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Taxonomy and biology of a new ambrosia gall midge *Daphnephila urnicola* sp. nov. (Diptera: Cecidomyiidae) inducing urn-shaped leaf galls on two species of *Machilus* (Lauraceae) in Taiwan

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Abstract

Recent field surveys show that galls induced by *Daphnephila* spp. (Cecidomyiidae) on *Machilus* spp. (Lauraceae) are common in Taiwan, yet only five species, four leaf-gall inducers and one stem-gall inducer on *M. thunbergii*, have been named in the past. Here we describe a new species, *Daphnephila urnicola* sp. nov. Chiang, Yang & Tokuda, inducing urn-shaped galls on leaves of both *M. zuihoensis* and *M. mushaensis*. Comparisons of *D. urnicola* populations on *M. zuihoensis* and on *M. mushaensis*, indicate that they belong to one species, a result supported by gall midge morphology, life-history traits, gall shape and structure, the developmental process of gall tissues, fungal associations, and DNA-sequencing data. Size and structure of the gall operculum was found to differ between *M. zuihoensis* and *M. mushahaensis*.

Key words: fungus, gall tissue, life cycle, mycangia, parasitoid

Introduction

Daphnephila Kieffer (Diptera: Cecidomyiidae) species in Taiwan induce at least 43 different sorts of galls, which can be placed into eight groups based on gall morphology, on eight species of *Machilus* (Lauraceae) (Yang & Tung 1998; Tung *et al.* 2006; Chiang & Yang unpublished data). This is currently considered to be the most diverse genus of gall-inducing insects in Taiwan (Yang & Tung 1998; Tung *et al.* 2006). However, only five of the species have been described, all from *Machilus thunbergii* Sieb & Zucc., including four leaf- and one stem-gall inducing taxa (Yang & Tung 1998; Tung *et al.* 2006; Tokuda *et al.* 2008; Gagné & Jaschhof 2014).

Daphnephila belongs to Asphondyliini, which usually induce ‘ambrosia galls’ with fungal hyphae growing around the inside of larval chambers within galls (Bissett & Borkent 1988; Bronner 1992; Carroll 1992; Rohfritsch 2008). Galls induced by species of *Daphnephila* on the leaves of *M. thunbergii* in Taiwan develop a well-defined nutritive tissue with fungal hyphae occurring among the cells of those tissues (Chen & Yang 2008; Chao & Liao 2013). The commonly occurring fungus in such ambrosia galls is *Botryosphaeria dothidea* (Ascomycota: Botryosphaeriales: Botryosphaeriaceae), a common gall endophyte recorded in France, Canada, USA, South Africa, Australia and Japan (Bissett & Borkent 1988; Bronner 1992; Rohfritsch 1992, 2008; Adair *et al.* 2009; Kobune *et al.* 2012). In addition to *B. dothidea*, four other fungal genera isolated from galls, *Epicoccum*, *Alternaria*, *Phoma* and *Fusarium*, have been reported (Adair *et al.* 2009).

Besides the five *Daphnephila* in Taiwan, there are three named species in India and one in Japan (Kieffer 1905;