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Possible sound producing structures present in some Macrosiphini (Homoptera: Aphididae)

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Abstract. Some aphid species of the tribe Macrosiphini possess a row of peg-like hairs on the hind tibiae, which resemble the plectrum of the sound producing apparatus in *Toxoptera* (tribe Aphidini). In addition to the three earlier recorded cases in the genus *Macrosiphoniella* (*M. jaroslavi* Szelegiewicz, *M. myohyangsani* Szelegiewicz, *M. spinipes* Basu) and *Macrosiphum* (*Sitobion*) *gravelii* van der Goot, these hind tibial pegs were found in *Macrosiphoniella millefolii* (DeGeer) and 10 species of the genus *Uroleucon*. In the Aphidini the plectrum is a transformed posterior row of hairs (rastral setae), whereas in Macrosiphini it is a posteroventral row of hairs. If in the latter it forms part of a sound producing apparatus, then the only available structure which might function as the file (strigil) is the reticulate zone at the apices of the siphunculi.

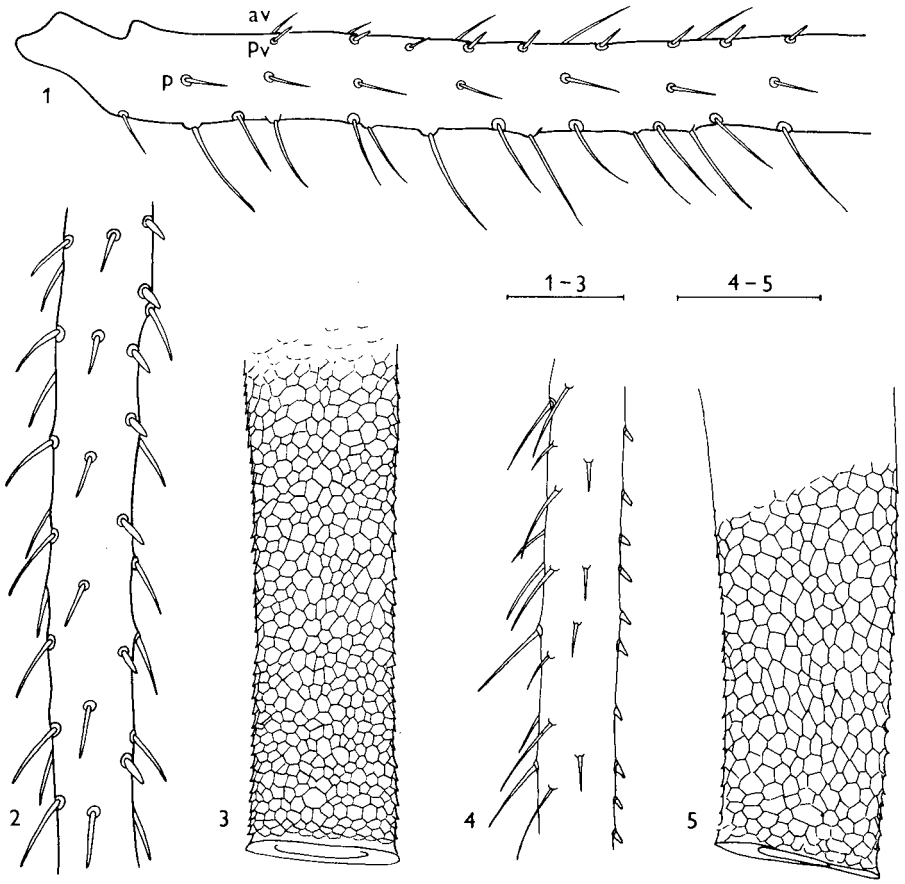
INTRODUCTION

Sound production by aphids was first reported by Williams (1922). He found that, when disturbed, large colonies of *Toxoptera aurantii* (Boyer de Fonscolombe) produce a scraping sound which can be perceived by the human ear up to eighteen inches away. An account of the morphology of the sound producing mechanism and the taxonomy of the species of the tribe Aphidini, which possess it was given by Eastop (1952, 1966). In *Toxoptera aurantii* the frictional stridulating mechanism consists of a row of peg-like hairs on the hind tibiae (scraper, plectrum) and a lateroventral reticulate pattern of serrate ridges (file, strigil) on abdominal sternites 5–6. Pegs on the hind tibiae are also present in other species of the genus *Toxoptera* and in *Aphis eugeniae* van der Goot (= *A. hardyi* Eastop) but in these species the strigil is weakly developed or indistinct.

