

ULTRASTRUCTURE OF THE SENSORY ORGANS OF MALE *EXORISTA* SP. (DIPTERA: TACHINIDAE) COLLECTED FROM AL-BAHA, KSA.

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INTRODUCTION

Tachinidae is a large and rather variable family of the true flies within the Order Diptera, with more than 8200 known species. Many species are important natural enemies of major pests. Some species are used in biological pest control. Only few species are host species-specific. The typical characteristics of this family is that most of them are parasitoids (the larva develop inside a living host, ultimately killing it), and a few are parasite (don't kill the host). Larvae of this family are endoparasites of butterfly and moth caterpillars, adult and grub beetles, sawfly larvae, various types of true bugs and grasshoppers, rarely in centipedes. As the olfactory organs play an important role in the recognition of the host or the other sex (mating process). The aim of this paper is to describe the different types of the different sensillae present on the sense organs of the male tachinid fly *Exorista* sp.

MATERIAL AND METHODS

Collection of the flies

Adult tachinid flies were unusually collected from baited traps established at Gebel el-Zaher, Al-Baha Governorate, Kingdom Saudi Arabia. Traps were set in two rows, 4 traps in each row. The distance between each trap was 10 meters (unpublished ecological data). The collected flies were anaesthetized by freezing for half an hour, identified and grouped into families, and kept in 70% alcohol to which were added few drops of glycerin until used for scanning.

Ultra-structural preparation

Proteinacious substances that could obscure cuticular details were removed according to Dyer *et al.*, (1982) procedure. The studied specimens were immersed in

a tris buffer solution (0.0115 M CaCl₂, pH 7.5) for one hour at 37°C. then rinsed 3 times for 15 min in the same buffer. The specimens were then dehydrated in a graded ethanol series (70%, 90%, 100%, and 100 %) for 5 min each, rinsed in acetone, and air-dried. The antennae, maxillary palpi, legs and isolated head capsule were mounted on standard horizontal Philips aluminum stubs with conductive carbon glue. Specimens were then coated with gold in an Oxford/Hexland CT 1500 evaporator; and viewed with Philips EMS 525 scanning microscope (SEM) in the secondary electron imaging mode at accelerating voltage ranging from 15-30KV.

Description and measurements of each type of sensillae present follow the morphological and functional typology reviewed by Zacharuk (1985) and Zacharuk and Shields (1991).

RESULTS AND DISCUSSION

Antennae

In the resting position, the antennae of the aristate type are situated in-between the two compound eyes in a cephalic groove located in the forehead, the antennal fossa. The antenna consists of a scape, pedicel, funicle and arista (Fig. 1). Both the scape and the pedicel are heavily covered with microtrichia and bear bristles. The arista articulates from the dorso-lateral margin of the funicle measuring up to 1600µm in length with an average of 1480µm. The slender funicle measures up to 1175µm with an average of 1266µm in length and 410µm with an average of 386µm in width. The pedicel shows a maximum length of 425µm with an average of 386.25µm and a maximum of 425µm with an average of 321.3µm in width.

1. Sensilla trichodea type (IV) (TrIV)

Fig. (2) reveals the presence of one row of setae-like structure at the periphery of the pedicel near the base of the funicle. At the base of each sensilla, a socket is present with an average maximum width of 1.84µm. The shaft of the sensilla is standing erect with sharp pointed free end. The shaft varies from 67.11 to 40µm with an average maximum length of 47.11µm. The walls, of these trichoid sensilla (Tr IV), seem very thick and has angular borders (Fig.3). These trichoid sensillae are mechanoreceptors in function.

2. Sensilla trichodea type (III) (TrIII)

The sensilla trichodea type (III) (TrIII) are found at the margin separating the pedicel and the funicle (Figs. 3&4). It is bristle-like in shape with pointed tip,

and smooth curvature, nearly straight. This sensory hair arises from a discoid socket that seems to be over the surface of the antenna. It has an average of 77.5 μ m in length (76.3-80 μ m) and a maximum width of 7.5 μ m.

The two types of trichoid sensillae present on the antenna are aporous.

Similar findings were reported by Berned (1985), and Kuhbandner (1984) in *Calliphora erythrocephala*; by Sukontason *et al.* (2004) in *Chrysomya penguins*, *C. megacephala*, *C. rufifacies* and *Lucilia cuprina*, and by Fernandes *et al.*, (2004) in *Cochliomyia hominivorax*. However Rahal *et al.* (1996) reported the presence of multiporous trichoid, sensillae on the funicle of *Pseudoperichaeta nigrolineata*, meanwhile, Giangiuliani *et al.* (1993) mentioned that *Trichopoda pennipes* completely lack trichoid sensillae.

3. Basiconic sensilla type (I) (B1)

In the floor of the funicle are found a group of aporous basiconic sensilla type (I) (B1) covering the whole length of the funicle and intermingled with dense microtrichia (M) (Fig. 5). Each sensilla has a swollen base (3.75-2.25 μ m in diameter with an average of 2.71 μ m) which gradually reduces into narrow and curved tapered free end. The maximum length of this basiconic sensilla varies from 12.5-9.25 μ m with an average length of 10.04 μ m.

