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AN ARRAY OF SPATULATE SENSILLA ON ANTENNAE OF MALE *BRACHYMERIA LASUS* (HYMENOPTERA: CHALCIDIDAE)

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ABSTRACT

An array of spatulate sensilla on the ventral flagellar surface of each antenna of male *Brachymeria lasus* occurs only on segments IV-VII and is absent on female antennae. Most such sensilla are on segment VI. Each spatulate sensillum was 15 μ by 16.7 μ, with a stalk extending 17 μ from the antennal base. Pores were not apparent, but the sensillum surface was imbricated. The sensilla are speculated to have a role in the courtship sequence of this chalcid by functioning both as chemoreceptors of the female-produced sex pheromone and as mechanoreceptors to indicate female receptivity, as female *B. lasus* typically raise the abdomen to expose the genital pocket.

The chalcid wasp, *Brachymeria lasus* (Walker), a native of Japan, India and Indonesia (Joseph et al. 1973, Habu 1960) was imported and released as a potential biological control agent against the gypsy moth, *Lymantria dispar* (L.), in the United States between 1908–1914 (Burgess and Crossman 1929). This solitary pupal parasitoid failed to establish, possibly due to climatic differences, and subsequent releases were discontinued. Recently, *B. lasus* has been reintroduced and released in gypsy moth infested areas in North America and renewed interest has prompted ongoing biological investigations (Weseloh and Anderson 1982).

Observations of the courtship behavior of *B. lasus* confirmed that the antennae were preemptory to successful mating. We describe the gross morphology and antennal location of these apparent sensory receptors and propose their possible function in mate location and courtship.

MATERIALS AND METHODS

A laboratory culture of *B. lasus* was maintained (Simser and Coppel 1980a) and wasps were provided with pupae of the greater wax moth, *Galleria mellonella* L. Parasitized host pupae were placed singly in gelatin capsules (#00) until parasitoid eclosion. Newly eclosed males and females were placed within a freezer for one hour, then examined with a dissecting microscope at 20–40x. Ten male and ten female wasps were examined. The location and number of spatulate sensilla per segment was recorded. Antennae were also prepared for scanning electron observation after freezing. Male and female heads were ablated, fixed to a metal stub with silver conducting paint, and vacuum coated with a 100 Å layer of gold-palladium in

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a Tousimis Samsputter 2A automatic sputter-coating apparatus. Specimens were examined in a JSM -840 scanning electron microscope at 15 kV and viewed at various angles for appropriate photo-documentation.

