



Morphology of the antennal sensilla of *Rhus* gall aphids (Hemiptera: Aphidoidea: Pemphiginae): A comparative analysis of five genera

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Abstract

Rhus gall aphids induce sealed galls which are rich in tannic acid and have been widely used for chemical and medicinal purposes. Identification of these aphids at the genus and species levels can be a challenge due to their morphological similarity and unusually complex life cycles. The external morphology of the antennae of 11 taxa was examined by both light and scanning electron microscopy, each antenna comprising a basal scape, a pedicel, and an elongate flagellum of three or four segments covered with secondary sensilla of five morphologically distinct types. Aphids with *Rhus chinensis* as primary host have five antennal segments; those with *R. potaninii* and *R. punjabensis* var. *sinica* as hosts have six segments. In *Schlechtendalia* species, each flagellar segment is covered with a large placoid sensillum that is separated by sunken grooves and appears as irregular plates with numerous microtrichia. In *Nurudea* species, the secondary sensilla look like annular rings, with the surface almost fully covered with microtrichia. *Floraphis meitanensis* has annular sensilla with smooth surfaces, and each ring is surrounded by longer microtrichia. *Meitanaphis* and *Kaburagia* species have a large sheet secondary sensillum occupying half to three-fourths of the area of each flagellar segment. The secondary sensilla of two species of *Meitanaphis* showed great differences indicating the need for revision of the genus.

Key words: *Rhus* gall aphids; antennal sensilla; Pemphiginae; scanning electron microscopy

Introduction

Rhus gall aphids are a small group of insects in the subfamily Pemphiginae. They have complex life cycles with cyclical parthenogenesis and multiple generations with alternative hosts. According to the current classification, they are divided into five genera, nine species and four subspecies (Zhang *et al.*, 1999). Each species or subspecies induces sealed, sac-like galls that vary greatly in shape, size, structure, and galling-site (Zhang *et al.*, 2006). The galls are rich in tannins, and have been used in China for medicine and chemical purposes for more than two thousand years, and they continue to be an important resource and traditional export product (Zhang *et al.*, 1999; Zhang *et al.*, 2008).

Rhus gall aphids are species-specific to their hosts, but galls are induced only on the primary host. The life cycle includes sexual and asexual reproduction, and alternation between the primary hosts (*Rhus*) and certain secondary hosts (mosses). Three primary host plant species and more than fifty secondary host moss species have been reported. Generally, each gall is initiated by a single aphid (fundatrix). The fundatrix reproduces parthenogenetically for three generations within a gall and the apterous fundatrigeniae live in it for about three to five months. In the summer or fall, after the galls mature and dehisce, alate fundatrigeniae migrate from the gall to mosses nearby. They produce larvae asexually, and each larva excretes wax around it to gradually become a small wax ball that overwinters on the root or tender stem of the mosses. Next spring, the larvae moult and become alate sexuparae which fly to a branch of their primary host, deposit male and female