Similar findings were reported on the funicle of *P. nigrolineata* antennae by Rahal *et al.*, (1996); in *T. pennipes* by Giangiuliani *et al.* (1993); in *Calliphora erythrocephala* by Kuhbandner (1984); in *Chrysomya penguins*, *C. megacephala*, *C. rufifacies* and *Lucilia cuprina* by Sukontason *et al.* (2004); and in *Cochliomyia hominivorax* by Fernandes *et al.*, (2004). However, Sukontason *et al.*, (2007) noticed the presence of two types of large aporous and small porous basiconical sensillae on the funicle of *C. penguins*.

Maxillary Palpi

The maxillary palp of the tachinid fly is one segmented with terminal club-shaped free end (Fig. 6). The maxillary palp is covered by many setae as well as hairy structures.

1. Sensilla trichoidea type II (TrII)

The sensilla trichoidea type II (TrII) lies usually at the lateral margins of the maxillary palp. It has a curved shaft, looking like a hook, with a length measuring from 90 μ m-77.3 μ m (Fig. 7).

Sensilla trichoidea type II (TrII) were not recorded by Sukontason *et al.*, (2007) on the maxillary palp of *C. penguins*.

2. Basiconic (aporous) sensilla type II (B2)

Smaller in size with an average length of 4.73 μ m (5 - 3.75 μ m) and average diameter of 2.95 μ m (3.5-2.5 μ m). These (B2) stand erect, hooklets in shape with sharp curved pointed end, and occupy the whole length of the maxillary palp (Fig. 8). In contrast Sukontason *et al.*, (2007) mentioned the presence of small multiporous basiconical sensillae on the maxillary palp of *C. penguins*.

3. Multiporous trichoid sensilla (MPTr)

The multiporous trichoid sensilla (MPT2) is found at the margin of the maxillary palp (Fig. 9). It has a pointed tip, smooth curved shaft which is provided with many pores. It ranges from 24.8-41.8 μ m in length and 5.8-10 μ m in width at the base of the shaft. Similar finding was reported by Van Der Staree and Tempelaar (1976) in *Calliphora vicina*.

Tarsus

The tarsus in male *Exorista* sp. is composed of five-segmentes ending with two claws and two fleshy pulvelli (Fig. 10).

1- Multiporous sensilla (MPS)

It resembles the trichodea sensilla in shape, with a smooth curved to nearly straight shaft (Fig. 11). Multiporous sensilla (MPs) originates from a discoid socket deeply inserted in the cuticle of the tarsi, ending with a blunt free tip which contains 3 terminal pores. The three terminal pores are rounded or ovoid slits-like in shape, measuring 0.89, 0.71 and 0.54 μ m, respectively from left to right (Fig. 12). The cuticle of the shaft showed oblique longitudinal striations running the whole length of the shaft. The multiporous sensilla has a maximum average length of 70.91 μ m, and a maximum width of 20.91 μ m at the base.

Multiporous sensilla, either grooved or pitted, are considered to be primarily olfactory receptors (Rahal *et al.*, 1996; Shields and Hildebrand, 1999; Broeckling and Salom, 2003) or are chemosensory in function (Zacharuk, 1971; Steinbrecht and Muller, 1971; Slifer, 1972; Steinbrecht, 1969 & 1973; Schneider, 1971; Zacharuk, 1980; Altner *et al.* 1977 and Keil, 1982).

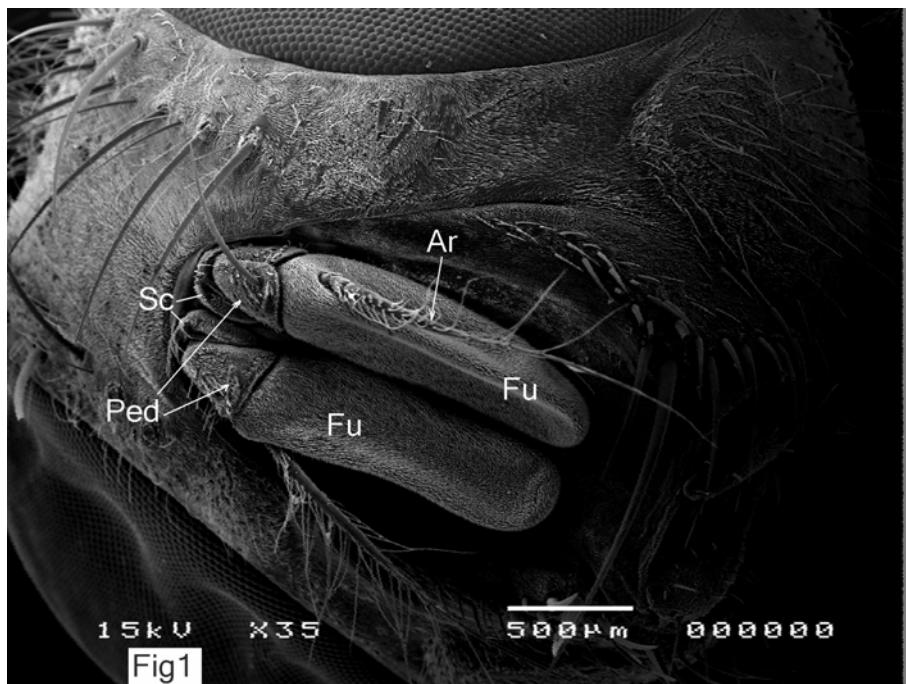


Fig 1: Head capsule including the antennae Sc: Scape, Ped: Pedicel, Fu: funiculus: Funicle.

