A NEW SPECIES OF *MEGASTIGMUS* (HYMENOPTERA: TORYMIDAE: MEGASTIGMINAE) FROM CHINA

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ABSTRACT: In this paper a new parasitoid *Megastigmus* Dalman, 1820 (Hymenoptera: Chalcidoidea: Torymidae: Megastigminae) species was described in the subgenus *Torymus*, associated with the gall-forming *Leptocybe invasa* Fisher & La Salle (Hymenoptera: Eulophidae) in eucalypt plantations in Sichuan Province, China.

KEY WORDS: Chalcidoidea, *Eucalyptus camaldulensis*, China, galls, gall wasp entomophagous

Megastigmus (Hymenoptera: Chalcidoidea: Torymidae) was described by Dalman (1820) as the subgenus *Torymus* Dalman with its type species being *Pteromalus bipunctatus* Swederus, 1795. Later, *Megastigmus* was recorded as a valid genus by several authors (Curtis, 1829; Walker, 1833; Dalla-Torre, 1898; Ashmead, 1900, 1904). Crosby (1913) designated its type species as *P. bipunctatus*. Boucek (1988) keyed out *Megastigmus* in the Subfamily Megastigminae, and provided the diagnostic characters of the genus, stated that the genus contains 44 species in Australia, 35 spp. from Holarctic region in America south only to Mexico, but about 3 spp. are present in the Old World in eastern and southern Africa, while South Asia has at least 15 spp., and 1 species is found on Fiji. Grissell (1999) listed 133 world species with 5 subspecies of *Megastigmus* including 9 species of *Bootanomyia*, and gave their synonyms, distributions and literature references, and stated that 19 keys to the species of *Megastigmus* were provided by several authors in the world. Roques & Skrzypczynska (2003) studied the native and introduced species of the European phytophagous *Megastigmus*, and provided an identification key to the species. Grissell (2006) described a new species, *Megastigmus zebrinus* Gissell that galls seed capsules of *Eucalyptus camaldulensis* Dehnhardt (Myrtales: Myrtaceae) from South Africa and Australia. Noyes (2012) listed 140 world species of *Megastigmus* and gave their synonyms, distributions and literature lists. Doğanlar & Hassan (2010) studied the species of *Megastigmus* related with *Eucalyptus* from all over the world, described some new species from the Palearctic region and Australia, and Doğanlar (2015) provided an identification key for the species of *Megastigmus* associated with *Eucalyptus*.

Up to now, 15 species of *Megastigmus* have been recorded from China by several works (Crosby, 1913; Yano, 1918; Hussey & Kamijo, 1958; Yasumatsu & Kamijo, 1979; Sheng, 1989; Xu & He, 1989, 1995, 1998, 2003; Roques & Sun, 1995; Noyes, 2016), but 3 of them, *Megastigmus maculipennis* (Yasumatsu &

Kamijo, 1979), *M. nipponicus* (Yasumatsu & Kamijo, 1979), *M.* zhaoi (Xu & He, 2003), were tranferred to *Bootanomyia* Girault by Doğanlar (2012). Twelve species are phytophagous, mainly on seeds of Pinaceae, except one of them, *Megastigmus sinensis* (Sheng, 1989).

Recently, some specimens of *Megastigmus* sp. was reared from the galls, formed by *Leptocybe invasa* Fisher & La Salle (Hymenoptera: Eulophidae), on *Eucalyptus camaldulensis* in China, in July, 2016. They were sent to the first author for identification, and it was described as a new species for science, and as a new record for China as a natural enemy of *L. invasa*.

MATERIAL AND METHODS

The type specimens of the new species were obtained from mature galls of *L. invasa* on *E. camaldulensis* leaves and stems, which were collected in Xiashagou Village (101° 75' E, 26° 49' N), Renhe Town, Panzhihua City, Sichuan Province, China by the last author (X-L Z) in July 27, 2016. Morphological terminology follows Roques & Skrzypczynska (2003), Doğanlar & Hassan (2010) and Doğanlar (2015).

Antennae of the holotype and some parts of the male and female paratypes was slide-mounted in Canada balsam. The holotype and the paratypes were deposited in the Insect Collection of Department of Plant Protection, College of Agriculture, Guangxi University, Nanning 530004, P.R. China. Photographs of diagnostic characters of the new species were taken by a digital camera attached to a stereo-microscope, and some of them by SEM (SU8020 10.0 kV).

