

Taxonomic Notes on *Gronottoma* (Hymenoptera :
Eucoilidae) Parasitic on the Serpentine
Leafminer, *Liriomyza trifolii* (Diptera :
Agromyzidae)

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**Taxonomic Notes on *Gronotoma* (Hymenoptera: Eucoilidae)
Parasitic on the Serpentine Leafminer, *Liriomyza trifolii*
(Diptera: Agromyzidae)**

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Abstract. The parasitoid *Gronotoma micromorpha* is redescribed and the male of *G. guamensis* is described. *Gronotoma guamensis* is newly recorded from Honshu, Kyushu and Amami-oshima Is., Japan, and from Pingtung Hsien, Taiwan. *Gronotoma micromorpha* resembles *G. guamensis*, but they can be distinguished from each other by the structure of the antenna and mesosoma.

Key words: parasitoid, biological control, description, distribution.

Introduction

The serpentine leafminer, *Liriomyza trifolii* (Burgess), is well known as a serious pest of vegetables and ornamentals throughout the world (Spencer, 1990). This leafminer has developed resistance to insecticides (Spencer, 1990), so that biological control using parasitoids is even more important to combat the pest (Rathman *et al.*, 1991).

In 1990, *L. trifolii* was recorded in Japan for the first time in Shizuoka Prefecture (Saito, 1992). It then spread rapidly throughout Japan, and invaded Okinawa mainland in 1993 (Saito, 1997). The spread of *L. trifolii* has undoubtedly been augmented by human agency through the movement of infested plants rather than its own dispersive ability.

The family Eucolidae consists of parasitoids of the Cyclorrhapha including Agromyzidae. Four eucolids, *Gronotoma micromorpha* (Perkins), *Gronotoma guamensis* (Yoshimoto), *Ganaspidium utilis* Beardsley and *Disorygma pacifica* (Yoshimoto), are known to be parasitoids of *L. trifolii* in subtropical regions (Schreiner *et al.*, 1986; Beardsley, 1988; Konishi, 1998).

Members of the genus *Gronotoma* are parasitoids of Agromyzidae (Buffington, 2002). Some species of this genus have been known to parasitize serious pests of Agromyzidae in the subtropics. Abe & Konishi (1995) described *Gronotoma hiranoi* Abe et Konishi and recorded *G. adachiae* Beardsley as parasitoids of the major soybean pest *Melanagromyza sojae* (Zehntner) from Indonesia. Independently, Van den Berg *et al.* (1995) revealed that *Gronotoma* sp. is most prevalent among the hymenopterous parasitoids of the pest in Indonesia. This *Gronotoma* species is probably *G. hiranoi* or *G. adachiae*. Furthermore, in Guam, *G. micromorpha* is a dominant parasitoid of *L. trifolii* on cole crops and cucurbits (Johnson, 1993). Also, *G. micromorpha* seems to be predominantly parasitic on *L. trifolii* on Okinawa mainland (Konishi, 1998).

Gronotoma micromorpha was described by Perkins (1910) under the name *Eucoilidea micromorpha* from Hawaii. As the original description was too brief, Yoshimoto (1962) redescribed it, but also described *Eucoilidea rufula* from Hawaii. However, Beardsley (1988) synonymized *E. rufula* with *E. micromorpha*, and transferred this species to the genus *Gronotoma*.

Eucoilidea Ashmead 1887 was synonymized with *Gronotoma* Förster 1869 by Hedicke (1930), but his treatment was not followed by Yoshimoto (1962), Burks (1979) or Quinlan (1986). However, Nordlander (personal communication cited by Beardsley, 1988) confirmed Hedicke's treatment as a result of comparison between the type species of both genera. Buffington (2002) formally documented the synonymy of *Eucoilidea* with *Gronotoma*.

Gronotoma micromorpha is an egg-pupal and larval-pupal parasitoid (Abe, 2001), and this species reproduces thelytokously (Arakaki & Kinjo, 1998). Moreover, the daily progeny production and thermal influence on development and adult longevity of this parasitoid were verified (Abe & Tahara, 2003). These studies indicate that *G. micromorpha* is amenable to mass production and can be used as a biological control agent for *L. trifolii* (Abe & Tahara, 2003). In order to clarify the validity of *G. micromorpha* as a biological control agent for *L. trifolii*, it is necessary to identify this species correctly. Therefore, we redescribe *G. micromorpha* and confirm the junior synonym of *E. rufula* in the present paper. Furthermore, the diagnostic characteristics are presented to distinguish *G. micromorpha* from the closely similar species *G. guamensis*.

