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Antennal Sensory Plaque Organs of Tettigometridae (Homoptera: Fulgoroidea) 【Research report】

蟻蠟蟬科之觸角瓦楞感覺器(同翅目：蟻蟬總科) 【研究報告】

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Abstract

The antennal sensory plaque organs of 15 species of Tettigometridae were examined. Four types of sensory plaque organs were observed: type I, the cuticular ring plain, the porous plate outwardly expanded marginally; type II, the cuticular ring elevated, the porous plate not expanded, protruding from dorsal margin of ring; type III, the cuticular ring elevated, smooth, the porous plate distinctly separated from ring; and type IV, same as in type III but elevated cuticular ring irregularly ridged. The evolutionary trend of this organ based on the developmental data is suggested to be type I → type II → type III → type IV.

摘要

本文共檢查蟻蠟蟬科15個種之觸角瓦楞感覺器，發現感覺器共有四型。第一型：表皮環平坦，有孔盤之邊緣向外擴展；第二型：表皮環升高，有孔盤不擴展，從表皮環之背緣突起；第三型：表皮環升高、平滑，有孔盤與表皮環明顯分開；第四型：除升高之表皮環具有不規則之脊起外，皆同於第三型。依據這項觀察資料之顯示，此種感覺器之演化趨勢推論為第一→二→三→四型。

Key words: Tettigometridae, antennae, sensory plaque organs.

關鍵詞: 蟻蠟蟬科，觸角，瓦楞感覺器。

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Antennal Sensory Plaque Organs of Tettigometridae (Homoptera: Fulgoroidea)

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ABSTRACT

The antennal sensory plaque organs of 15 species of Tettigometridae were examined. Four types of sensory plaque organs were observed: type I, the cuticular ring plain, the porous plate outwardly expanded marginally; type II, the cuticular ring elevated, the porous plate not expanded, protruding from dorsal margin of ring; type III, the cuticular ring elevated, smooth, the porous plate distinctly separated from ring; and type IV, same as in type III but elevated cuticular ring irregularly ridged. The evolutionary trend of this organ based on the developmental data is suggested to be type I → type II → type III → type IV.

Key words: Tettigometridae, antennae, sensory plaque organs.

Introduction

The porous sensory plaque organs are distributed on antennal pedicels of the Fulgoroidea (Bourgoin, 1985; Asche, 1987). Fulgoroidea is the only group bearing sensory plaque organs in Auchenorrhyncha. Tettigometridae is a small family of Fulgoroidea, containing 12 genera and 70 species (O'Brien and Wilson, 1985), and is considered to possess the most primitive character state of the Fulgoroidea (Emeljanov, 1990; Yang and Hsieh, 1994).

Extensive structural variations occur in the antennal sensory plaque organs of different families in Fulgoroidea (Marshall and Lewis, 1971; Bourgoin and Deiss, 1994). The sensory plaque organs in Tettigometridae were first studied by Bourgoin (1985), and this author reported the characteristic plaque organ of the

family as having a flat plate surface and an unsculptured edge. This paper is one of a serial of papers on the sensory plaque organs in which we examine every species available throughout the entire Fulgoroidea. Four types of sensory plaque organs have been detected, and they are useful for phylogenetic analysis.

Materials and Methods

Dried specimens of 15 species of several genera of Tettigometridae were examined in this study: in Tettigometrinae are *Brachycephala laeta* (Herich-Schaffer), *Micrometrina baranii* (Signoret), *Tettigometra costulata* Fieber, *Tettigometra hexaspina* Kolenati, *Tettigometra hispanica* Fieber, *Tettigometra impressifrons* Mulsant et Rey, *Tettigometra obliqua* Panzer, *Tettigometra picta* Fieber, *Tettigometra sulphurea* Mulsant et Rey,

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Tettigometra eremi Lindl., and *Tettigometra* sp.; in Egropinae is *Egropa bengalensis* Distant; and in Hildinae are *Hilda undata* Walker, *Hilda patruelis* Stal, and *Euphyonarthex phyllostoma* Schmidt.

The antennae were amputated and treated in a hot solution of 10% KOH for 25 min, then dissected and pressed in glycerin in order to check the number of sensory plaque organs through a light microscope. For scanning electron microscopic observation, the antennae were taken from the KOH solution and rinsed in distilled water. Then the antennae were fixed at 4°C for 2 h in phosphate-buffered 0.1 M glutaraldehyde, dehydrated through 50%, 70%, 80%, 90%, 95% and 100% alcohol for 20-30 min respectively, then replaced with isoamyl acetate for 20 min. The samples were critical-point dried, coated with gold, and examined with a Hitachi S-450 scanning electron microscope.