RESULTS AND DISCUSSION

Megastigmus sichuanensis Doğanlar & Zheng sp. n.

(Figs. 1a-g; Figs. 2a-d; Figs. 3a-f; Figs. 4a-d)

Description of Female. Length (body + ovipositor): 1.63 + 1.2 mm. Colour: Body (Fig. 1a, b) yellow, except around ocelli, some sutures of mesosoma pale yellow, first tergum of metasoma dorsally with apical 1/3 and brown, ovipositor black. Wigs hyaline, veins yellow, prestigma and stigma dark brown. Pilosity of body pale, having black base, pretarsi black.

Morphology: Head (Figs. 1a,b; Figs. 2a,b) with fine longitudinal striae, face smooth. Antennae inserted slightly above lower ocular line. Relative measurements: head width 22, height 22, dorsal length 18, frons width 8; eye in frontal view 7; MOL 3; OOL 4, POL 7, Odia 2.5, eye 12: 10, malar space 6; TO 2, TCly 5; Temple 2, eye in dorsal view 7; flagellum with pedicel 25. Antennae (Fig. 1d; Figs. 2a,b) clavate, flagellar segments transverse, in same length, except first 1.2 × longer than broad, and distinctly widening, 7th 1.8x broader than F1; combined length of flagellum with pedicellus 1.2x longer than width of head and 2.4 × transverse diameter of eye. Scape with 2-3 rows of setae dorsally, nearly cylindrical, slightly broder medially, 3.7 × as long as broad, and as long as transverse diameter of eye. Relative measurements of antenna (l:w): scape 56: 15, pedicellus 22: 13, anellus 5: 8, F1 12: 10; F2 8: 12; F3 9: 13; F4 8:13; F5 8: 14; F6 10: 16; F7 10: 18, club 37: 20 (C1 12, C2 14, C3 11). Sensillae on flagellum long and sparse, with 2-3 longitudinal linear sensillae in a row. Club slightly shorter than 4 preceding segments combined, 1.85× as long as broad, ventrally without micropilosity. Mesosoma (Figs. 1a,b) 2.1 × as long as mesoscutum broad, as broad as height; pronotum about 1.25 × as long as broad; mesonotum about 1.42 × as

broad as long, with fine transverse striae, 3-4 pairs of setae, along deep notauli; scutellum (Figs. 1a-b; Fig. 2c) as long as broad, with fine transverse striae, frenal groove indistinct, frenum almost smooth, scutellum with 2 pairs of setae on each sides basaly. Forewing (Fig. 1d) 2.3 × as long as broad, costal cell bare in basal half, apically with 2 rows of sparse hairs, speculum broad, closed below, basal and cubital veins with 5-6 hairs, basal cell almost bare, open, with a few minute setae in basal half, with two setae apically. Stigma (Figs. 1d-f) 1.4x as long as width. Relative measurements of forewing: costal cell 38: 3; parastigma 11, marginal vein 16, post marginal vein 13, stigmal vein 2, stigma (l: w) 7: 5, uncus 2. Hind wing 4.6 × as long as broad. Hind coxae (Fig. 1g) dorsally with 3-4 setae. Propodeum (Figs. 2c,d) 0.7 × as long as scutellum, about as long as distance between inner edges of spiracles, median carina distinct in apical half, plicae slightly indicated, mainly smooth, broadly wrinkled basally between spiracles, the latter distinctly separated from posterior margin of metanotum. Metasoma (Fig. 1a) almost as long as mesosoma, broad, 1.8 × as long as broad, its dorsal surface finely striated. Ovipositor sheath 1.6 × as long as metasoma, 3.3 × as long as hind tibia.