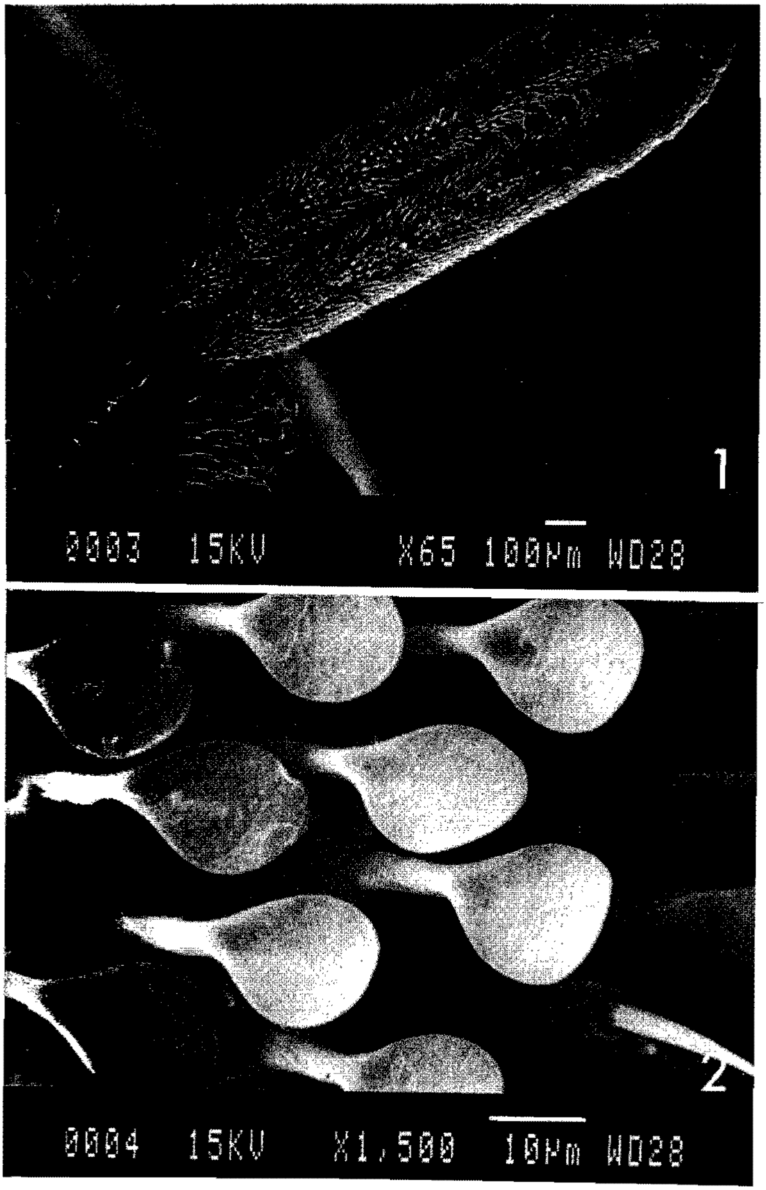
RESULTS AND DISCUSSION

The geniculate, 11-segmented antenna of *B. lasus* is composed of a scape, pedicel and ring segment (I-III) and flagellum (IV-XI) terminating with a concave distal tip. Although sensilla trichoidea and chaetica (Zacharuk 1980) are distributed on all antennal segments, discrete spatulate sensilla are restricted to the ventral surfaces of segments IV-VIII (Fig. 1) in a uniform arrangement. No other sensillar types were noted within this zone. The morphological nature of these discrete sensilla permit their description as spatulate, or 'spoon-shaped and attached at the narrow end.' Thus, spatulate sensilla are restricted to a localized section of male *B. lasus* antennae and are not present on the female. Male *B. lasus* had 86.8 (ave.) spatulate sensilla, the majority of which are on segments V and VI (Table 1). Numbers varied with different males.

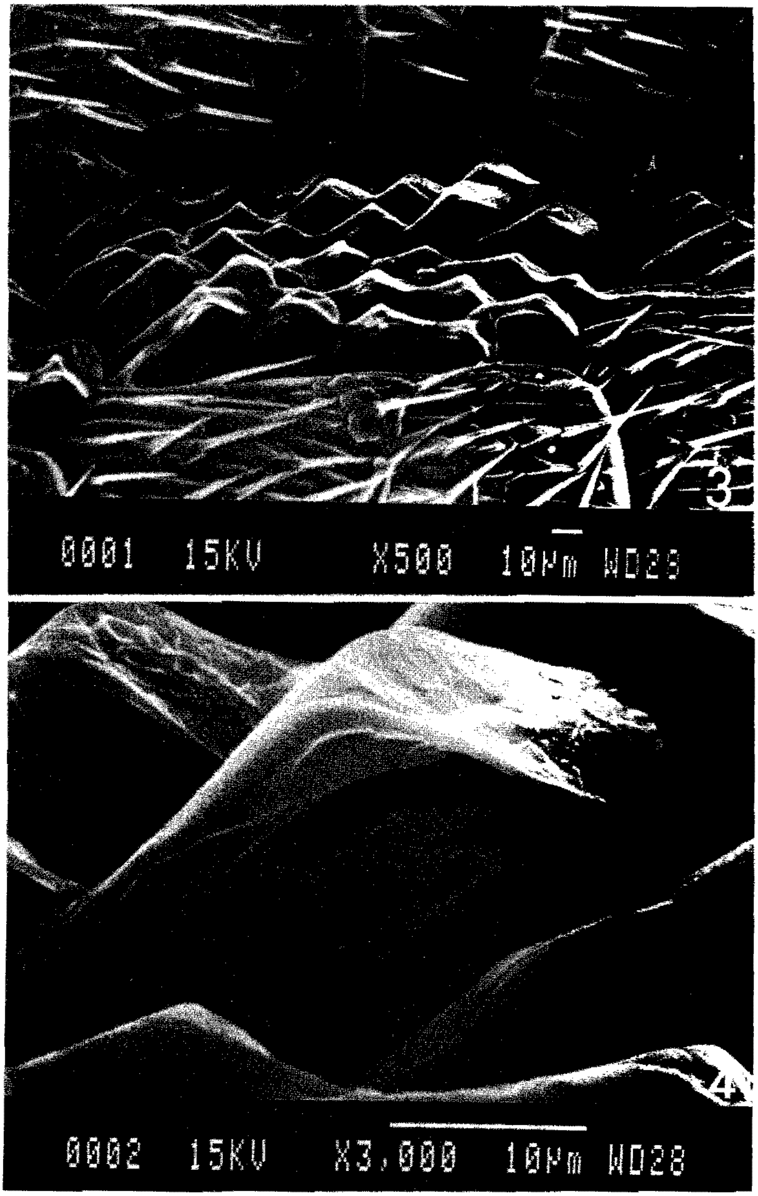
The sensilla were oriented to be flattened in the ventral plane, thus affording greatest surface area, although the sensillar surfaces were not contiguous, nor were individual sensillum in contact (Fig. 2 and 3). Each sensillum originates from the ventral antennal surface by a stalk 17 μ long from base to point of proximal attachment. This stalk may serve as a point of articulation. The flattened spatula was 16.7 μ long and 15 μ at its widest diameter (Fig. 2) and gradually tapered to both proximal and distal ends. The dorsal surface is apparently imbricated with a series of discrete and localized zones (Fig. 4), but pores were not observed. Numerous sensilla trichoidea, placodea and basiconica were observed on all flagellar segments, but none in the spatulate sensillar zone.