Materials and Methods

The holotypes of *G. micromorpha*, *E. rufula* and *G. guamensis*, which are dry-mounted and preserved in Bishop Museum, were examined.

Other examined dry-mounted specimens of *G. micromorpha* were reared from *L. trifolii* collected in Haeburu-cho and Itoman City, Okinawa mainland, Japan. The data of the *G. micromorpha* specimens collected by Mrs. K. Kinjo from Haeburu-cho in 1995 are as follows: 1 female, 24. V; 16 females, 12. VI; 1 female, 29. VI. Five females were collected by the first author from Itoman City on 27 October 1997.

The *G. micromorpha* specimens immersed in ethanol were also examined. They were collected by Dr. N. Arakaki from Okinawa mainland, Miyako Is. and Ishigaki Is., Japan. The specimens of the Okinawa mainland population were reared from *L. trifolii* on *Phaseolus vulgaris* collected in the Okinawa Prefectural Agricultural Experiment Station as follows: 3 females, XI. 1996; 3 females, I. 1997; 13 females, II. 1997; 1 female, III. 1997; 3 females, IV. 1997. Moreover, 1 female was reared from *L. trifolii* on *P. vulgaris* collected in Hirara City, Miyako Is. on 16 December 1997, and 1 female was from the same host species on tomato in Kawahara, Ishigaki Is. on 18 December 1997. Further, Dr. N. Arakaki fed a female of the Okinawa mainland population with antibiotic (tetracycline), and the female produced male progeny. Three males preserved in ethanol were also examined.

Other examined dry specimens of *G. guamensis* were collected from Japan except one female from Taiwan. The collection data are as follows: 1 female, Kentin Park, Pingtung Hsien, Taiwan, 14. III. 1968, Y. Arita; 1 female, Yona, Okinawa mainland, 18. X. 1963, Y. Hirashima; 1 female, same locality, 19. X. 1963, S. Miyamoto; 2 females, Hatsuno, Amami-oshima, Kagoshima Pref., 11. XI. 1962, A. Azim; 3 males, Mt. Hiko-san, Fukuoka Pref., 18. VII. 1968, K. Kanmiya; 1 female, same locality and collector, 20. IX. 1969; 1 female, same locality, 2. VII. 1970, K. Nozato; 1 female, same locality and collector, 8. VII. 1970; 1 female, same locality, 31. V. 1971, K. Takeno; 1 female, Kamiozoegawa, Fuji, Saga Pref., 4. VII. 1973, K. Yamagishi; 1 female, Kooridono, Ojiya, Niigata Pref., 1. VIII. 1970, K. Yamagishi; 1 female, same locality and collector, 9. VIII. 1970.

External structure of the specimens which were collected from Okinawa mainland and are preserved in the Okinawa Prefectural Agricultural Experiment Station was examined with an Olympus SZ-ST stereo microscope, and that of other specimens was examined with a Nikon SMZ stereo microscope. One female specimen of *G. micromorpha* was gold coated with a sputter coater and examined with a JSM-5510LV scanning electron microscope.

Gronotoma micromorpha (Perkins, 1910)

(Fig. 1)

Eucoilidea micromorpha Perkins 1910, Fauna Hawaiiensis, 2(4): 676 (type locality: Oahu, Hawaii); Yoshimoto 1962, Pacif. Insects, 4: 844; Schreiner *et al.* 1986, Tropical Pest Management 32: 335 (Guam).

Eucoilidea rufula Yoshimoto 1962, Pacif. Insects, 4: 845 (type locality: Oahu, Hawaii); Yoshimoto 1963, Pacif. Insects, 5: 443 (Tahiti).

Gronotoma micromorpha: Beardsley 1988, Proc. Hawaii. Entomol. Soc., 28: 38 (Florida); Arakaki & Kinjo 1998, Appl. Entomol. Zool., 33: 579 (Okinawa mainland, Miyako Is., Ishigaki Is., Japan)

Female holotype.

