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A preliminarily study on adult characters of whiteflies (Hem.: Aleyrodidae)

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Abstract

In order to study of the adult characters of whiteflies (Hemiptera: Aleyrodidae), the male and female species belonging to seven genera, *Aleurochiton* TULLGREN, *Aleuromarginatus* CORBETT, *Aleyrodes* LATREILLE, *Bulgarialeurodes* CORBETT, *Dialeurodes* COCKERELL, *Neomaskellia* QUAINANCE & BAKER, *Trialeurodes* COCKERELL, were collected from different localities in Iran. The characters assumed to be valuable at genus level were antennal sensoria, ommatidia of compound eyes connecting the upper and lower lobes, and genitalia. An identification guide to the adult males and females of the studied genera is provided.

Key words: Aleyrodidae, Whiteflies, Identification key, Adult, Iran.

Zusammenfassung

An verschiedenen Orten im Iran gesammelte Aleyrodidae (Hemiptera) lassen sich den 7 Gattungen *Aleurochiton* TULLGREN, *Aleuromarginatus* CORBETT, *Aleyrodes* LATREILLE, *Bulgarialeurodes* CORBETT, *Dialeurodes* COCKERELL, *Neomaskellia* QUAINANCE & BAKER, *Trialeurodes* COCKERELL zuordnen. Die Gattungsmerkmale liegen im Bau der Fühler, der Augen und des Genitals. Ein Bestimmungsschlüssel zur Identifizierung der genannten Gattungen für beide Geschlechter wird vorgestellt.

Introduction

Whiteflies comprise a single hemipterous family, Aleyrodidae, which are tiny and sap-sucking insects with a curious life cycle (MARTIN 2003). They are four-winged and fully mobile with the body length of 1-3 mm, a feeding rostrum and seven-segmented antennae. Forewing venation is reduced to a simple or once-branched major vein (MARTIN et al. 2000). The white powdery wax that covers the body of most species in this family is secreted from abdominal glands. Some species have dark spots on the wings, although these may not develop until a few hours after emergence. Moreover, a few species are not white.

The basis for present generic classification was laid by QUAINANCE & BAKER (1913-1914) who divided the family into three subfamilies. The generic classification of the Aleyrodidae is based on the structure of the fourth larval instar, which is called the pupal case, not on the structure of adults (MOUND & HALSEY 1978). Hence, a little attention has been paid to adults in whitefly taxonomy, which is briefly mentioned below.

According to MASKELL (1895), adult whiteflies appear to differ only slightly in their morphological characteristics, so have a little value in distinguishing species. HULDEN (1986) stated that the number of ommatidia connecting the upper and lower lobes is an important character. GILL (1990) has shown major differences between the adult whiteflies of the Aleyrodinae and Aleyrodicinae. BINK-MOENEN (1992) studied the wing venation of the six species of *Aleuroviggiatus* IACCARINO, while describing four new species of this genus. The characteristics of the paronychium and forewing venation have already been used to distinguish adults of two subfamilies, Aleyrodinae and Aleyrodicinae (e.g. RUSSELL 2000). Recently, the genus *Udamoselis* ENDERLEIN and its subfamily, Udamoselinae, were reappraised on adult characters, including wing venation, paronychium structure and distribution of abdominal wax gland by MARTIN (2007). Comparative studies of adult characters of the species of some genera, *Lipaleyrodes* TAKAHASHI, *Bemisia* QUAINANCE & BAKER and *Singhiella* SAMPSON have also been provided (CHEN & KO 2007, DUBEY et al. 2009).

The aim of the current study is the evaluation of adult characters of whiteflies and introducing some characters based on the available materials to distinguish the genera studied. An identification key to the adult males and females of the studied genera is also presented.

Materials and methods

Field-collected adult specimens were slide-mounted and Canada balsam was employed as the permanent mounting medium. They were identified based on their pupae. Specimens studied (table 1) were deposited at Hayk Mirzayans Insect Museum (HMIM), Insect Taxonomy Research Department, Iranian Research Institute of Plant Protection, P.O. Box 1454, Tehran 19395, Iran.

Results

In order to study of adult whiteflies, the body was dissected and different parts (such as the head, antennae, wing and genitalia) were slide mounted. The important differences in both sexes were observed in compound eyes, the length of antennal segments and type of sensorial cones, and the genitalia.