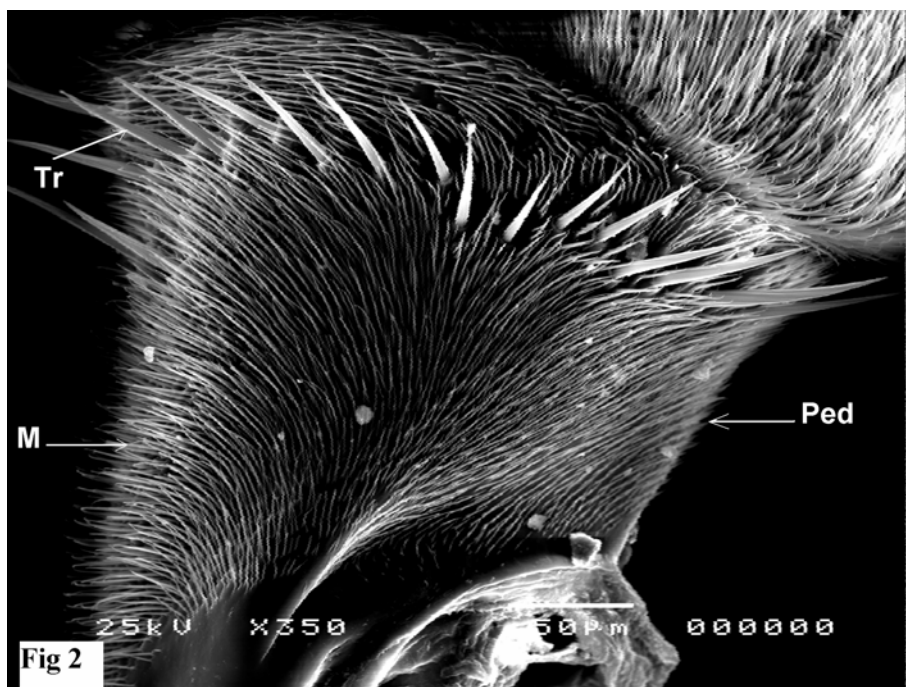


Fig 2: The pedicel segment of the antenna showing the trichodea sensilla. M: Microtrichia, Tr: Trichodea sensilla (III).

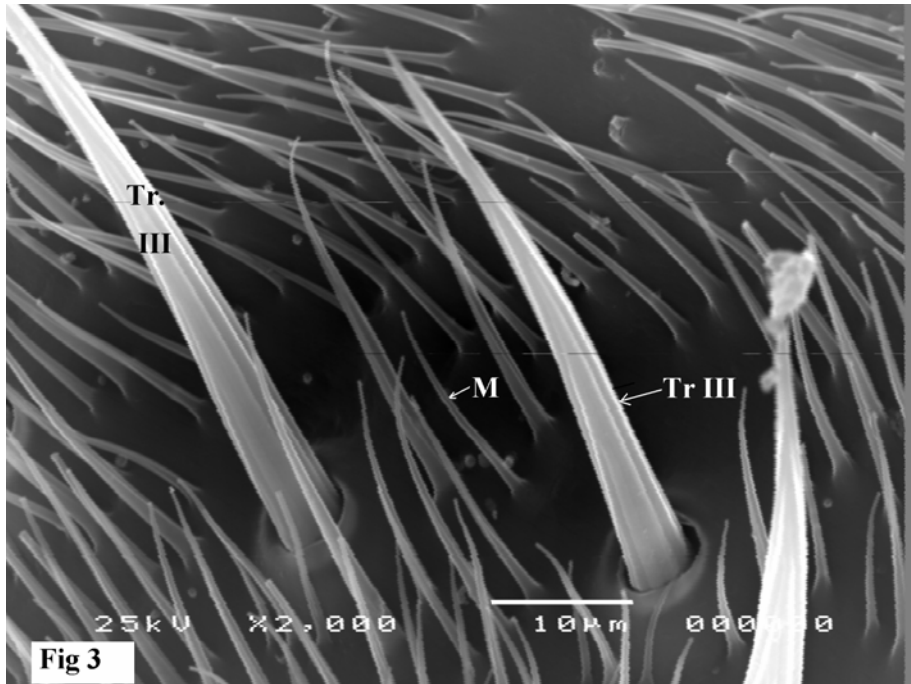


Fig 3: Trichodea sensillaa with pointed tip (Tr III).

