

ASIANIDIA ZACHVATKIN IN MADEIRA (HOMOPTERA: AUCHENORHYNCHA, CICADELLIDAE): ECOLOGY AND SPECIES PROBLEMS ¹

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With 1 Plate and 2 Tables

ABSTRACT. A general account on the ecology of the species of *Asianidia* Zachvatkin present in the Madeiran archipelago is given. Most species of this genus are endemic to Madeira and the Canaries and offer a good example of adaptive radiation in these islands. Although some species are relatively polyphagous, being found on different plants, many appear to be oligophagous or even monophagous, i.e., restricted to single plant species. Most of the host plants are also endemic to the Madeiras or to Macaronesia. At least three species groups occur in Madeira, viz.:

(i) Those related to *A. apiculata* (HORVÁTH), viz. *A. albula* (LINDBERG), *A. decolor* (LINDBERG) and *A. vallicola* (LINDBERG) and several undescribed species. Each species of the group seems to be closely associated with at least six endemic plant species;

(ii) The *A. atlantica* (CHINA) and *A. chrysanthemi* (LINDBERG) group and at least one other undescribed species which have colonized three endemic plant species;

(iii) Those related to *A. perspicillata* (HORVÁTH), viz. *A. chinai* (LINDBERG), *A. insulana* (LINDBERG) and *A. madeirensis* (CHINA) which were found on at least seven plant species, the majority of which are also endemics.

Moreover, an analysis of the type material and illustrations of the main diagnostic characters of *A. insulana* (LINDBERG), *A. madeirensis* (CHINA), *A. albula* (LINDBERG) and *A. decolor* (LINDBERG) are given to ensure a better understanding of the delimitation of these species.

RESUMO. O presente estudo faz uma análise geral da ecologia das espécies do género *Asianidia* Zachvatkin presentes no arquipélago da Madeira. A maioria das cigarrinhas deste género são endémicas para a Madeira e a Macaronésia, oferecendo um óptimo exemplo de irradiação adaptativa nestas ilhas. Se bem que algumas espécies sejam relativamente polífagas, muitas parecem ser oligófagas e mesmo monófagas, i.e., ocorrem apenas em plantas particulares, a maioria das quais, por sua vez, são também endémicas para a Madeira ou a Macaronésia. Pelo menos três grupos de

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espécies podem ser reconhecidos no arquipélago da Madeira, viz.:

(i) O de *A. apiculata* (HORVÁTH), viz. *A. albula* (LINDBERG), *A. decolor* (LINDBERG) e *A. vallicola* (LINDBERG) e outras espécies ainda por descrever. As cigarrinhas deste grupo parecem estar associadas a pelo menos seis plantas endémicas;

(ii) um segundo grupo com apenas duas espécies descritas - *A. atlantica* (CHINA) e *A. chrysanthemi* (LINDBERG) - e pelo menos com uma outra ainda por descrever e que colonizaram três plantas endémicas;

(iii) finalmente, um terceiro grupo, pertencente ao complexo *perspicillata* (HORVÁTH) e com três espécies descritas, viz. *A. chinai* (LINDBERG), *A. insulana* (LINDBERG) e *A. madeirensis* (CHINA), foi encontrado em pelo menos sete plantas hospedeiras, a maioria das quais são igualmente endémicas.

Este estudo contribui ainda para clarificar algumas situações taxonómicas, como seja a delimitação dos pares de espécies *A. insulana* (LINDBERG) - *A. madeirensis* (CHINA) e *A. albula* (LINDBERG) - *A. decolor* (LINDBERG), através da análise dos tipos e da ilustração dos principais caracteres diagnósticos.

INTRODUCTION

Asianidia Zachvatkin is a genus of leafhoppers allied to *Zygina* FIEBER and *Erythroneura* FITCH within the Typhlocybinæ. Of the 26 described species 22 are endemic to Macaronesia (NAST, 1972) but preliminary research suggests that this is a conservative tally as other unnamed species of *Asianidia* found in Madeira are clearly new to science but await description (REMANE, 1984; QUARTAU, unpublished data). Of the eight species of *Asianidia* found on the Madeiran Archipelago (Table 1) five are endemic - *albula*, *atlantica*, *chinai*, *insulana* and *madeirensis* whilst three others - *chrysanthemi*³, *decolor* and *vallicola* also occur on the Canaries Archipelago (QUARTAU, 1993).

TABLE 1 - Species of *Asianidia* occurring on the Archipelago of Madeira. Where the species are also represented on the Canaries the specific islands are shown in brackets.