Forewing length 1.3 mm. Body almost smooth and bare. Head, mesosoma and metasoma reddish brown; antennae, mandibles, palpi, tegulae and legs more or less yellowish brown.

Head slightly wider than mesosoma in dorsal view. Antenna 13-segmented; relative lengths of flagellar segments 1-11: 15, 16, 17, 17, 16, 16, 15, 15, 15, 14, 19. Face, clypeus, malar space and occiput with sparse setae; malar space with two striations parallel and close to malar suture.

Pronotum setose; pronotal plate distinct, posterior margin of pronotum weakly concave, two foveae on either side of medial bridge open; outer pronotal plate (lateral flat area on either side of pronotal plate) marked by a distinct ridge laterally and posteriorly; lateral portion of pronotum crenulate along outer margin of outer pronotal plate. Notauli distinct, with sparse setae, convergent posteriorly but separated by a carina. Coalesced series of crenulations present along lateral margins of mesoscutum, sparsely setose. Anteromedian and parapsidal lines absent. Scutellum with two foveae at base; apical four-fifths of scutellar cup with a large depression which has a large pit in the center, margin of depression with about 10 small pits, each small pit bearing a very short fine seta; scutellar disc punctate-reticulate, setose, apically with long setae, apex of disc not overlapped by scutellar cup. Mesopleural suture distinct; subalar triangle unstriated and with a few setae. Metapleuron pubescent. Propodeum pubescent; lateral propodeal carinae weakly bowed medially in dorsal view; area between carinae narrower in lower portion.

Marginal cell of forewing elongate, closed on wing margin, M and Rs + M weakly indicated, wing surface closely ciliated.

Metasomal tergite 2 with sparse setae basolaterally, enclosing posterior segments.

Male.

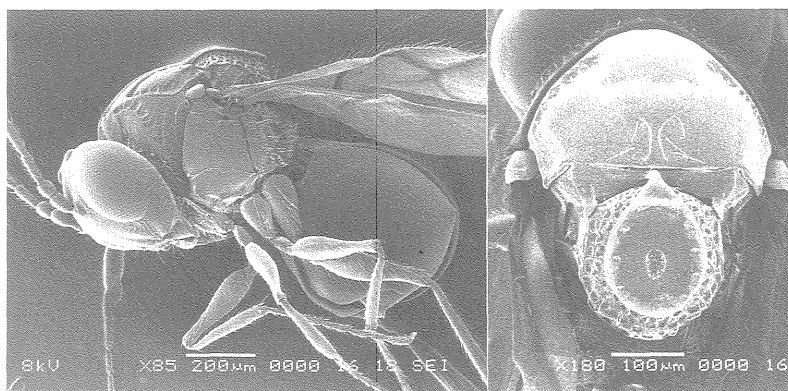


Fig. 1. *Gronotoma micromorpha*, female. Left: head, mesosoma and metasoma (lateral aspect); right: mesosoma (dorsal aspect).

Differs from the holotype as follows. Head and mesosoma black; metasoma dark brown. Antenna 15-segmented; relative lengths of flagellar segments 1-13: 20, 15, 16, 16, 16, 16, 16, 15, 15, 15, 15, 17. The flagellar segment 1 incised on outer margin. Metasomal tergite 2 largest, but tergites 3, 4 and 5 visible.

Geographical distribution. Japan (Okinawa mainland, Miyako Is., Ishigaki Is.); Hawaii (Maui, Molokai, Oahu); Guam; Florida; Tahiti.

Variation. The body of the holotype of *E. rufula* is also reddish brown, but the head and mesosoma are black and the metasoma is dark brown in the *G. micromorpha* specimens from Japan. Two or three striations exist parallel and close to the malar suture in the Japanese specimens, as Beardsley (1988) showed in the Hawaii, Guam and Florida populations.

Forewing length: 1.0-1.5 mm.

In females, metasomal tergite 2 has a transverse and very fine line or depression on the lateral portion in 11 of the 23 specimens of the Okinawa mainland population of *G. micromorpha*. The holotypes of *G. micromorpha* and *E. rufula* do not have such a line or depression. The line or depression suggests that the large metasomal tergite 2 was originally composed of two tergites.

Discussion. As a result of examination of the holotypes of *G. micromorpha* and *E. rufula*, we confirmed that the two are synonymous. The Japanese specimens examined correspond to the holotype of *G. micromorpha*. We found a difference in body coloration between them (see *Variation*), but we think that this difference does not have taxonomic value. Probably, the coloration of the holotype has changed after dry-mounting on the card.