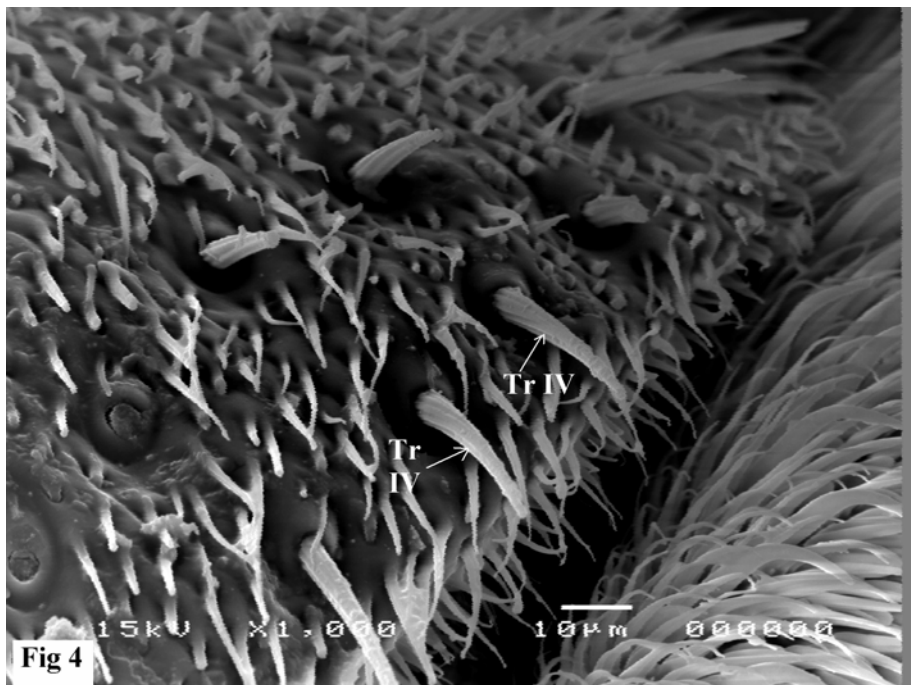


Fig 4: Trichodea sensilla type IV at the margin of the pedicel.

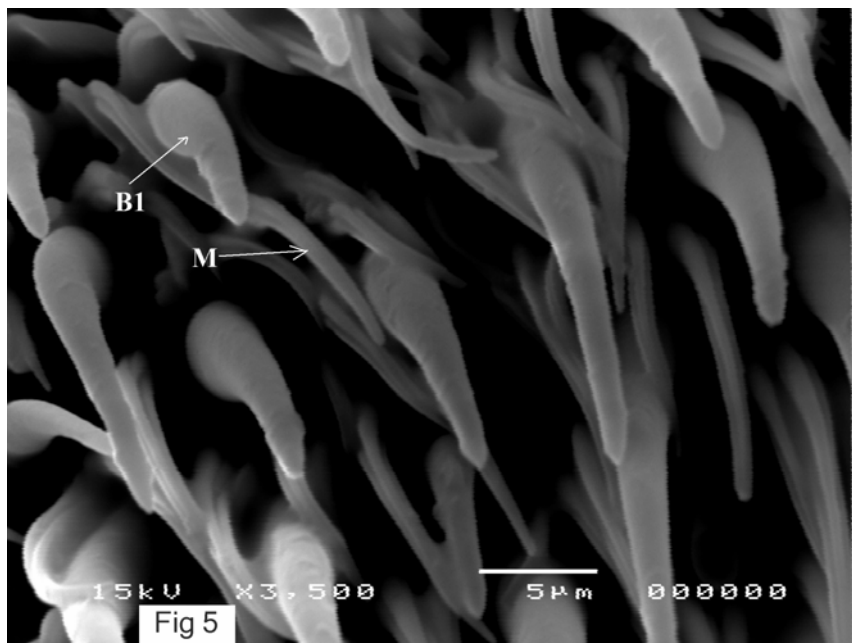


Fig 5: Basiciconical sensilla type I (B1) covering the whole area of the funicle intermingled with the microtrichia (M).



Fig 6: Out line of the maxillary palp (Max palp) showing different types of sensillae covering its surface. TrII: Trichodea sensilla, MPS: multipolar trichodea sensilla, B2: Basiciconical sensilla.