In the species studied, the upper and lower lobes of compound eyes, if undivided, were connected with one ommatidium and/or with several ommatidia. It is quite likely that the number of ommatidia connecting these lobes to have an important value as a distinguishing character, but it needs more material from different genera to be examined. For example, in *Aleuromarginatus tephrosiae* CORBETT, *Neomaskellia andropogonis* CORBETT and *Bulgarialeurodes cotesii* (MASKELL) the upper and lower lobes of compound eyes are connected with three ommatidia in females. In *Dialeurodes citri* (ASHMEAD), these lobes are connected with one ommatidium (fig. 3) in both sexes. In *Aleurochiton pseudoplatani* VISNYA and *B. cotesii* they are undivided completely (fig. 2) in males. Compound eyes of the three examined species of *Aleyrodes* (table 1) and *Trialeurodes vaporariorum* (WESTWOOD) are divided in both sexes (fig. 1). It is worth mentioning that compound eyes might have pigmented ommatidia (fig. 1) (as in the four latter species), which could be a character if more specimens are studied.

The primary sensoria and sensorial cones were observed on some segments of the antenna in the all species studied (table 1). In *D. citri*, sensorial cones are modified as sensorial plaques. Having said this, there is no information available to know if this is true for the other species of *Dialeurodes*. The number of primary sensoria and their position on different segments, and its shape (if differs in other species) could be valuable characters if more specimens are studied. The same conclusion would be assignable for the sensorial cones. Moreover, the length of antennal segments seems to be a good character at genus level.

In male genitalia, the number of setae on the claspers was found to be variable in the specimens studied. For example, in *A. pseudoplatani* and *B. cotesii* each clasper has less than 8 and at least 8 setae, respectively. Also, the shape of genitalia seems to be an important character to separate some genera, e.g. *Aleyrodes* (in the three species studied (table 1), the shape was the same) and *Trialeurodes* (only one species studied).

In female genitalia, the absence/presence of the group of setae on the outer margin of the paired gonapophyses, and possibly the number of setae in the group, could be a good character. In *N. andropogonis*, there are three setae located subapically on the outer margin of each gonapophysis of the paired gonapophyses (fig. 14). Furthermore, the number of setae in the apical/subapical part of the unpaired gonapophysis was found to be a valuable character. In the representatives of all genera studied (table 1), except *T. vaporariorum*, there are two setae in the above-mentioned area while the latter species have four setae in the same position on the unpaired gonapophysis (figs 16-17).

The males and females belonging to the genera studied might be separated by the following keys.

Key to male adults

- 1 Compound eyes divided (fig. 1) 4
- Compound eyes undivided, upper and lower lobes at least connected with one ommatidium or broadly connected with several ommatidia (figs 2-3) 2
- 2 The upper and lower lobes of compound eyes broadly connected with several ommatidia (fig. 2); antennae with sensorial cones on some segments (fig. 5) 3
- The upper and lower lobes of compound eyes connected with only one ommatidium (fig. 3); antennae with sensorial plaques on segments III-VII (fig. 6) *Dialeurodes*
- 3 Claspers with less than 8 pairs of setae (fig. 7) *Aleurochiton*
- Claspers with at least 8 pairs of setae (fig. 8) *Bulgarialeurodes*
- 4 Claspers broad for over two-third of its length from the base (fig. 9) *Trialeurodes*
- Claspers broad for about half of its length from the base (fig. 10) *Aleyrodes*

Key to female adults

- 1 Compound eyes divided (fig. 1) 5
- Compound eyes undivided, upper and lower lobes at least connected with one ommatidium or broadly connected with several ommatidia (fig. 2-4) 2
- 2 The upper and lower lobes of compound eyes connected with three ommatidia (fig. 4); antennae with sensorial cones on some segments (fig. 12, 13) 3
- The upper and lower lobes of compound eyes connected with only one ommatidium (fig. 3); antennae with sensorial plaques on segments III, IV, VI and VII (fig. 11) *Dialeurodes*
- 3 Antennal segment VII longer than the other segments (at least slightly longer than segment III) (fig. 12) *Aleuromarginatus*
- Antennal segment III longer than the other segments (fig. 13) 4
- 4 Paired gonapophyses each with three long setae on subapical margin (fig. 14) *Neomaskellia*
- Paired gonapophyses without setae on subapical margin (fig. 15) *Bulgarialeurodes*
- 5 Unpaired gonapophysis with a pair of setae located subapically (fig. 16) *Aleyrodes*
- Unpaired gonapophysis with two pairs of setae located subapically (fig. 17) *Trialeurodes*

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Table 1: Material examined in this study.