Results

Sensory plaque organs in Tettigometridae differ from those in other families of Fulgoroidea in having a cuticular ring without denticles and a porous plate without plaques. The 4 types of this organ observed are described below.

Type I: The cuticular ring plain; the porous plate outwardly expanded marginally (Figs.2, 3, 11).

The cuticular ring not elevated, surface plain. Margins of porous plate strongly expanded outwardly, expanded portion about 1/5 the length of diameter of median hole. Margin of porous plate strongly incurved, incurved portion fused with surface of cuticular ring.

Type II: The cuticular ring elevated; the porous plate not expanded, protruding from dorsal margin of ring (Figs.4, 5, 12).

The cuticular ring elevated distinctly. Margins of porous plate not expanded outwardly, protruding from dorsal margin of elevated cuticular ring directly. Mar-

gin of porous plate somewhat incurved but indistinct.

Type III: The cuticular ring elevated, smooth; the porous plate distinctly separated from the ring (Figs.8, 13).

The cuticular ring elevated, surface smooth. Margin of porous plate slightly expanded outwardly, distinctly incurved. Space between porous plate and cuticular ring deeply grooved, with a few fine ridges connecting them.

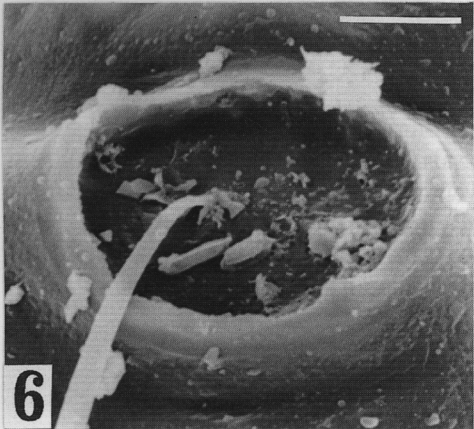
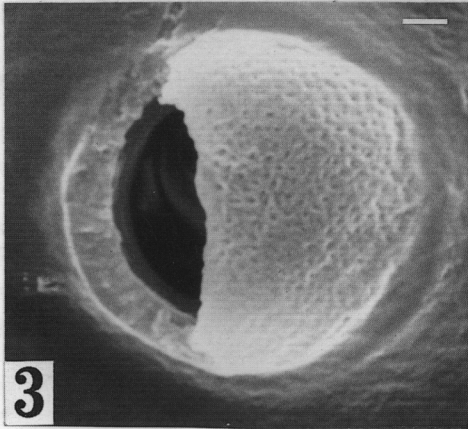
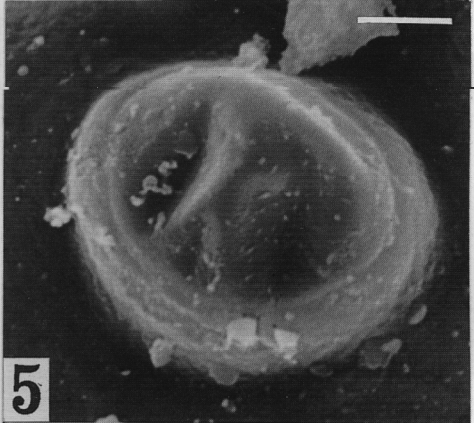
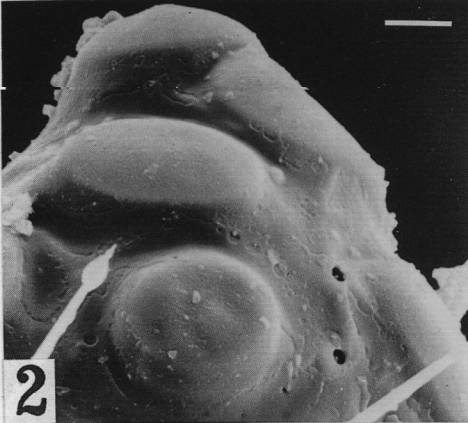
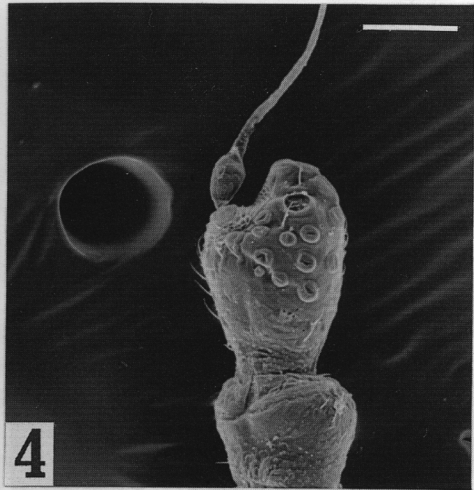
Type IV: Same as in type III except elevated cuticular ring irregular, obliquely ridged (Figs.10, 14).