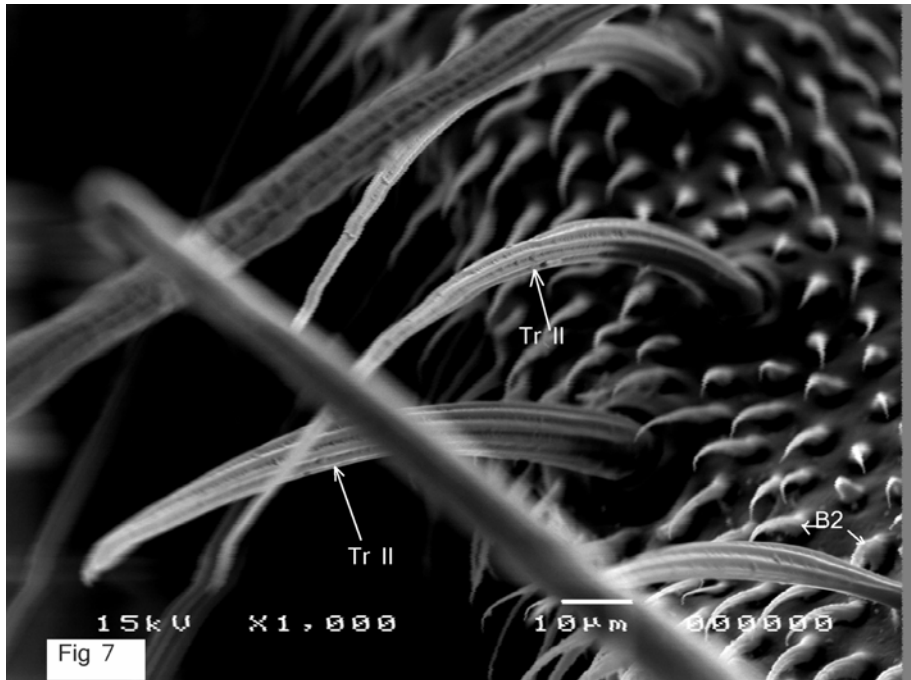


Fig 7: Trichodea sensilla (Tr II) type II at the lateral margin of the maxillary palp.

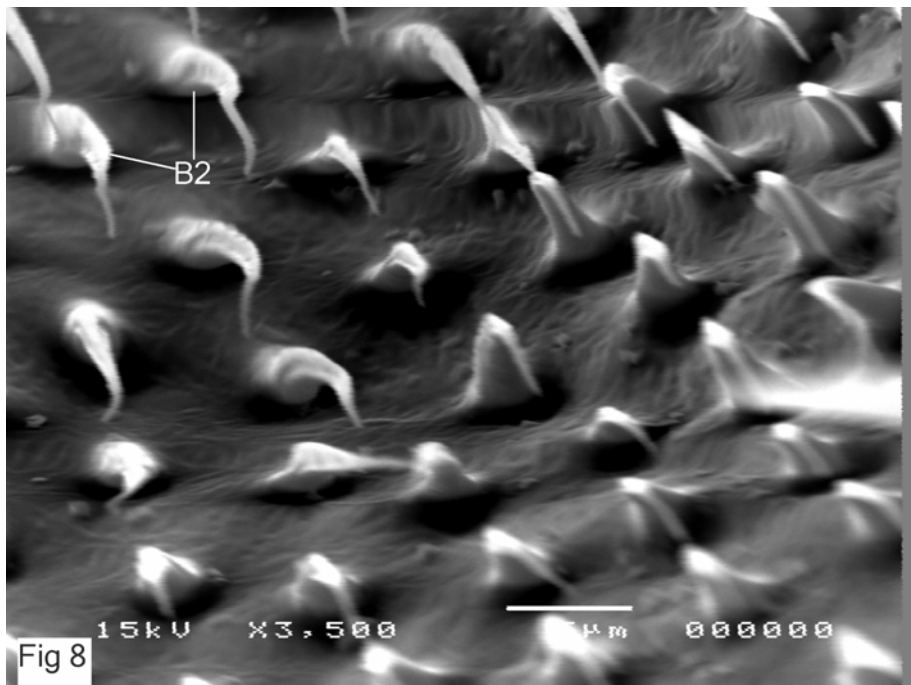


Fig 8: Basiciconical sensilla (B 2) covering the whole background of the maxillary palp.

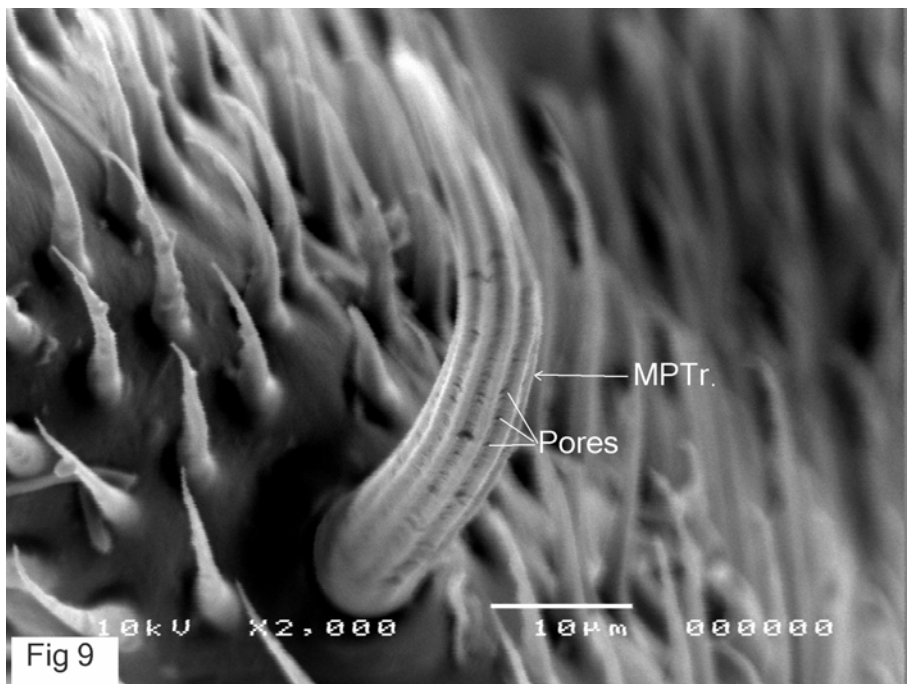


Fig 9: Multipolar Trichoid sensilla of the maxillary palp. Pores is found on the shaft.

