal of the club. PS1 and 2 are distributed over the club except on the ventral surface which contains falcate sensila. PS1 and 2 are arranged alternately around the club from dorsomedial to dorsolateral (Figs. 2 A & B and 4 A).

Styloconic sensilla (StS)

Styloconic sensillum is curved with a longitudinally fluted surface (figs. 4 A, 6 and 7). StS is seated upon an elevated conical cuticular base, about 0.92 µm in height. StS is 11.8 ± 0.1 µm long. One StS occurs at the apex of the female antenna, but not detected on the male antenna.

Trichoid sensilla (TS)

Trichoid sensilla types have been designated on the basis of external structure and size. Three types (TS 1, 2 and 3) were found on the female antenna.

Trichoid sensilla, type 1 is relatively long (27 ± 0.23 µm), has no socket and is tapered with a small bulb-like protrusion at the apex; TS1 has a small area of smooth cuticle basally and longitudinally fluted wall toward the apex (figs. 2 A, 4 A and 7). TS1 occur only on the female club; ten TS1 are dispersed on the dorsal surface.

Trichoid sensilla, type 2 (figs. 2 A and 7) is 10.97 ± 0.22 µm long, tapering arising directly from the cuticle (no socket is present) and terminates with a small hooked apex. TS2 are the most abundant sensilla type with more than 104 on the female antenna. Numerous TS2 occur on the proximo-ventral region and half of the lateral surface of the club (Figs. 2 A & 7); a few occur on the proximo-dorsal surface. TS2 are arranged in one row around the first funicle, and 2-3 rows on the second funicle (Fig. 2 A); they occur more frequently on the ventral surface than on any other surface of these segments. TS2 similar to ChS2 in external appearance but differs in insertion into the cuticle.

Trichoid sensilla type3 is relatively short 4.35±0.25 µm long and occurs only on half the dorsal surface of the scape. TS3 is unsocketed, has a smooth cuticular wall and tapers toward a blunt apex. Four TS3 occur on the female antenna. Female and male TS3 appear identical (Fig. 2 A).

MALE ANTENNAL SENSILLA

Six groups of antennal sensilla were recognized and classified into 12 types of sensilla on the male antenna of *T. evanescens*: basiconic capitate peg sensilla (type 1, 2), campaniform sensillum, chaetica sensilla (type 1, 2

and 3), coeloconic sensillum, placoid sensilla (type 1, 2) and trichoid sensilla (3, 4 and 5).

Basiconic capitate peg sensilla

Six BCPS2 occur on the male antenna, 3 on the funicle segments and 3 on the club segment. Their structure, cuticular wall, length and basal width are similar to those of the female. Each BCPS 2 is located near a joint-line furrow on the antennal cuticular surface (Figs. 8 A & B). One BCPS1 organ is located on the dorsolateral surface of the club (Fig. 8 A).

Campaniform sensilla

Campaniform sensilla are present on the apex of the male pedicel and have the same external features as those on the female pedicel.

Chaetica sensilla

Chaetica sensilla (types 1, 2 and 3) occur on the male antenna.

As for the three types 1, 2 and 3 of Chaetica sensilla they were found similar as in the female insects.

Coeloconic sensillum

Two CoS occur on the male's club, the first is situated on the second anellus; another is on the second funicle (Fig. 8 A), their structure resembles those of the female.

Placoid sensilla

Two PS1 and 2 PS2 occur on the male (Fig. 8 A). PS1 and 2 on the female and male antennae are similar externally but the male PS types are longer than the females PS. PS1 and PS2 are 40.9 ± 0.31 and 38.5 ± 0.22 µm long, respectively.

Trichoid sensilla

Trichoid sensilla (types 3, 4 and 5) occur on the male antenna, type 3 is smooth, short and only occurs on the dorsal region of the scape, their structure and number are identical to the female.

