Description, host range and distribution of a new Macrodiplosis species (Diptera: Cecidomyiidae) that induces leaf-margin fold galls on deciduous Quercus (Fagaceae) with comparative notes on Palaearctic congeners

WANGGYU KIM¹, JUNICHI YUKAWA¹, KEITH M HARRIS², TSUNEKO MINAMI³, KAZUNORI MATSUO¹ & MALGORZATA SKRZYPCZYŃSKA⁴

¹Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan. E-mail: kincho3@gmail.com
²81 Linden Way, Ripley, Woking, Surrey, UK
³Asahikawa-shi, Hokkaido, Japan
⁴Agricultural University of Cracow, Poland

Abstract

A gall midge that induces upwardly folded leaf-margin galls on Quercus serrata, Q. mongolica and Q. dentata (Fagaceae) in Japan and South Korea is described as Macrodiplosis selenis sp. n. (Diptera: Cecidomyiidae). M. selenis is distinguished from Palaearctic congeners by a combination of morphological characters. Genetic differences supported the result of morphological comparison and indicated that M. selenis is closely related to the European M. roboris, whose gall is similar to that of M. selenis.

Key words: DNA Barcode, eastern Palaearctic Region, identification

Introduction

Quercus (Linnaeus 1753) is a large genus in the family Fagaceae, consisting of at least 600 species in the Holarctic and Oriental Regions (Mabberley 1997). Various insects induce galls on Quercus, and cynipids (Hymenoptera) are the most abundant (e.g., Felt 1965; Yukawa & Masuda 1996; Abe et al. 2007). Species of gall midges (Diptera: Cecidomyiidae) that induce galls on Quercus are fewer in number than cynipids, 45 and 43 species having been recorded from the Palaearctic and the Nearctic Region, respectively (Gagné & Jaschhof 2014). Among gall midges, the genus Macrodiplosis Kieffer, 1895 is one of the main gall inducers on Quercus. Four Palaearctic and nine Nearctic species of Macrodiplosis have been previously described.

Monzen (1932) recorded an upwardly folded leaf-margin gall on Quercus serrata Murray from Mt. Hayachine and Morioka City, Iwate Prefecture, Japan. He thought that the gall was likely induced by Macrodiplosis volvens Kieffer, 1895, (now synonymized with M. roboris Hardy, 1854), but he did not definitively identify the gall inducer. Later, Shinji (1944) attributed the upwardly folded leaf-margin gall on Q. serrata to Silvestrina quercifoliae Shinji. However, since species of Silvestrina are known to be predators on mites or other minute arthropods (e.g., Gagné & Jaschhof 2014) his assumption was incorrect.

In 2011, upwardly folded leaf-margin galls were rediscovered on Q. serrata (Fig. 1) and Q. dentata (Fig. 2) in Fukuoka Prefecture, Japan, and subsequently on Q. mongolica (Fig. 3) in Hokkaido, Nagano and Fukuoka Prefectures. In 2012 and 2013, the same sort of gall was also found on Q. serrata in Ibaraki, Hyogo, Kagawa and...
Discussion

Identification of the species. The percent divergence in COI sequences between *M. selenis* and other Palaearctic congeners were from 6.5 to 8.7%, which are distinctly higher than the 2% divergence proposed by Hebert *et al.* (2003) as an acceptable distance to consider two closely related entities as distinct species. Thus, the genetic analyses supported the morphological identification of *M. selenis*, indicating its occurrence in Japan and South Korea, and determining its host range (Fig. 34).

The analysis also indicates the existence of another species, *Macrodiplosis* sp. 2, which induces folded leaf-margin galls (downward type) on *Q. dentata* and *Q. mongolica* in Hokkaido and Miyazaki Prefecture, Japan. During the course of this study, we reared only a single male of *Macrodiplosis* sp. 2, terminalia of which are rather similar to those of *M. roboris* and *M. selenis* but distinctly different from those of *M. flexa* in the Russian Far East (cf. Fig. 18 in Kovalev 1972). *Macrodiplosis* sp. 2 will be described as a new species when more adults are obtained.

Various phylogenetic and evolutionary studies have demonstrated that gall shape and structure are ‘extended phenotypes’ of gall-inducing insects (e.g., Fukatsu *et al.* 1994; Stern 1995; Stone & Cook 1998; Nyman *et al.* 2000). The current genetic analysis also demonstrated that *M. selenis* and *M. roboris*, which share a similar gall shape (Figs 1, 5), are more closely related to each other than to other congeners with different gall shapes (Figs 34–35). Considerable genetic differences indicate that Palaearctic species have diverged widely from Nearctic species, with accompanying diversification of gall shape and structure.

These previously unreported molecular sequences will be helpful in identifying *Macrodiplosis* species, particularly when only larval specimens are available.

Host range and geographical distribution. The current study supports the previously known host range of *Macrodiplosis*, which is associated only with the genus *Quercus* in the Holarctic Region. This suggests possible species diversification of *Macrodiplosis* on a single host plant genus, as has been noted for other cecidomyiid genera (e.g., Skuhravá 1986; Roskam 1992; Yukawa *et al.* 2005; Gagné & Jaschhof 2014; Tokuda 2012; Gagné & Moser 2013). Information on geographical distribution is still limited, but collecting records from Hokkaido, Honshu, Shikoku, and Kyushu, Japan and Gyeongsangbukdo, South Korea indicate that *M. selenis* is widely distributed in Japan and Korea, suggesting possible occurrence in China and the Russian Far East. However, its distribution may not extend to the Oriental Region, as no galls of *Macrodiplosis* species have yet been found on evergreen *Quercus* species in southern Japan and southeastern Asia.

Acknowledgements

We express our sincere gratitude to R.J. Gagné (Systematic Entomology Laboratory, USDA) for reviewing an early draft of this paper and for providing us with specimens of Nearctic *Macrodiplosis*. We also thank C. Borkent, P. Kolesik and one anonymous referee for their valuable comments on the manuscript. We are very grateful to K. Matsunaga (Chikushino City), N. Gyotoku (Kurume City), M. Tokuda (Saga University), J.C. Paik (Sunchon National University, South Korea) and J. Moser (Southern Research Station of USDA Forest Service) for their support in collecting galls and larval specimens. We extend our hearty thanks to T. Hirowatari (Kyushu University) for his valuable comments on the draft and to M. Maruyama (Kyushu University Museum) for his help in genetic analysis. Our thanks are due to the following colleagues for their distributional information on *Macrodiplosis* species: N. Kaiwa, A. Nagai, S. Yamauchi and H. Yoshimura, H. Im, and O. Ji. J.Y. thanks the late E. Möhn for allowing him to examine the cecidomyiid collection of E.H. Rübsaamen in Staatliches Museum für Naturkunde in Stuttgart. W.K. thanks O. Tadauchi, Y. Abe, S. Kamitani and D. Yamaguchi (Kyushu University) for their continuous guidance and encouragement. This is a contribution from the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka (series 7, No. 6).

References


http://dx.doi.org/10.1093/molbev/msr121


http://dx.doi.org/10.1111/j.1479-8298.2012.00539.x


http://dx.doi.org/10.1303/aez.2009.655


http://dx.doi.org/10.1079/ber2002218


http://dx.doi.org/10.1016/j.baae.2005.07.004