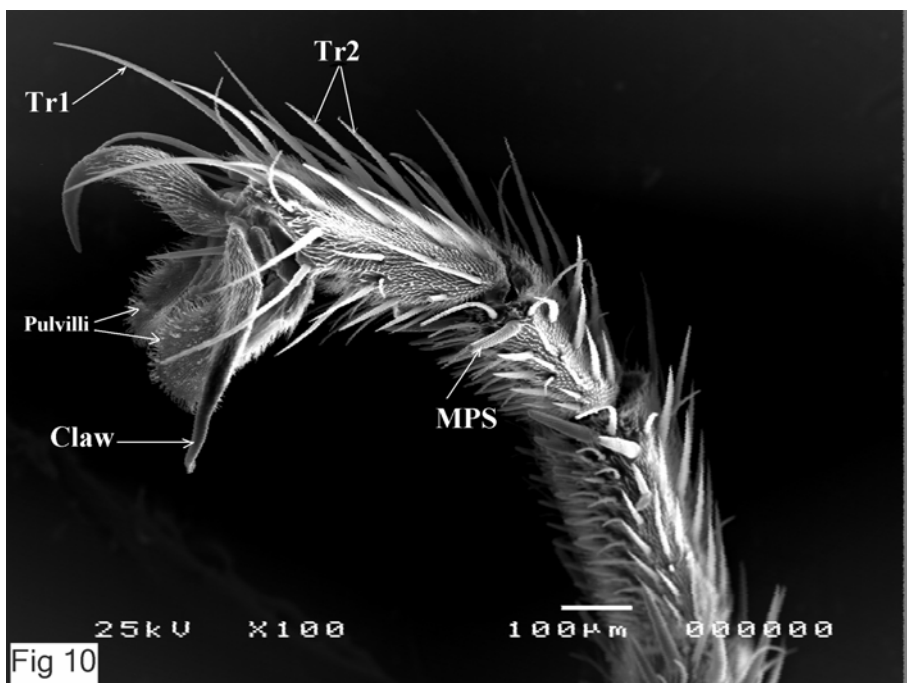


Fig 10: Outline of the tarsi showing various types of sensillae. MPS: multiporous sensillae, TrI & TrII: type 1&2 of the trichodea sensilla.

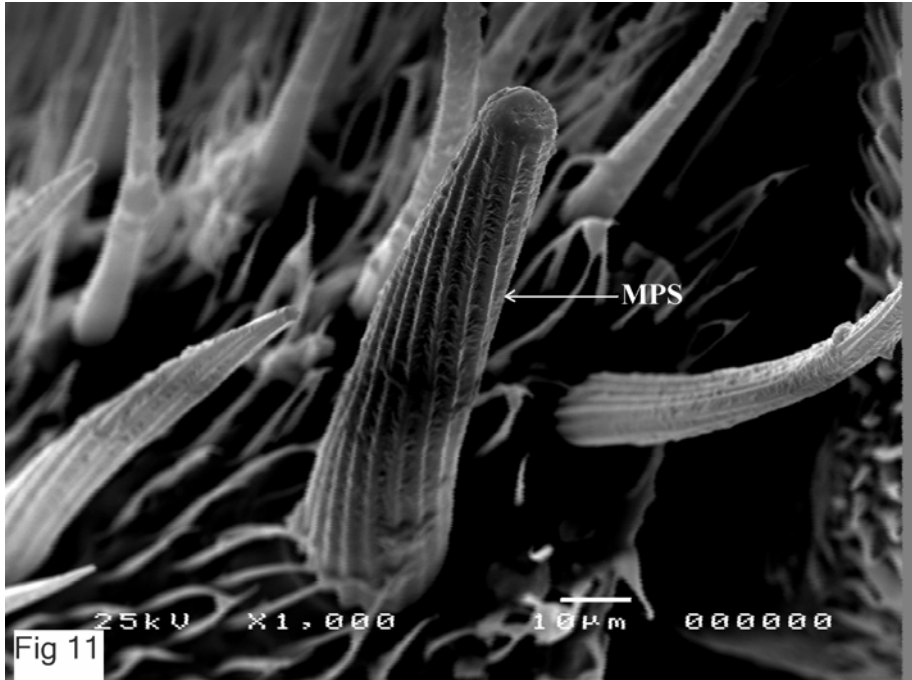


Fig 11: Multiporous sensilla (MPS) on the tarsi with blunt tip.