Joseph et al. (1973) described spatulate sensilla on male *B. lasus* as flattened sensilla trichoidea. However, morphological comparison reveals differences, as sensilla trichoidea are represented by filamentous or hair-like structures (Zacharuk 1980), whereas the spatulate sensilla are typically shaped with a broad surface extending from a basal stalk. Spatulate shaped receptors have been described in other Insecta, including a tortricid moth, *Cydia nigricana* F. (Wall 1978) and a tenebrionid beetle, *Tenebrio molitor* L. (Harbach and Larsen 1977). In the tortricid, the spatulate structures were identified as sensilla auricillica. These sensilla were morphologically distinct from the spatulate sensilla of *B. lasus*, however, as they were longitudinally grooved and elongate. The male tenebrionid has an antennal spatulate bristle that is 50.6 μ long and is common on antennal segments V–IX. Each bristle has a corrugated surface and an apical pore. In either case, the spatulate receptors were not found in an array as noted in *B. lasus*. Scanning or transmission electron microscope examinations of hymenopterous parasites have not revealed zones or arrays of distinct sensilla as in *B. lasus*, although specialized receptors are noted (Borden et al. 1973, 1978, Norton and Vinson 1974, Richerson et al. 1972, Voegele et al. 1975, Weseloh 1972).

The few studies of courtship behavior by *Brachymeria* species have reflected the importance of antennae in the behavioral sequence between male and female conspecifics. Leonard and Ringo (1978) documented that 69% of discrete courtship behaviors involved use of the male antennae for female location and subsequent courtship. Similarly, Simser and Coppel (1980b) demonstrated that *B. lasus* males utilized a similar proportion of antennal behaviors in their courtship sequence. Males respond to a female pheromone by directing their antennae forward and ceasing random movements. This behavior orients the spatulate sensilla toward the female pheromone source. The male then advances with a side to side oscillatory movement and presses the antennae on to the wings and dorsum of the female.



Figures 1–2. Spatulate sensilla on male *Brachymeria lasus*: 1 ventral surface of antennae (× 65); 2 surface of spatulate sensilla showing array (× 1,500).



Figures 3–4. Spatulate sensilla on male *Brachymeria lasus*: 3 lateral view of sensilla showing orientation (× 500); 4 surface of sensilla showing imbricated surface (× 3,000).

Table 1. Segmental location of spatulate sensilla on male *B. lasus* antennae*.

Antennal segment	Average number of spatulate sensilla	SEM
I	0	-
II	0	-
III	0	-
IV	15.3	0.88
V	29.8	1.02
VI	23.4	0.75
VII	13.1	0.64
VIII	5.2	0.28
IV	0	-
X	0	-
XI	0	-

*Average number of sensilla from ten male *B. lasus*; number of sensilla from right and left antenna combined.

Following a series of antennal presses and wing buzzes, receptive females respond by raising the abdomen about 45°. This action appresses the spatulate sensilla to her abdomen. At this point, the male ceases courtship activity and attempts intromission. The presence and positioning of spatulate sensilla indicates their possible role in reception of mechanical and/or chemical cues to afford the continuing success of *B. lasus*.

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