In addition to these descriptions, the types and total number of sensory plaque organs in each pedicel of 15 species are given in Table 1.

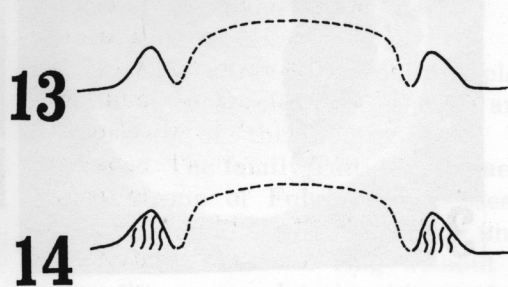
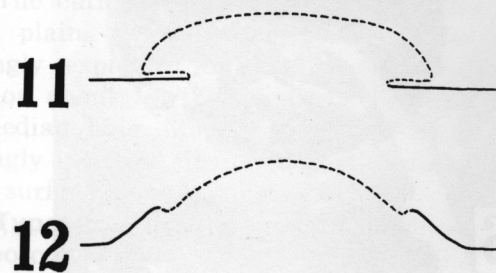
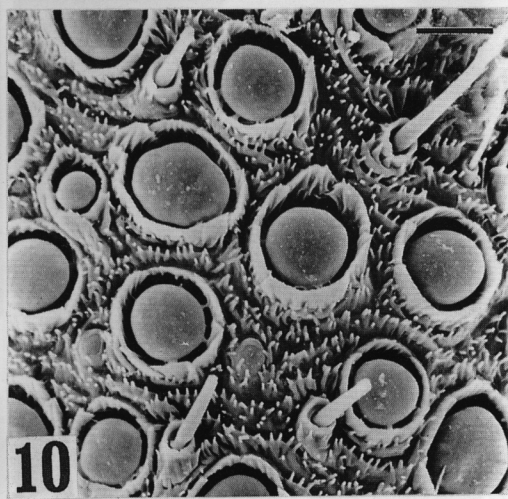
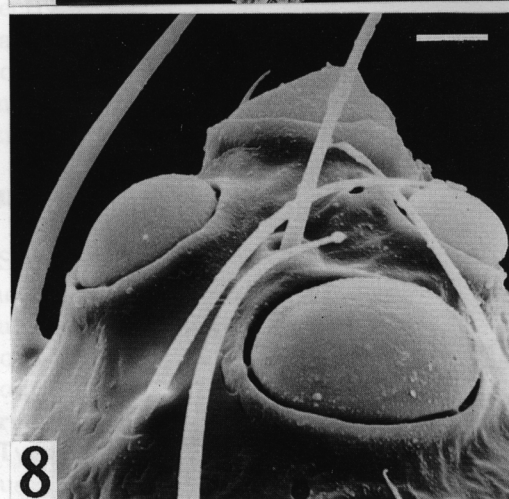
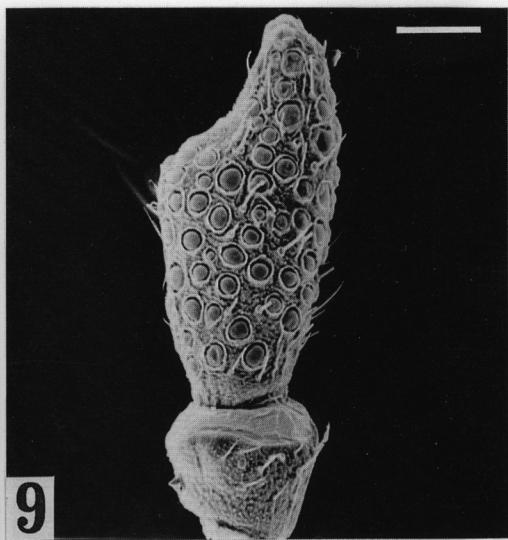
Discussion

Plate sensory organs are similar to the domes of the sensilla campaniformia in external morphology, but the internal structures of these two sets of organs are distinctly different. Snodgrass (1926) concluded that the plate sensory organ did not evolve from the sensilla campaniformia. The porous plate organs could have evolved from the sensilla basiconica through reduction or from the sensilla placodea. This plate type is the simplest sensory plaque organ in Fulgoroidea. Marshall and Lewis (1971) considered the sensory plaque organs of other types on fulgoroid antennae to be derived from porous plate organs.