Genus	Species	Sex
<i>Aleurochiton</i> TULLGREN	<i>A. pseudoplatani</i> VISNYA	Male
<i>Auromarginatus</i> CORBETT	<i>A. tephrosiae</i> CORBETT	Female
<i>Aleyrodes</i> LATREILLE	<i>A. singularis</i> DANZIG	Male & Female
	<i>A. proletella</i> (LINNAEUS)	Male & Female
	<i>A. sp. nr. lonicerae</i> WALKER	Male & Female
<i>Bulgarialeurodes</i> CORBETT	<i>B. cotesii</i> (MASKELL)	Male & Female
<i>Dialeurodes</i> COCKERELL	<i>D. citri</i> (ASHMEAD)	Male & Female
<i>Neomaskellia</i> QUAINANCE & BAKER	<i>N. andropogonis</i> CORBETT	Female
<i>Trialeurodes</i> COCKERELL	<i>T. vaporariorum</i> (WESTWOOD)	Male & Female

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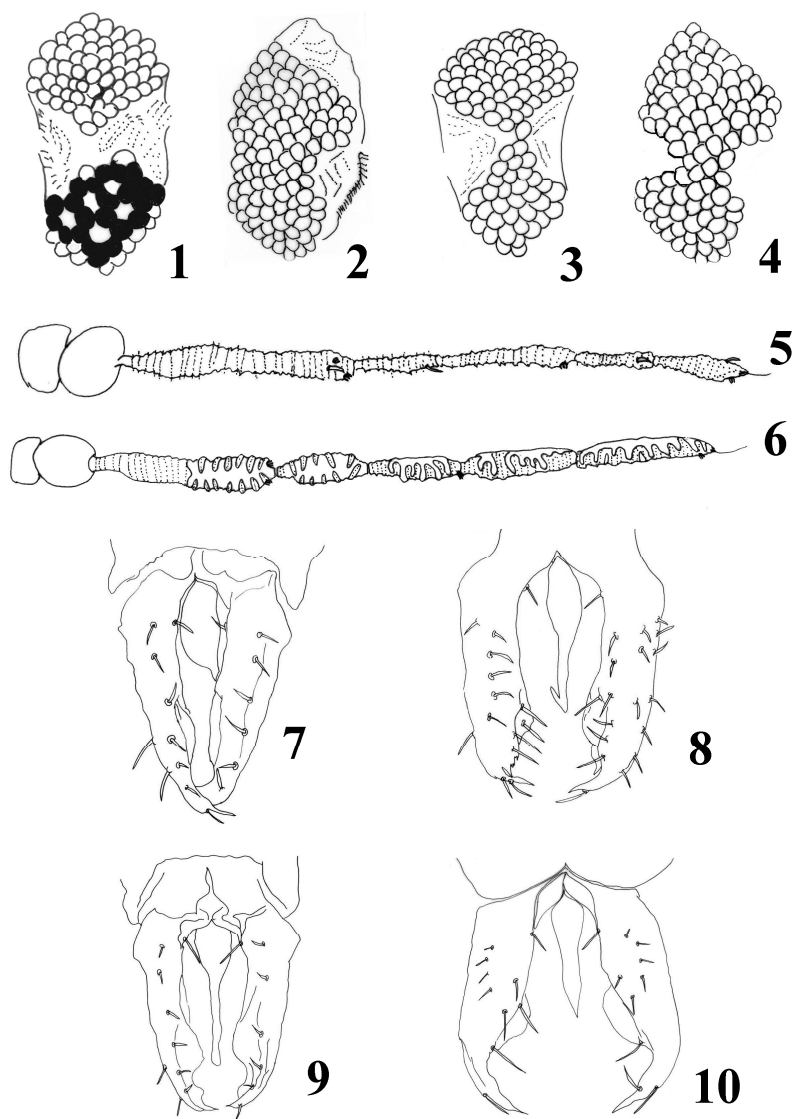