Trichoid sensilla type 4 is the most abundant of trichoid types and distributed over the entire of the club (Figs. 8 B) and 39 in number, they were not observed on the female antenna. TS4 resemble TS1 as both lack a socket arising from the corrugated cuticular wall, their bases are smooth (Fig. 8 B) and shafts are slightly fluted. TS4 measures 59.47 ± 1.65 µm in length and 1.47 ± 0.1 µm wide at their base.

Trichoid sensilla type 5 is a long and only located on the club's apex (Fig. 8 B). One TS5 occurs on the dorsomedial surface. TS5 lacks a socket; the cuticular wall is smooth, the apex is blunt and the shaft is 35.52 ± 1.32 µm long. TS5 occur only on the male antenna.

Fig. 8 A) Higher magnification of the funicel segments with BCPS2, CoS and TS4 (X 1500)
B) Higher magnification of the club segment with BCPS1 & 2 and TS4 & 5(X 1000)

DISCUSSION

Sensilla on female and male antennae differ in their structure, type, numbers and distibution. A greater abundance and variety of antenna1 sensilla occur in the female antenna.

The basiconic capitate peg sensilla (BCPS) described in the current study resemble the "multiporous pegs sensilla" on the eulophid *Tetrastichus hagenowii* (Ratz.) (Barlin *et al.* 1981). Type 1 is practically the same as type 2 but can be differentiated on the basis of the basal depression and stalk. The same organ was found and described by Amornsak *et al*. (1998). BCPS 2 in *T. evanescens* resemble those described and termed “ampullacea” by Voegelè *et al*. (1975) for *T. brasiliensis* and *T. maltbyi*. Similar structures to BCPS type 1 and type 2 have been reported on the pteromalid *Pteromallus cerealella* (Ashmead) and called “basiconic capitate peg sensilla” (Onagbola *et al*. 2008). In *T. evanescens*, BCPS are found on all flagellar segments, except the anelli. Basiconic capitate peg sensilla have been suggested to have an olfactory function on the basis of external appearance (Dahms, 1984; Wibel *et al.* 1984; van Baaren *et al*. 1996) or to be hygro-, thermo- and mechanoreceptors (Wibel *et al*. 1984). The grooves appear punctate, which may indicate that pores support an olfactory function for BCPS.

Amornsak *et al.* (1998) found only one type in *T. australicum* which is similar to the unperforated domed cupola. CaS occur on the distal surface of the pedicel of both sexes in *N. vitripennis* and *T. australicum.* Campaniform sensilla have not been reported on the pedicel of other *Trichogramma* species (Voegelè *et al*. 1975; Olson and Andow, 1993).

Chaetica sensilla in *T. evanescens* appears similar to sensilla described in *T. australicum* by Amornsak *et al*. (1998) and “aporous (AP) sensilla trichodea B” in *T. nubilale* (Olson and Andow, 1993). In all these species, the number of ChS1 is precisely the same as found on the pedicel, anelli and funicle, but differ on the scape and club. Olson and Andow (1993) reported that only one type of sensillum occurred on the scape and pedicel of *T. nubilale* and this was probably a mechanoreceptive sensillum. These sensilla types have been assigned a mechanoreceptor function by Barlin *et al*. (1981); Dahms (1984) and Isidoro *et al*. (1996). ChS3 have been described as “hairplates” in *T. minutum* by Schmidt and Smith (1987) and in *T. australicum* by Amornsak *et al*. (1998). In the present work ChS 3 are found only on the radicle and pedicel, in both sexes, in the same distribution and morphology, but their numbers differed as 14 and 6 sensilla were detected on the radicle and pedicel, respectively. Amornsak *et al*. (1998) found the same number in *T. australicum*; meanwhile, in *T. minutum* Schmidt and Smith (1987) counted 14 and 5 sensilla on the radicle and pedicel, respectively, and suggested that they act as proprioceptors.