In Japan, *G. micromorpha* has been reared from *L. trifolii* alone, but this agromyzid

leafminer is an immigrant. More work is needed to clarify the native host(s) of the Japanese population of *G. micromorpha*.

A total of 46 *G. micromorpha* specimens collected on Okinawa mainland were all females. Arakaki *et al.* (2001) indicated that *Wolbachia* infection induces thelytoky in the Okinawa mainland population of *G. micromorpha*. Yoshimoto (1962) recorded a male of *G. micromorpha* under the name *Eucoilidea micromorpha* from Oahu, Hawaii. Further investigation is needed to clarify the sex ratio, the mode of reproduction and the rate of *Wolbachia* infection in the Oahu population of *G. micromorpha*.

Gronotoma guamensis (Yoshimoto)

Eucoilidea guamensis Yoshimoto 1962, Insects of Micronesia, 19: 107 (type locality: Guam); Yoshimoto & Yasumatsu 1965, Pacif. Insects, 7: 660 (Okinawa mainland and Ishigaki Is., Japan)

Gronotoma guamensis: Buffington 2002, Proc. Entomol. Soc. Wash., 104: 598.

Diagnosis. The holotype female of *G. guamensis* resembles, in general appearance, the examined *G. micromorpha* specimens including the holotype female. However, female *G. guamensis* is distinguished from female *G. micromorpha* by the following seven character-states: 1) the flagellar segment 1 is straight in *G. micromorpha* but is weakly incised on outer margin in *G. guamensis*; 2) the flagellar segment 3 is slightly longer than the flagellar segment 2 in *G. micromorpha*, but shorter in *G. guamensis*; 3) the mesosomal setae in *G. micromorpha* are shorter and sparser than those in *G. guamensis*; 4) the scutellar cup does not extend to the apex of the disc in *G. micromorpha* but does extend to the apex in *G. guamensis*; 5) the margin of the depression on the scutellar cup has about 10 small pits in *G. micromorpha*, but does have about 20 in *G. guamensis*; 6) the scutellar cup is 1.4-1.5 times as long as wide in *G. micromorpha*, but is 1.8 times as long as wide in *G. guamensis*; 7) the propodeal carinae are not medially protrudent in lateral view in *G. micromorpha*, but medially protrudent in *G. guamensis*.

Male.

Differs from female as follows. Antenna 15-segmented; relative lengths of flagellar segments 1-13: 16, 10, 10, 10, 10, 9, 9, 9, 8, 8, 8, 7, 8; flagellar segment 1 strongly incised on outer margin.

Geographical distribution. Japan (Honshu, Kyushu, Amami-oshima, **new distributional records**; Okinawa mainland, Ishigaki Is.); Taiwan (Pingtung Hsien), **new distributional record**; Guam.

Variation. The relative lengths of flagellar segments 1-3: 5, 6, 5 in the holotype, but

they are equal or becoming slightly shorter apically in females from Japan and Taiwan.

Discussion. As a result of examination of the holotype, we confirmed that this species belongs to *Gronotoma* on the basis of the structure of the pronotum, the distinct notauli, the large scutellar cup and the absence of a hairy ring at the base of metasomal tergite 2. Gum adheres to the mesoscutum and scutellum of the holotype, and the gum was also illustrated in the figure of the original description. The figure of *G. guamensis* was redrawn by Yoshimoto & Yasumatsu (1965).

Gronotoma guamensis is known to be parasitic on *L. trifolii* infesting yard-long bean *Vigna unguiculata* on Guam (Schreiner *et al.*, 1986), suggesting that the Guam population of this wasp inhabits open habitats. Parasitoid fauna attacking *L. trifolii* was studied in Japan (Konishi, 1998) and Taiwan (Lin & Wang, 1992), but this wasp has not been reared from *L. trifolii*. The host(s) of *G. guamensis* is unknown in Japan and Taiwan. The localities of collection suggest that the Japanese and Taiwanese populations do not inhabit open habitats. The taxonomic value of the slight morphological difference (see *Variation*) is uncertain, so that the individuals from Japan and Taiwan are tentatively included in *G. guamensis* in the present paper.

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