In this study the sensory plaque organs of 15 species in 6 genera and 3 subfamilies of this family have been examined. The family Tettigometridae is a special group of Fulgoroidea possessing sensory plaque organs with the unique feature of a cuticular ring without denticles; the porous plate is without plaque. However, we found 4 types of sensory plaque organs in this family. In type I, the cuticular ring plain is not elevated; the porous plate is outwardly expanded



Figs.1-3 *Brachycephala laeta* (Herrich-Schaffer). 1. Whole feature of antenna. 2. Sensory plaque organs of type I. 3. Broken sensory plaque organ. (Scale: 1=100 μ m, 2=10 μ m, 3=1 μ m) Figs.4-6 *Tettigometra impressifrons* Mulsant et Rey. 4. Whole feature of antenna. 5. Sensory plaque organs of type II. 6. Broken sensory plaque organ. (Scale: 4=100 μ m, 5=5 μ m, 6=10 μ m)



Figs.7-8 *Tettigometra* sp. 7. Whole feature of antenna. 8. Sensory plaque organs of type III. (Scale: 7=100 μ m, 8=10 μ m) Figs.9-10 *Hilda patruelis* Stal. 9. Whole feature of antenna. 10. Sensory plaque organs of type IV. (Scale: 9=100 μ m, 10=20 μ m) Figs.11-14 Diagrammatic representation of the different types of sensory plaque organs in Tettigometridae. 11. Type I; 12. Type II; 13. Type III; 14. Type IV.

Table 1. Types and total number of sensory plaque organs in Tettigometridae

Taxon	Plaque organ types	Number of plaque organs
Tettigometrinae		
<i>Brachyceph laeta</i>	I	25
<i>Micrometrina baranii</i>	I, II	13
<i>Tettigometra costulata</i>	I, III (most)	14
<i>Tettigometra hexaspina</i>	III	32
<i>Tettigometra hispanica</i>	III	18
<i>Tettigometra impressifrons</i>	I, II	26
<i>Tettigometra obliqua</i>	III	21
<i>Tettigometra picta</i>	I, II	16
<i>Tettigometra sulphurea</i>	III	37
<i>Tettigometra eremi</i>	III	18
<i>Tettigometra sp.</i>	III	15
Egropinae		
<i>Egropa bengalensis</i>	III	130
Hildinae		
<i>Hilda undata</i>	IV	63
<i>Hilda patruelis</i>	IV	103
<i>Euphyonarthex phyllostoma</i>	IV	82

marginally, with the expanded portion about 1/5 the length of the diameter of the median hole (Fig.3). In type II, the cuticular ring is elevated (Fig.6) and the porous plate retreated, protruding from the dorsal margin of the cuticular ring directly. In type III, the cuticular ring is still elevated but the porous plate is retreated once more; the space between the cuticular ring and porous plate is deeply grooved. Type IV is nearly the same as type III, except the elevated cuticular ring is irregular and it is obliquely ridged. This ridged state of cuticular rings is inferred to evolve into the guard denticles of other families. Based on the above data, the evolutionary trend of these 4 types of sensory plaque organs is proposed to be type I → type II → type III → type IV.

The total number and distribution of sensory plaque organs and their types are not related, although, the total number of plaque organs of every pedicel in types I and II are from 13 to 26, with most of these distributed in the apical 2/3 (Fig.1)

or apical 1/2 (Fig.4). Both types I and II are found in Tettigometrinae. But the plaque organs of several type II species are usually not uniform. Types I and II may occur at 1 antenna of a species, for example, *Micrometrina baranii* (Table 1). This may imply an intermediate process of evolution. In type III, the total number of plaque organs of every pedicel are from 14 to 37, distributed in the apical (Fig.7), apical 1/2 or 2/3 portion in Tettigometrinae; there are 130 in Egropinae and they nearly cover the entire surface. The plaque organs in Hildinae belong to type IV; the number of plaque organs of every pedicel are from 63 to 103, and they also nearly cover the entire surface (Fig.9).

The above data indicate that the total number and distribution of plaque organs are not related to the types. In spite of the extensive structural variations of plaque organs in the subfamily Tettigometrinae, it possesses a primitive character state in Tettigometridae. The subfamily Hildinae possibly represents

the most advanced character state in this family.

Acknowledgments

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蟻蠟蟬科之觸角瓦楞感覺器(同翅目：蟻蟬總科)

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摘要

本文共檢查蟻蠟蟬科15個種之觸角瓦楞感覺器，發現感覺器共有四型。第一型：表皮環平坦，有孔盤之邊緣向外擴展；第二型：表皮環升高，有孔盤不擴展，從表皮環之背緣突起；第三型：表皮環升高、平滑，有孔盤與表皮環明顯分開；第四型：除升高之表皮環具有不規則之脊起外，皆同於第三型。依據這項觀察資料之顯示，此種感覺器之演化趨勢推論為第一→二→三→四型。

關鍵詞：蟻蠟蟬科，觸角，瓦楞感覺器。