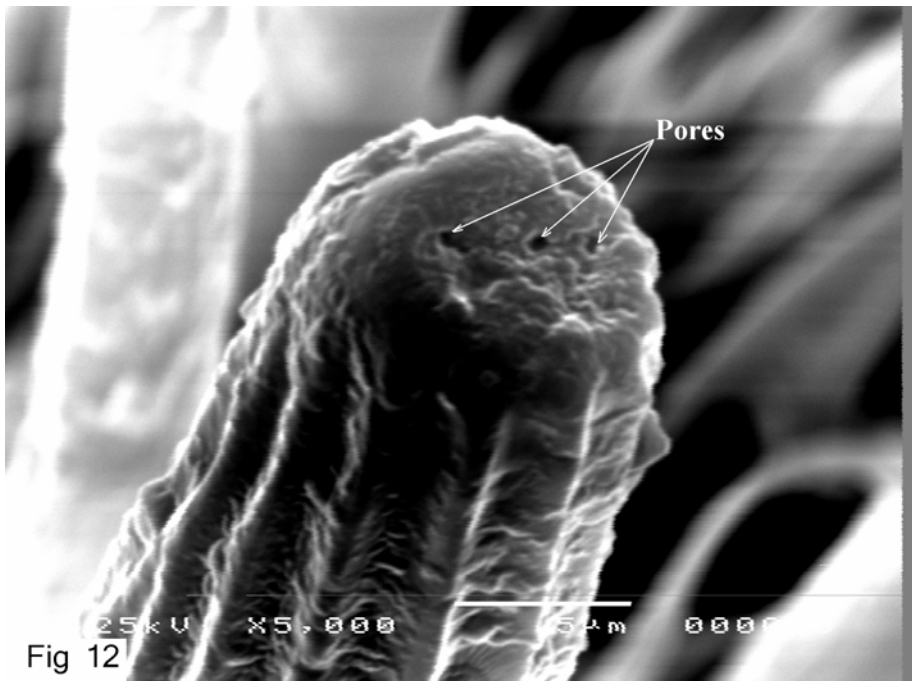


Fig 12: Free blunt tip of the multiporous sensillae showing the terminal pores.

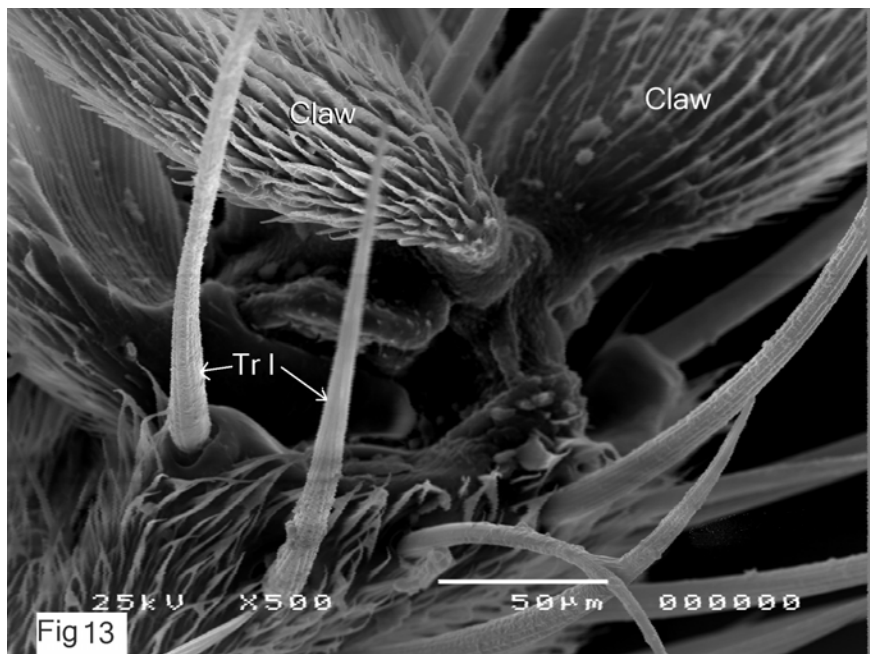


Fig 13: The end of the tarsi with a paired claws, showing type one of the trichoid sensillae, and their socket at the base.

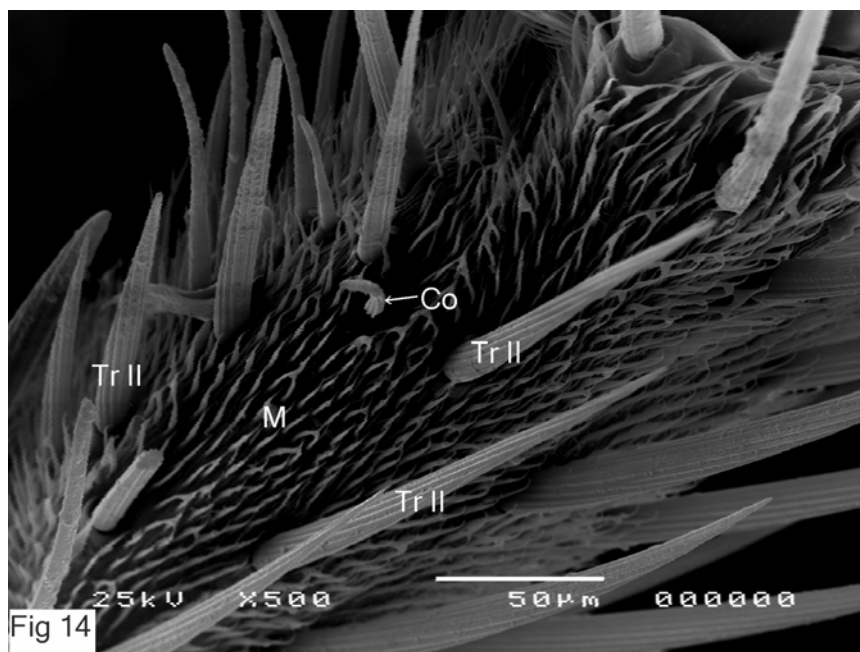


Fig 14: Tarsomere implanted with microtrichia (M) in the floor, lateral margin guarded with trichodea sensillae type 2 (Tr II) and a single coeloconic sensilla (Co).