1. *A. albula* (Lindberg, 1961): Madeira.
2. *A. atlantica* (China, 1938): Madeira, Porto Santo and Ilhéu Chão.
3. *A. chinai* (Lindberg, 1961): Madeira.
4. *A. chrysanthemi* (Lindberg, 1954): Madeira, Porto Santo (La Gomera, Tenerife).
5. *A. decolor* (Lindberg, 1936): Madeira (La Gomera, Tenerife, Gran Canaria).
6. *A. insulana* (Lindberg, 1961): Madeira.
7. *A. madeirensis* (China, 1938): Madeira.
8. *A. vallicola* (Lindberg, 1954): Ilhéu de Fora (Hiero, Tenerife).

³ This also occurs on the Azores (S. Miguel) to where it might have been introduced with the host plant (*Argyranthemum* sp.) (QUARTAU, unpublished data).

HOST PLANTS

Observations indicate that these leafhoppers have colonized a wide range of interesting plant species, a high proportion of which are endemic to Madeira or Macaronesia. Furthermore, these *Asianidia* species demonstrate considerable host specificity, some are relatively polyphagous, living on several different plant species, many oligophagous and others monophagous. *Asianidia* spp. were also observed on the following non-endemic genera: *Chinopodium*, *Epilobium*, *Prunella*, *Ranunculus* and others.

In Table 2 the host plants observed in Madeira are given and their distribution throughout the whole of Macaronesia is shown (HANSEN & SUNDING, 1993).

TABLE 2 - A list showing the distribution of endemic host plants for *Asianidia* spp. Key: Mad = Madeira, D = Desertas, PS = Porto Santo, S = São Miguel, SM = Santa Maria, TE = Terceira, J = S. Jorge, PI = Pico, FA = Faial, FL = Flores, C = Corvo, GC = Gran Canaria, F = Fuerteventura, G = Gomera, H = Hierro, L = Lanzarote, P = La Palma, T = Tenerife (Source: HANSEN & SUNDING, 1993)

ASTERACEAE

Andryala glandulosa spp. *glandulosa* - Mad, D, PS, L.

Andryala glandulosa ssp. *varia* - Mad, PS, L, F.

Argyranthemum pinnatifidum ssp. *pinnatifidum* - Mad, S.

Artemisia arborescens - Mad, D, PS.

Helichrysum melaleucum - Mad, D, PS.

Pericallis aurita - Mad, PS.

EUPHORBIACEAE

Euphorbia mellifera - Mad, T, G, P.

GERANIACEAE

Geranium maderense - Mad.

Geranium palmatum - Mad.

Geranium rubescens - Mad.

LAMIACEAE

Bystropogon maderensis - Mad.

Cedronella canariensis - Mad, SM, GC, T, G, H, P.

Sideritis candicans var. *candicans* - Mad.

RANUNCULACEAE

Ranunculus cortusifolius - Mad, S, TE, J, PI, FA, FL, C, L, F, GC, T, G, H, P.

SALICACEAE

Salix canariensis - Mad, GC, T, G, H, P.

SCROPHULARIACEAE

Isoplexis sceptrum - Mad.

Examples of endemic plants to the archipelago of Madeira (cf. Table 2) are *Argyranthemum pinnatifidum* (recently introduced in the Azores), *Artemisia arborescens*, *Bystropogon maderensis*, *Geranium maderense*, *G. palmatum*, *G. rubescens*, *Helichrysum melaleucum*, *Isoplexis sceptrum*, *Pericallis aurita* and *Sideritis candicans* var. *candicans*.

With respect to the distribution of these plants in Madeira, and with the exception of a few which are littoral (e. g., *Artemisia arborescens* and *Andryala glandulosa* ssp. *glandulosa*), most tend to occupy areas of medium to high altitudes, sometimes in clearings but generally in the moist and shady underground of the *laurisilva* (laurel woods). Therefore, the same applies to these leafhoppers. In fact, the main areas where they have been collected during the author's own prospections in Madeira include medium to high altitude sites within or near the laurel woods, such as at Encumeada, Lombo do Mouro, Queimadas, Rabaçal, Ribeiro Frio, Seixal, etc.