Male: (Figs. 3a-f; Figs. 4a-d). Similar to female except as follows: body (Figs. 3a,b) 1.6 mm, yellow excepts head and pronotum pale yellow; club black, metasoma with first tergite black. Relative measurements: head (Figs. 3a,b; Figs. 4a,b) width 55, height 45, dorsal length 27, frons width 25; eye in frontal view 17, transverse diameter of eye 17; MOL 4; OOL 3, POL 13, Odia 4, eye 24: 16, malar space 15; temple 8, eye in dorsal view 13; flagellum with pedicel 77. Antenna (Fig. 3c; Figs. 4a,b) slightly clavate, having pedicellus with flagellum 1.4 × as long as wide of head. Relative measurements of antenna (l: w): scape 17: 6, pedicel 9: 4, anellus 2: 1.5, F1 4:3; F2 3: 3; F3 3: 4; F4 3.5: 4; F5 4: 5; F6 4: 5; F7 4: 6; club 16: 6 (C1 4, C2 7, C3 5). Flagellum with erect, sparse setae. Club as long as 4 preceding segments combined, 2.67 × as long as broad. Forewing (Fig. 3d) 2.3x as long as width; stigma (Figs. 3d-f) 1.2x as long as width, upper and lower sides as fig. 2 e, f. Propodeum (Figs. 4c,d) with spiracle smaller than that of female, separated from metanotum by more than one and half of its own diameter. Metasoma (Figs. 3a,b) 0.75 × as long as mesosoma and 2.0 × as long as hind tibia.

Material Examined: HOLOTYPE female, CHINA: Xiashagou Village (101°75' E, 26°49' N), Renhe Town, Panzhihua City, Sichuan Province, leg. Dr. Xia-Lin Zheng. PARATYPES. 4 f and 5 m, same data as the holotype. The types are deposited in the Insect Collection of Department of Plant Protection, College of Agriculture, Guangxi University, Nanning 530004, P.R. China

Host: *Megastigmus sichuanensis* emerged from galls of *Leptocybe invasa* as noted by Dr. X.-L. Zheng.

Remarks. *Megastigmus sichuanensis* n.sp. is similar to *M. pretorianensis* Doğanlar, *M. judikingae* Doğanlar and Hassan and *M. zvimendeli* Doğanlar and Hassan in both sexes in having scutellum with two pairs of setae, but *M. sichuanensis* n.sp. differs from *M. pretorianensis* in having body yellow (in *M. pretorianensis* body in both sexes mostly black); the new species is also similar to *M. zvimendeli* in having body yellow, ovipositor sheath 1.6 × as long as metasoma, 3.3 × as long as hind tibia, but **in female** it differs from *M. zvimendeli* with mesosoma 2.1x as long as broad; antenna with flagellum distinctly clavate; F7 1.8x as wide as length and 1.75x as wide as F1; forewing with stigmal vein 0.29x as long as length of stigma; costal cell 12.6x as long as its

maximum width (in *M. zvimendeli* mesosoma 1.5x as long as width; antenna with flagellum slightly clavate; F7 1.16x as wide as length and 1.5x as wide as F1. Forewing with stigmal vein 0.19x as long as length of stigma; costal cell 7.0x as long as its maximum width). The new species is similar to *M. judikingae* in having mesosoma twice as long as broad, but it differs from *M. judikingae* in having ovipositor sheath 1.6 × as long as metasoma; pedicellus 1.7x as long as width; F7 1.8x broder than F1, 1.8x as broad as length; club as long as 4 preceding segments combined; metasoma almost as long as mesosoma; stigma 1.4x as long as width; stigmal vein 0.29x as long as length of stigma; parastigma 0.7x as long as marginal vein (in *M. judikingae* ovipositor sheath 1.3x as long as metasoma; pedicellus 2.33x as long as width; F7 1.92x broder than F1, 1.6x as broad as length; club as long as 3 preceding segments combined; metasoma 1.3x as long as mesosoma; stigma 1.55x as long as width; stigmal vein 0.21x as long as length of stigma; parastigma 0.6x as long as marginal vein). **In male,** *M. sichuanensis* n.sp. differs from *M. zvimendeli* and *M. judikingae* in having metasoma 0.75 × as long as mesosoma (in both species metasoma at least 0.88x as long as mesosoma) and pleural sutures, propodeum yellow, metasoma basally black, head 1.6x as wide as long (in *M. zvimendeli* pleural sutures, anterior half of propodeum medially, metasoma with tergum 4 black, flagellum brown; head 1. 41x as wide as long, and in *M. judikingae* head 1.53x as wide as long).