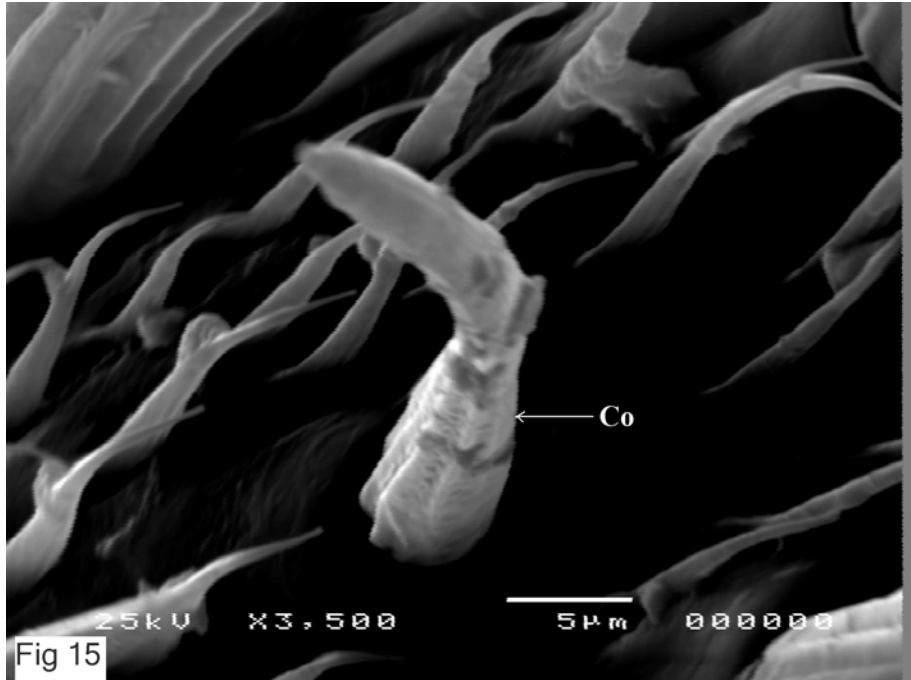


Fig 15: Coeloconic sensilla (Co) near the end of each tarsomere.

2- Trichodea sensilla type (I) (TrI) (aporous sensilla)

This type of trichoid sensilla type (I) (TrI) is seen near the base of the last tarsus segment, just before the articulation with the two claws (Fig. 13). Each has a long straight shaft (average of 146.4µm), ending with sharp pointed tip. The shaft is cylindrical, showing longitudinal striations. The diameter is very thick (8.99 – 12.5µm) near the base and much reduced (1.8µm) near the tip. The surface and the tip didn't show any pores (Aporous sensilla).

3- Trichodea sensilla type (II) (TrII)

It has the same features as that found on the maxillary palp. The recorded average length is 96.13µm and an average of 10.83µm in width. It acts as the two lateral margins of the outline of the tarsi (Fig. 14). However Sukontason *et al.*, 2007 did not record trichodea sensilla (TrII) on the legs of *C. pinguis*.

4- Coeloconic sensilla (Co)

It has a characteristic shape with stout conical base, which is constricted in the middle and curved at the upper third of the shaft ending with pointed tip. The measurement

of the sensilla is 18.75µm in length and 5µm in width at the base of the shaft. This type of sensillae (Co) is few in number, approximately 2 sensillae on each tarsomere (Fig. 15).

Coeloconic sensilla was observed not on the tarsus but on the antenna of *Hydrotaea chalcogaster* and *C. pinguis* (Sukontason *et al.*, 2006 & 2007), *Phlebotomous argentipes* (Ilango, 2000), and *P. nigrolineata* (Rahal *et al.*, 1996).

CONCLUSION

All the investigated sensillae, with the exception of the MP of the maxillary palp and the tarsi, are all aporous. No pores are found on either the shaft or the tip of the such sensillae. The majority of the aporous sensillae are mechanoreceptive, some are known to be hygrosensitive, xerosensitive, or thermo sensitive as reported by Altner *et al.*, (1977) and Zacharuk (1980).

SUMMARY

Investigation of the sense organs (antenna, maxillary palpi and tarsi) of the male Tachinidae fly *Exorista* sp. revealed the presence of two types of multiporous sensillae one with terminal pores (MPS) at the blunt end of the shaft located in the tarsomeres. The other one (MPTr) is found on the maxillary palp resembling the trichoid sensilla with the pores located on the shaft of the sensilla. Two types of basiconic sensillae, one type (B1) covering the whole length of the funiculus and the second one (B2) covering the maxillary palp. A single type of coeloconic sensilla (Co) found on the tarsomeres. Four types of sensilla trichoidea (TrI, TrII, TrIII and TrIV) predominate over the whole length of the sense organs investigated.

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