GROUPS OF SPECIES WITHIN *ASIANIDIA*

So far, three main groups of species within *Asianidia* can be recognized in Madeira:

(i) A group of species close to *A. apiculata* (HORVÁTH), whose populations have colonized mostly *Andryala glandulosa*, *Cedronella canariensis*, *Helichrysum melaleucum*, *Pericallis aurita*, *Prunella vulgaris*, *Salix canariensis* and *Sideritis candicans*. These leafhoppers are typically small, whitish or yellowish without visible external markings and have the aedeagus terminating in a more or less expanded triangular lobe as can be seen in the species *A. albula* (LINDBERG), *A. decolor* (LINDBERG) and *A. vallicola* (LINDBERG). The holotypes and a few paratypes of the two former species have been examined and illustrations of the aedeagus can be seen in Figs. 1-3. LINDBERG (1954, 1961), however, did not give the plants where they were taken in Madeira, but at least for *A. albula*, which was originally collected in the area of Serra d'Água, the host plant might be either *Andryala glandulosa* ssp. *varia* or *Pericallis aurita*, which are both common in that area. This complex of species presents, however, some taxonomic difficulties since, in spite of showing some differences in the general colouration, which may vary from whitish to more or less yellowish, in the overall size, as well as in the lengths of legs, head and beak, have a very similar genitalic pattern, even at the level of the aedeagus. However, such closely related populations occurring in different plants might well be not just host races, but instead may belong to distinct sibling species as discussed later.

(ii) The *A. atlantica* (CHINA) species group is made of apparently monophagous or oligophagous leafhoppers, which are unmarked externally or with some shadowing (as in *A. chrysanthemii*) and are characterized by a typical aedeagus which terminates in

an enlarged lobe with two pairs of small extensions (e.g., Fig.4). Different species are apparently associated with different plants: so far, this group includes *Asianidia atlantica* which lives on *Artemisia arborescens* and *Asianidia chrysanthemii*, which is associated with different species of *Argyranthemum*, namely *Argyranthemum pinnatifidum*. *Euphorbia mellifera* was also found to host one species of *Asianidia* in this group, which appears to be undescribed (QUARTAU, unpublished data).

(iii) A third group belonging to the *Asianidia perspicillata* (HORVÁTH) complex includes three described species: *A. chinai* (LINDBERG), *A. insulana* (LINDBERG) and *A. madeirensis* (CHINA). This is quite an interesting group since the species can be distinguished externally through their distinctive dark patterns (as in *insulana* and *madeirensis*, Figs. 6 and 7, respectively, or in just one of the two forms of *A. chinai*). The male aedeagus is also typical of the group, showing a pair of long arms (e.g., Figs. 5 and 8). Interestingly also, only *A. chinai* appears to be a monophagous species, feeding and ovipositing on *Isoplexis scaptrum*. On the contrary, both *A. insulana* and *A. madeirensis* can be found on several plants. In fact *A. madeirensis* has been collected by the author on *Prunella vulgaris* and on *Chinopodium ascedens*, while *A. insulana* has been found on different species of *Geranium*, some of which endemic to Madeira (*maderense*, *robertianum* and *rubescens*), as well as on *Ranunculus* spp. (e.g., *cortusifolius*). Both species tend to occur in the undergrowth of the *laurisilva* (e.g., in Queimadas, Rabaçal and Ribeiro Frio) and of course *A. chinai* has only been found where *I. scaptrum* occurs (ravines of the interior or along levadas or roads where specimens have been planted by the Forestry Service).

Scrutiny of the descriptions of *A. insulana* and *A. madeirensis* given by LINDBERG (1961) shows that the illustrations on p.71 depicting the aedeagus are mixed up. An examination of the holotype of *A. insulana* and the recently collected material shows that LINDBERG's (1961) Fig. 9a on p. 71 should refer to *A. insulana* and Figs. 9b and 9d to *A. madeirensis*, i.e., the aedeagal arms touch or are very close to the shaft in *A. insulana*, contrarily to what happens in *A. madeirensis*. The present Figs. 5 and 6 are taken from the holotype and depict the main diagnostic characters of *insulana*. The holotype of *madeirensis*, on the other hand, could not be traced, but taking into consideration Fig. 18 of CHINA (1938), where the external morphology of this species is illustrated, and analysis of recently collected material with the same colour pattern and from the site of the holotype it was possible to give the correct interpretation of the external morphology and the male genitalia of this species (Figs. 7 and 8).

DISCUSSION

Many so-called host races in the entomological literature have been found in

recent decades to be valid species (e. g., ROSS, 1962; MAYR, 1963; BUSH, 1969a, b; WHITE, 1978) and probably this also applies to the Madeiran *Asianidia*. Therefore, especially within the *A. apiculata* complex, this would provide a good example of species which have suffered specific divergence without showing clear-cut morphological differences.