CONCLUSION

Chen & Gu (1999) stated that 207 local species of insects feeding on *Eucalyptus* were recorded in China, which belong 10 order and 50 genera. 149 species of them are widely distributed in Orient region, accounting for 71.98%, and 58 species across fauna, amount to 28.02%. Up to now, no pest insect with origin in China have been found. In order to protect the in break of the pest, it is necessary to conduct quarantine on pest of *Eucalyptus*. Xu et al. (2008) studied on the population regularity and spatial distribution pattern of *Leptocybe invasa* Fisher & La Salle (Hymenoptera: Eulophidae) at eucalyptus, and Zhao et al. (2008) studied on evaluation for the growth loss of eucalyptus caused by *Leptocybe invasa*. Wu et al. (2009) and Chen et al. (2009) stated *Leptocybe invasa,* a new invasive forest pest making galls on twigs and leaves of eucalyptus trees in China.

Chen et al. (2009) gave the first description of the male of *L. invasa* from China. The male of *L. invasa* has bee also found and described in Turkey by Doğanlar, O. (2005) and in India by Akhtar et al. (2012), and discussed its occurrence and pest status.

Further studies are necessary to determine the life cycle of this Chinian parasitoid species and its parasitization rates under laboratory and field conditions, as part of the effort to determine whether its use in a biocontrol program against *L. invasa* in eucalyptus plantations in China is feasible.

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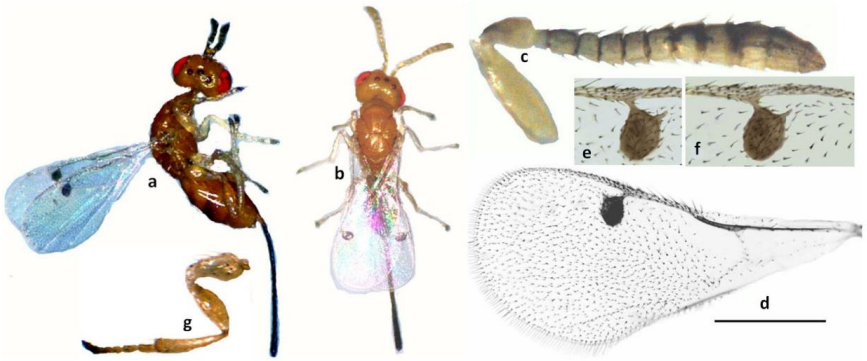

Figure 1. *M. sichuanensis* sp. nov. **a-g.** female. **a, b.** body, **a.** in lateral view; **b.** in dorsal view; *c.* antenna; **d.** forewing; **e, f.** stigma, **e.** in upper view; **f.** in lower view; **g.** hind leg. (Scale bar: for a, b = 0.95 mm; for = 0.15 mm; for d = 0.55 mm; for e, f= 0.27 mm; for g = 0.22 mm).

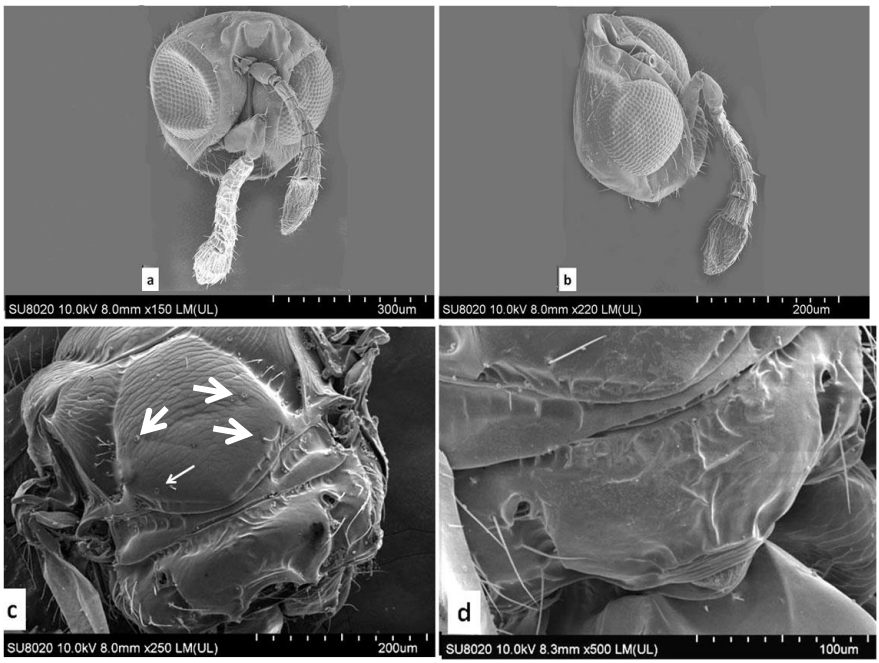

Figure 2. *M. sichuanensis* sp. nov. **a-d.** female. **a, b.** head, **a.** in front view, **b.** in lateral view; **c.** scutellum and propodeum; **d.** metanotum and propodeum.(Arrow states the base of setae).