The coeloconic sensilla seen in *T. evanescens* are similar in distribution, number and structure as those on the antenna of *T. australicum* by Amornsak *et al*. (1998). However, Olson and Andow (1993) found another CoS sensillum on the proximo-ventral surface of the club in other species of parasitic Hymenoptera.

Falcate sensilla in *T. evanescens* appear similar to sensilla described in *T. australicum* by Amornsak *et al.* (1998). The falcate sensilla found in *Trichogramma* have not been reported in other parasitic Hymenoptera. Female wasps probably use these sensilla in drumming behaviour on the host surface with the apicoventral part of the club which bears falcate sensilla. Moreover, Olson and Andow (1993) reported that the multiporous pitted sensilla trichodea C in *T. nubilale* served as mechanoreceptors and contact chemoreceptors used in detecting chemical marks present on hosts that have been parasitized.

The same Placoid sensilla (PS) observed in *T. evanescens* was described by Amornsak *et al.* (1998) in *T. australicum*. Both types 1 and 2 generally alternate in a ring around the distal segment (Barlin and Vinson, 1981). PS1 in *T. evanescens* is longer than PS2 whereas in *M. zaruptor* PS1 is slightly shorter than PS2. Two types of multiporous plate sensilla were found only in Chalcidoidea Barlin and Vinson (1981) and van Baaren *et al.* (1996) suggested that they serve as an olfactory function. On the basis of the appearance of pores on the cuticular surface, we think that placoid sensilla may also play a role in olfaction

The only styloconic sensillum found at the apex of *T. evanescens* female antenna may be involved in host recognition and host acceptance as it is found at the tip of the antenna. The appearance of a terminal pore in this sensillum supports that it is probably a contact chemoreceptor as suggested by Olson and Andow (1993) in *T. nubilale* and in *T. australicum* by Amornsak *et al.* (1998).

No pores were observed on the trichoid sensilla of *T. evanescens,* only a fluted surface on TS1. Olson and Andow (1993) found relatively few pores (ca 3 pores per µm) on the surface along the length of multiporous pitted (MPP) sensilla trichodea A in *T. nubilale* indicating that they may be olfactory receptors. Furthermore, they were similar to the slightly longer types found over the flagellum of the male antenna in that species.

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أعضاء الحس على قرن إستشعار طفيل *Trichogramma evanescens* (HYMENOPTERA:TRICHOGRAMMATIDAE)

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تم دراسة أعضاء الحس الموزعة على قرن الاستشعار في طفيل البيض التريكوجراما إيفانسينز *Trichogramma evanescens* (رتبة غشائية الأجنحة) باستخدام الميكروسكوب الإلكتروني الماسح. وجد إختلاف واضح في شكل و تركيب قرن الإستشعار في كل من الذكر والأنثى. كما وجد على قرن إستشعار الأنثى
١٤ نوعاً من أعضاء الحس وهي :
campaniform, chaetica (types basiconic capitata peg (types 1 and 2), 1-3), coeloconic, falcate, placoid (types 1 and 2), styloconic and trichoid (types 1-3).
أما قرن إستشعار الذكر يحتوي على ١٢ نوعاً من أعضاء الحس وهي:
basiconic capitata peg (types 1 and 2), campaniform, chaetica (types 1- 3), coeloconic, placoid (types 1 and 2) and trichoid (types 3 -5).
أعضاء الحس falcate and styloconic وجدت فقط على قرن إستشعار الأنثى، بينما أعضاء الحس trichoid من النوع (٤ و ٥) وجدت على قرن إستشعار الذكر فقط.
إختلاف التركيب والتوزيع لأعضاء الحس في كلا الجنسين قد وصفت. ويعتبر هذا الحصر مفتاح يستخدم لتعريف أنواع التريكوجراما. كما يساعد في معرفة وظيفة كل من هذه الأعضاء في سلوك هذه الحشرات وعلاقة ذلك بعوائلها.