Probably speciation occurred through host transfers, each transfer having led to the establishment of a new phylogenetic line in a similar manner to the way ROSS (1958, 1962) has suggested in North America for complexes of leafhoppers within *Erythroneura*, a genus very close to *Asianidia*.

Elucidation of this problem requires, however, further ecological and new behavioural data. For all species eventual differences between nymphal and adult feeding and oviposition plants should be determined. Moreover, experiences for testing whether leafhoppers from each host show strong preferences for feeding and ovipositing on the plant from which they were collected coupled with mate choice experiments should be carried out.

On the other hand, electrophoretic studies for analysis of genetic variants of enzymatic proteins might be another area which might help to clarify this problem, in spite of speciation having proceeded at least in some insects with small electrophoretically detectable variation (e. g., AYALA, 1982). Another area of interesting research is the analysis of the songs produced by the males. It is well known that leafhoppers produce vibrational signals that are transmitted through the plant substrate on which they live and use them in mate recognition and courtship (e. g., CLARIDGE, 1985, 1993; QUARTAU *et al.*, 1992). These acoustic signals are species specific and therefore very helpful for the discrimination of the sibling species within leafhoppers, even in morphologically conservative groups.

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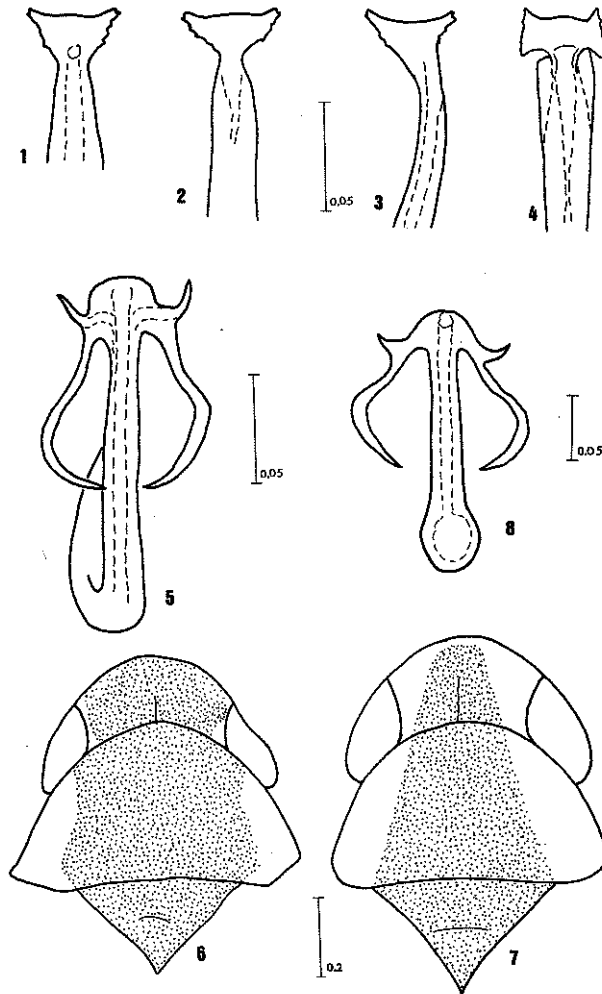


Plate 1 - Aedeagus of the holotype of *A. albula*, postero-dorsal view (Madeira: Serra de Água, 16-19.7.1957). 2. Aedeagus of a paratype of *A. decolor*, postero-dorsal view (Gran Canaria: Moya, 2591-typ.). 3. Aedeagus of a paratype of *A. decolor*, postero-latero-dorsal view (Tenerife: La Mercedes, spec. typ no. 7624). 4. Aedeagus of the holotype of *A. atlantica*, postero-dorsal view (N. Deserta: Ilheo Chão, WOLLASTON 1855-7). 5. Aedeagus of the holotype of *A. insulana*, postero-dorsal view (Madeira: Queimadas, 24-26.6.1957, spec. typ. no. 11333). 6. Crown, pronotum and scutellum of the holotype of *A. insulana*, dorsal view (Madeira: Queimadas, 24-26.6.1957, spec. typ. no. 11333). 7. Crown, pronotum and scutellum of *A. madeirensis*, dorsal view (Madeira: Rabaçal, 24.4.91). 8. Aedeagus of *A. madeirensis*, postero-dorsal view (Madeira: Rabaçal, 24.4.91). (scales in mm).

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