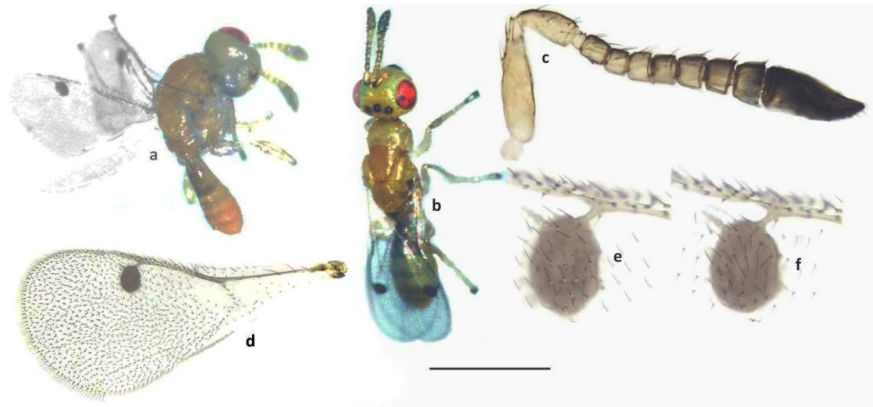

Figure 3. *M. sichuanensis* sp. n. male. **a, b.** body; **a.** in lateral view; **b**. in dorsal view; **c.** antenna; **d.** forewing; **e, f.** stigma; **e.** in upper view; **f.** in lower view. (Scale bar: for a, b= 0.97 mm; c = 0.52 mm; d = 0.5 mm; e, f = 0.28 mm).

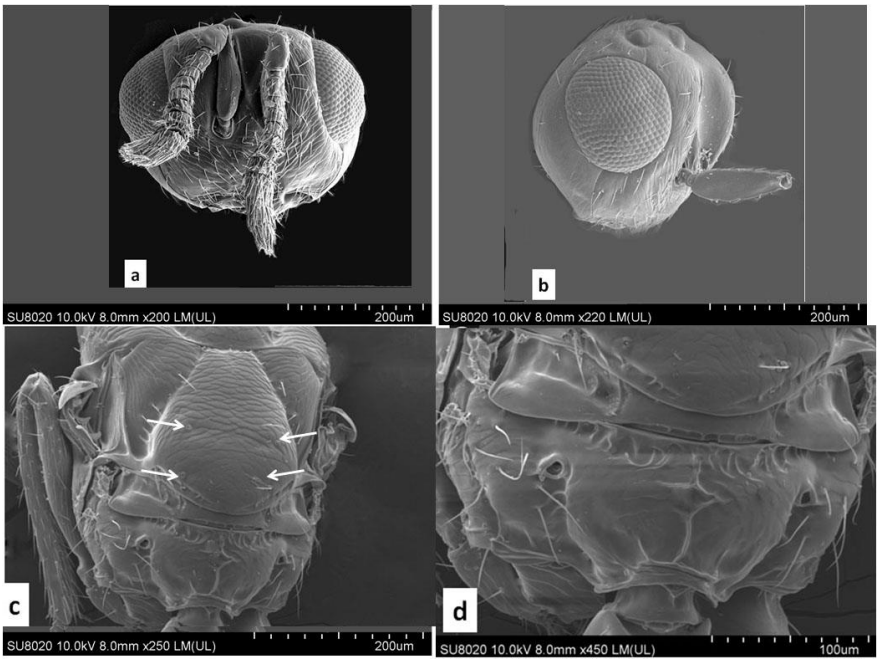

Figure 4. *M. sichuanensis* sp. nov. male. **a, b.** head, **a**. in frontal view, **b.** in lateral view; **c.** scutellum and propodeum; **d.** metanotum and propodeum. (Arrow states the base of setae).