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The 'cixiid-like' fossil planthopper families

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Abstract

The generalised planthopper venation pattern of Fulgoromorpha (Hemiptera) is reviewed and discussed in respect to superfamilies Coleoscytoidea, Surijokocixioidea, and Fulgoroidea. Characters of the superfamilies and included taxa are given and discussed, together with a more detailed review of Fulgoroidea fossil families, particularly for the paraphyletic Fulgoridiidae. Re-exploration of the basal evolution of the group with a comparative analysis of the only set of characters shared by all basal 'cixiid-like' families are presented. It shows that ancient fossil taxa share an impoverished venational pattern (brachy-micropterism?) that might indicate some adaptation to dry environments.

Key words: Coleoscytoidea, Surijokocixioidea, Fulgoroidea, Fulgoridiidae, Perforissidae, Lalacidae, Cixiidae, Neazoniidae, brachyptery, tegmen venation.

Introduction

Fossils planthoppers are not very diverse and they are currently grouped within a few major families (Bourgoin *et al*., 2004). However they represent a unique chance to provide new insights into evolution of the group allowing to test and/or complete studies only based on recent forms (Shcherbakov, 1996). The discovery of a new fossil family from the Lowermost Eocene of Northern France (Bourgoin and Szwedo, unpublished data) is therefore the opportunity to re-explore the basal evolution of the group and to provide a comparative analysis of the only set of characters shared by all these basal 'cixiid-like' families (Shcherbakov, 2007): the tegmina venation characters, which are re-analyzed here.

The taxa

Including fossils, Hemiptera Fulgoromorpha are currently divided in three superfamilies (Bourgoin *et al*., 2004): Coleoscytoidea Martynov, 1935, Surijokocixioidea Shcherbakov, 2000 – each one including one family – and Fulgoroidea Latreille, 1807. The latter comprises 24 families, three of them only know as fossil taxa: Fulgoridiidae Handlirsch, 1939, Lalacidae Hamilton, 1990 and Perforissidae Shcherbakov, 2007, plus another recently described fossil one, Neazoniidae Szwedo, 2007, but only known from nymphs (Szwedo, 2007).

The Fulgoromorpha tegmen

The generalised planthopper pattern provided by Shcherbakov (1996) from Surijokocixiidae includes a common basal stem ScP+R – an 'Auchenorrhyncha' apomorphy according to Kukalová-Peck (1991), but also present in Archescytinoidea (Shcherbakov, 1996) – forking first into ScP+R_1 and a simple Rs; an independent four-branched M forking later than ScP+R and CuA; a two branched CuA and a straight CuP. These 4 veins arise from the basal cell beyond an apomorphic short basicubital triangle (Shcherbakov, 1996). The claval Y-vein formed by Pcu and A1 is general, but also present in some Cicadomorpha. Veins are connected by braces (transversal 'veins') which allow to isolate closed areas or cells (Bourgoin, 1997) between branches of the same vein (C1 between R branches, C3 between M_{1+2} and M_{3+4}, C5 between CuA1 and CuA2) or between two different veins (C2 between R and M, C4 between M and CuA). Only C2 and C4 are closed by proximal braces. Basal Braces use to indicate the level of the 'nodal line', while the distal ones the post-nodal line.

The characters

Coleoscytoidea is characterised by C2 and C4 open, an autapomorphic proximal costal area strongly developed with its margin abruptly bent before joining its base; ScP separating from R almost perpendicularly before R_1 separates from Rs; M forking late and 2-3 branched; adaptative proximal r-m lost in most micropterous forms; radial cell closed: followed by C2 (in *Coleoscyta rotundata*) or just closed by a sub-distal r-m; basal cell longer than wide, wide and apically quadrate. No pterostigma. The brachy-micropterous tegmina make interpretation more delicate but obviously 3 groups of species are present and Martynov names are therefore maintained until more information is available: 1. *Coleoscytodes venosa*, *Coleoscytodes elytrata*, and *Coleoscyta kamensis* and *Coleoscyta occalata*, with all cells open; 2. *Coleoscyta ramosa* and *Coleoscyta* sp. Becker-Migdisova, 1960 sharing a common stem ScP+R+M and 3. *C. rotundata* and *Coleoscyta martynovi* with a proximal brace r-m and C1 and C2 closed.

Surijokocixioidea is characterised by a wide and long basicostal area, a short common stem ScP+R and by all intraveinal cells and C4 open; C2 is sometimes closed and basal cell is wide and apically quadrate. As is

Coleoscytoidea, a simplified venation pattern with few braces is observed. *Boreocixius* is characterised by a long open radial cell with R and M running in parallel and a very early forking of ScP and R from a short common stem. This common stem is absent in *Tricrosbia*, *Surijokocixius* and *Scytocixius*. In these three genera, as in *C. rotundata*, the radial cell is distinctly wider medially due to the basal curving of RP while M remains straight. It is hypothesised that the basal cell remains large and wide, as in Coleoscytidae, while it has not be observed in *Boreocixius*. Venation of *Surijokocixius* – while the two specimens illustrated by Becker-Migdisova (1961) are probably not congeneric – is very close to *Scytocixius* to which it differs by a costal area enlarged and wider proximally than apically.

Fulgoroidea Fulgoridiidae need a full revision and since Bode's numerous descriptions (1953) it has to be seen now as a paraphyletic assemblage. 'True' Fulgoridiidae share a long basal RP and a short CuA due to its early double forking (= long C5) before the nodal line level. *Fulgoridium* and *Eofulgoridium* (which differs from the former by numerous crossveins in the basicostal area and a multibranched Rs) have a long C1 and an uncommon early forking of CuA_2. In reverse, *Fulgoridulum* exemplifies a long ScP+R stem (= short C1), closed cells C2, C3 and C4 short, less than twice as long as wide and an unforked CuA_2.

Lalacidae were divided in various subfamilies by Hamilton when he described the taxa (1990). Particularly, tegmina are surrounded by a reinforced margin beyond ambient vein (appendix) bearing sclerous striations similar to Meenoplidae-Kinnaridae (at least also present in *Fulgoridulum*). However lalacid venation is rather different from members of this group that is characterised by veins not forking before the nodal line (Bourgoin, 1997) while this is only the case of M in lalacids.

Perforissidae taxa recently described by Shcherbakov (2007) have a simplified venation and share a short ScP+R+M common stem, an early forking of CuA while ScP+R and M fork at the nodal line level.

The new Fulgoroidea fossil family is characterised by a reinforced costa, a short ScP+R stem, a basally straight RP, and supernumerary terminals for RA, RP, M (10 branches) and CuA. Proximal braces r-m and m-cu are present and distal transverse veins associated in a curved post-nodal line.

With the recently described Fulgoroidea families Lalacidae, Neazoniidae and Perforissidae, this new family allows to review our perception of Cretaceous and Palaeogene planthopper world, much diverse than previously expected. Earlier, Jurassic Fulgoridiidae remains also quite abundant and probably artificially restricted to one family. It is interesting to note that Permian-Triassic Fulgoromorpha are characterised by a somewhat impoverished venational pattern in comparison with recent ones: in Coleoscytoidea all cells are open and braces almost absent as in Surijokocixioidea with C2 closed in some taxa only. Such open cells might be an indicator of brachy-micropterism. As already noticed for other related Hemiptera taxa (Kukalová-Peck and Brauckmann, 1992) it might indicate some adaptation to dry environments.

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