Fig. 1-10: 1-4 Compound eye. (1) = *Trialeurodes vaporariorum* and *Aleyrodes singularis*, *A. proletella* and *A. sp. nr. Lonicerae* (the both sex); (2) = *Aleurochiton pseudoplatani* and *Bulgarialeurodes cotesii* (male); (3) = *Dialeurodes citri* (the both sex); (4) = *Neomaskellia andropogonis*, *Aleuromarginatus tephrosiae* and *Bulgarialeurodes cotesii* (female). 5-6 Male antenna. (5) = *Trialeurodes vaporariorum*; (6) = *Dialeurodes citri*. 7-10 Male genitalia. (7) = *Aleurochiton pseudoplatani*; (8) = *Bulgarialeurodes cotesii*; (9) = *Trialeurodes vaporariorum*; (10) = *Aleyrodes singularis*, *A. proletella* and *A. sp. nr. Lonicerae*.

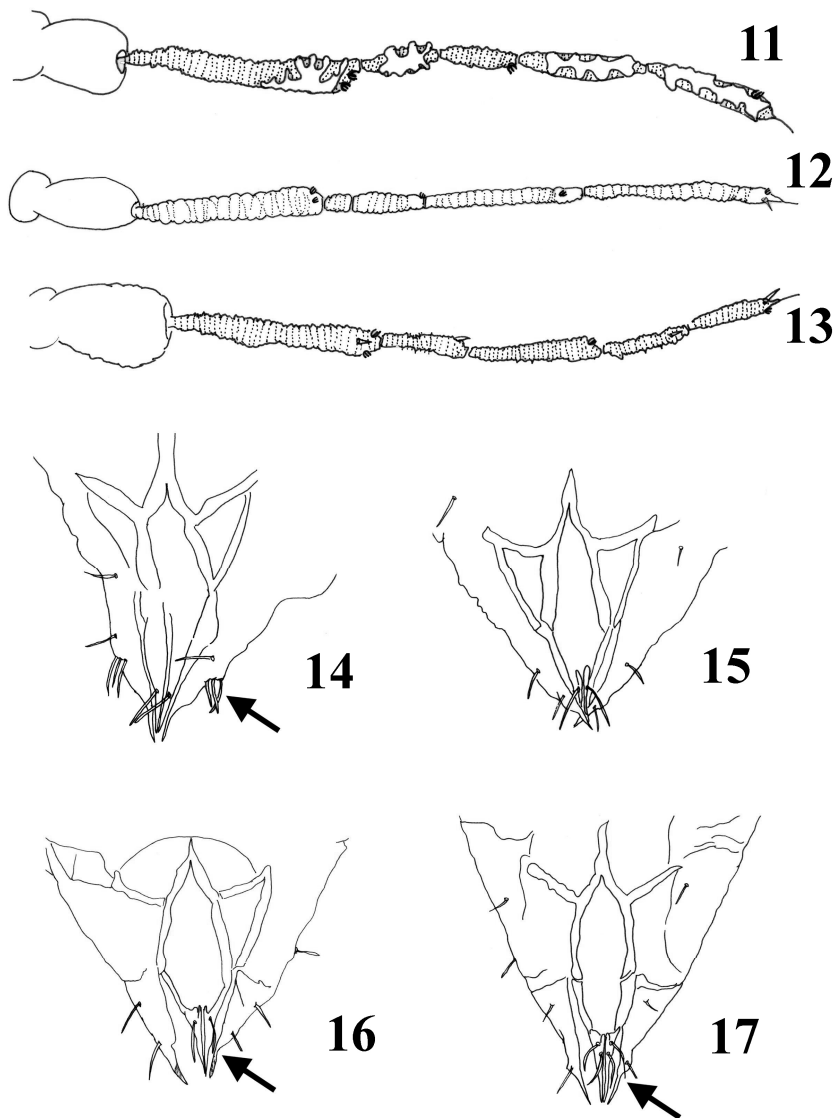


Fig. 11-17: 11-13 Female antenna. (11) = *Dialeurodes citri*; (12) = *Aleuromarginatus tephrosiae*; (13) = *Trialeurodes vaporariorum*. 14-17 Female genitalia. (14) = *Neomaskellia andropogonis*; (15) = *Bulgarialeurodes cotesii*; (16) = *Aleyrodes singularis*, *A. prolella* and *A. sp. nr. lonicerae*; (17) = *Trialeurodes vaporariorum*.

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