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Parasitoids of Dipteran leafminers, *Diglyphus* spp. (Insecta: Hymenoptera: Eulophidae)[1]

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Introduction

Diglyphus spp. wasps are promising biological control agents for agromyzid leafminers (Diptera: Agromyzidae). The species occurring in North America are *Diglyphus isaea* (Walker), *D. begini* (Ashmead), *D. websteri* (Crawford), *D. intermedius* (Girault), *D. pulchripes* (Crawford), and *D. carlylei* (Girault) (Lasalle and Parrela 1991; Stegmaier 1972).

Distribution

This genus of leafminer parasitoids occurs widely in Asia, Europe, North America, New Zealand, and Northern Africa (Minkenberg 1989).

Description

Adult

The adult parasitoid is a tiny wasp 1.5–2 mm long, depending on the species. The head, thorax and dorsal abdomen are generally metallic green in color, while the eyes are red. The scutellum has two pairs of setae, a submarginal vein with more than two dorsal setae, and the funicle is 2-segmented (Lasalle and Parrell 1991)



Figure 1. Adult *Diglyphus* sp. on a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS



Figure 2. Adult *Diglyphus* sp. on a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS

Egg

The adult female *Diglyphus* parasitoid stings the dipteran host larva to paralyze it. Then the female may lay one or more eggs on the late instar leafminer larva (Minkenberg 1986).

Larva

The parasitoid larva has three instar stages. The first instar larva is transparent, whereas second and third instars are yellowish. The parasitoid larva feeds externally on the leafminer larva, eventually killing the host. The parasitoid larva then pupates in the leaf mine before emerging as an adult. The development time is temperature dependent. *Diglyphus isaea* takes about 10 days at 25°C for complete development on both the American serpentine leafminer, *Liriomyza trifolii;* and the pea leafminer, *L. huidobrensis* (Bazzocchi et al. 2003).



Figure 3. *Diglyphus* sp. larvae, 1st, 2nd, and 3rd instar respectively left to right. The larvae were removed from the mine of a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS



Figure 4. Parasitoid *Diglyphus* sp. larva (top) feeding on a leafminer larva. The larva was removed from the mine of a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS



Figure 5. Two parasitoid *Diglyphus* sp. larvae (one is feeding horizontally on top, the second is positioned vertically to the right side of the larger host larva) feeding on a leafminer larva. The larvae were removed from the mine of a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS

Pupa

The third instar larva pupates in the leaf mine. The pupa is initially both transparent and light green, but eventually turns black.



Figure 6. Early stage of pupa of a *Diglyphus* sp. showing transparent and light green color, and red eyes (on right). The pupa was removed from the mine of a bean leaf. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS



Figure 7. Late stage of pupae of *Diglyphus* spp. turn black in color. In this image the head is to the right. Larvae in this genus are external parasitoids of dipteran leafminers.
Credit: Jian Li, UF/IFAS

Hosts

Diglyphus spp. are primary ectoparasitoids of dipteran leafminers in the family Agromyzidae. However, a *Diglyphus* sp. was also recorded parasitizing Lepidoptera (Lyonetiidae) larvae (Boucek and Askew 1968).

Economic Importance

Augmentative release of commercial *Diglyphus* spp. is used for controlling leafminers in greenhouses in North America and Europe. Bazzocchi et al. (2003) indicated that *D. isaea* parasitized at least 18 different agromyzid species. *Diglyphis isaea* is the most effective commercial biological control product for controlling the American serpentine leafminer, *Liriomyza trifolii*; the pea leafminer, *L. huidobrensis*; *L. bryoniae*; and the chrysanthemum leafminer, *Phytomyza syngenesiae* (Syngenta-bioline). Lasalle and Parrella (1991) indicated that *D. begini* also parasitizes *L. trifolii*, *L. huidobrensis* and *L. bryoniae* in North America. Kaspi and Parrella (2005) reported that the insecticide Abamectin has little impact on *D. isaea* adults or the larvae within the leaf mines of chrysanthemums.

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