Rows of peg-like hairs on the hind tibiae have been reported as characteristic also of some species of the genera *Macrosiphoniella* (Basu, 1968; Szelegiewicz, 1980), *Macrosiphum* (Ghosh et al., 1970) and *Uroleucon* (Holman, 1991). The purpose of the present paper is to summarize the data on the presence and morphology of this structure and discuss its presumed function in the tribe Macrosiphini.

REVIEW OF MORPHOLOGICAL DATA

There is a substantial difference between the Aphidini and Macrosiphini in the position of the peg-like hairs on the hind tibiae. The tibial hairs in most aphids are arranged in six longitudinal rows. In *Toxoptera* and *Aphis eugeniae* the pegs are transformed rastral setae e. g. the posterior row of hairs. In Macrosiphini the pegs are on the ventral margin of the hind tibiae and by their position correspond to the posteroventral row of hairs (Fig. 1).



Figs 1–5. 1 – *Macrosiphoniella millefolii* (DeGeer), basal part of the left hind tibia. p, pv and av – posterior, posteroventral and anteroventral row of hairs, respectively. 2, 3 – *Uroleucon* (*Uroleucon*) *cirsicola* (Holman). 2 – middle part of the hind tibia, 3 – apex of siphunculus. 4, 5 – *Macrosiphoniella spinipes* Basu. 4 – middle part of the hind tibia, 5 – apex of siphunculus. Scale bars are 0.01 mm.

Peg-like hairs have so far been found on the hind tibiae of four species of *Macrosiphoniella* one species of *Macrosiphum* and ten species of *Uroleucon*. The numbers and shape of hind tibial pegs in particular species are as follows.

Macrosiphoniella jaroslavi Szelegiewicz: the pegs are less than 30 in number, acute, gradually increasing in length towards apex, up to equal to the basal diameter of the antennal segment III (= BD III).

Macrosiphoniella myohyangsani Szelegiewicz: very numerous (over 60) on the whole length of the hind tibia, rounded or slightly acuminate 0.3–0.6 x BD III.

Macrosiphoniella spinipes Basu: very like the preceding species (Fig. 4).

Macrosiphoniella millefolii (DeGeer): about 25 in number, acuminate, about 0.5 x BD III, on distal quarter of the tibia longer, not much thicker than adjacent anteroventral hairs (Fig. 1).

Macrosiphum (Sitobion) gravelii van der Goot (= *M. spinotibium* M.R. Ghosh, A.K. Ghosh & Raychaudhuri): over 50 on the whole length of the hind tibia, short and thick.

Uroleucon (Uroleucon) caspicum Rezwani & Lampel: about 40, acuminate, thicker than other tibial hairs, 0.3–0.4 × BD III, distally longer.

Uroleucon (Uroleucon) cirsicola (Holman): as in the preceding species (Fig. 2).

Uroleucon (Uroleucon) monticola (Takahashi): about 45 on the whole length of the hind tibia, acuminate, 0.4–0.6 × BD III.

Uroleucon (Uromelan) adenophorae (Matsumura): some posteroventral hairs on proximal half of the hind tibia are peg-like, of unequal length, more or less acuminate.

Uroleucon (Uromelan) campanulae (Kaltenbach): about 10 on proximal two-thirds of the tibia, acuminate, 0.3–0.5 × BD III, posteroventral hairs on distal third of the tibia up to twice as long.

Uroleucon (Uromelan) carthami (Hille Ris Lambers): 8–10 hairs on proximal 0.5–0.6 of the tibia, 0.4–0.8 × BD III, obtuse or acuminate, more peg-like in samples from the Crimea and Bulgaria than in those from Slovakia.

Uroleucon (Uromelan) jaceae (Linnaeus): in some samples up to 20 on proximal 0.5–0.7 of the hind tibia, about 0.5 × BD III, mostly acuminate but in most examined specimens less numerous or longer.

Uroleucon (Uromelan) minor (Börner): typical peg-like hairs are present on the middle part of the hind tibia, a few ones are often scattered among the more distal longer and thicker posteroventral hairs.

Uroleucon (Uromelan) riparium (Stroyan): up to 12 on the basal half of the tibia, often of unequal length, sometimes setiform at apex, in samples from Central Europe and Russia less numerous and less typical.

Uroleucon (Uromelan) siculum Barbagallo & Stroyan: 10–12 on proximal 2/3 of the tibia, the typical ones mainly on the middle part of the latter, 0.2–0.5 × BD III.

In many other *Uroleucon* species the posteroventral hairs on the hind tibiae tend to be distinctly shorter than the adjacent anteroventral hairs and sometimes, especially in species related to *U. jaceae*, single or a few pegs occur in the posteroventral row among hairs of normal shape and length.

In *M. millefolii* and *U. campanulae* the pegs are differentiated already in the newborn specimens and in all morphs. The presence of the pegs in immature *M. spinipes* was reported by Ghosh A.K. et al. (1969).

DISCUSSION

Pegs on the hind tibiae have been found in a few Old World species of the genera *Macrosiphoniella*, *Macrosiphum* and *Uroleucon*. Numerous short pegs of about the same length and shape along nearly the whole length of the hind tibiae are present only in *Macrosiphoniella spinipes*, *M. myohyangsani*, *Macrosiphum spinotibium*, *Uroleucon caspicum*, *U. cirsicola* and *U. monticola*. In other species, if present, the pegs are less numerous (8–25), often of unequal size and confined mostly to the basal and middle parts of the

tibiae. There are differences in this respect even between specimens in particular samples of the same species, like *Uroleucon minor*, *U. riparium*, *U. jaceae* and related species.

The occurrence of the pegs does not correspond with the taxonomic position of the respective species. Whereas *Macrosiphoniella spinipes* and *M. myohyangsani* seem to be related, *M. jaroslavi* and *M. millefolii* are not and are well separated from other species of *Macrosiphoniella* s. str. Of the 10 species of *Uroleucon* with pegs two live on Campanulaceae and 5 on Asteraceae: Cynareae and might be classified as more plesiomorphic. *U. campanulae* in many respects is close to the hypothetical ancestral form of *Uroleucon*. On the other hand, the species of *Uroleucon* with the most numerous and typical pegs belong to the subgenus *Uroleucon* s. str. characterized by reduced pigmentation and other apomorphic features.

It is likely that the hind tibial pegs in Macrosiphini are a rudimentary structure conserved in a few species of some genera. What is their function?

The hind legs of aphids have been recorded as having several specific functions in addition to their ore in locomotion and attachment to plants. Communication with ants or spreading wax is not relevant to the species studied. Assistance in casting off the exuvia or in the birth of the larvae is not likely as other long-haired aphids moult and reproduce successfully without specialized structures on the hind tibiae. The same applies to kicking as a defensive reactions. That the hind legs are used to kick the drops of honey dew off the anus have been reported for the immature stages of many species of aphids (Kunkel, 1972), but these species have a brush-like group of long hairs on the hind tibiae.

If the pegs of the Macrosiphini studied are part of a sound producing mechanism as in *Toxoptera*, then at least in some species there should exist a complementary structure, the strigil, situated on the distal part of the abdomen. In view of the posteroventral position of the pegs, the strigil should be shifted laterally in comparison with its lateroventral situation in *Toxoptera*.

The Macrosiphini with hind tibial pegs lack any trace of a specialized structure on the abdomen not present in other members of the tribe. There are few structures that have a spiny or rough surface. The anal plate and cauda are unlikely to function as a strigil because of their ventral position and/or the presence of thick hairs (the strigil of *T. aurantii* is hairless). There are some reasons to believe that the strigil is the reticulate area at the apices of the siphunculi.

a) It can easily contact the whole of the posteroventral surface of the hind tibiae when the siphunculi are directed up- and outwards.

b) The species with numerous, short pegs possess a well differentiated reticulum on the siphunculi consisting of numerous small cells (Figs 2–5).

c) In intact and undisturbed aphids the siphunculi are at least partly hollow, not filled by wax cells, and might function as a resonant system.

Some facts seem to contradict this assumption. The subapical reticulation on the siphunculi is present and probably has evolved independently in several higher aphid taxa. It is an imaginal structure appearing after the last moult so that the sound producing apparatus would be functional only in the adults. The most important objection to the above conclusion is the absence of any behavioural evidence that species with well developed hind tarsal pegs use them for producing sound.

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