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A new genus and species of Tetrastichinae (Hymenoptera: Eulophidae) inducing galls in seed capsules of *Eucalyptus*

IL-KWON KIM & JOHN LA SALLE

CSIRO Entomology, GPO Box 1700, Canberra, ACT 2601, Australia
School of Botany and Zoology; The Australian National University, Canberra, ACT, 0200, Australia. E-mail: john.lasalle@csiro.au

Abstract

Leprosa milga Kim & La Salle **gen.** & **sp. nov.** (Hymenoptera: Eulophidae: Tetrastichinae) is described from *Eucalyptus* seed capsules. The new species is an Australian seed gall inducer which has become established in South Africa and Italy. The relationship of *Leprosa* to two other genera of seed gall inducing tetrastichines, *Quadrastichodella* and *Moona*, is discussed.

Key words: Tetrastichinae, *Leprosa*, *Quadrastichodella*, *Moona*, *Eucalyptus*

Introduction

Most members of Tetrastichinae are known to be entomophagous as primary or hyper parasitoids on a wide variety of insects, as well as a few other arthropod hosts, including even spider egg sacs and nematodes (La Salle 1994). However, several species are known to be phytophagous, and these include gall inducers (La Salle 2005). Within Australia, tetrastichine gall-inducers mainly attack *Eucalyptus*, and a few other Myrtaceae, and can induce galls on twigs, leaves, flower buds and seeds (Bouček 1988; Headrick *et al*. 1995; Noyes 2002, 2003; Kim *et al*. 2004; Kim *et al*. 2005; La Salle 2005). The vast majority of Australian tetrastichines are parasitoids, and many of them are associated with galls as inquilines or parasitoids (Bouček, 1988; La Salle 2005).

Several species of gall-inducing tetrastichines were accidentally introduced from Australia to other areas, and have become invasive pests (Flock 1957; Timberlake 1957; Bouček 1988; Headrick *et al*. 1995; Mendel *et al*. 2004; Kim *et al*. 2005; La Salle 2005). These include *Quadrastichodella nova* Girault (Flock 1957; Timberlake, 1957), *Leptocybe invasa* Fisher & La Salle (Mendel *et al*. 2004), *Epichrysocharis burwelli* Schauff (Schauff & Garrison 2000), *Oncastichus goughi* Headrick & LaSalle (Gough 1988; Redak & Bethke 1995; Headrick *et al*. 1995; Gates & Schauff 2005) and *Moona spermophaga* (Kim *et al*. 2005).

Among those gall-inducing tetrastichines, species in the genus *Quadrastichodella* and *Moona spermophaga* induce galls on seeds of several species of *Eucalyptus* and *Corymbia* (Bouček 1988; Ikeda 1999; La Salle 2005; Kim *et al*. 2005). These two genera appear closely related based on their seed-galling biology as well as morphological characters (Kim *et al*. 2005).

Quadrastichodella species induce galls in eucalypts. The best known species is *Quadrastichodella nova* Girault which was first reported from California (Flock 1957; Timberlake 1957, as *Flockiella eucalypti*). Although Australian in origin, it is now recorded from Israel, Spain, Italy, USA, Argentina and South Africa (Noyes 2002, 2003; La Salle 2005).

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Moona, the second genus of Tetrastichinae known to induce galls on eucalypt seeds, was described very recently from Australia. *Moona spermophaga* Kim & La Salle was first found from eucalypt seedlots which were exported to Argentina (Kim *et al*. 2005). Recently, this species was found in South Africa (Kim & La Salle, unpublished data).

Recently, a third genus of Tetrastichinae which induces galls on eucalypt seeds was found in seed capsules of *Eucalyptus* in South Africa. As specimens could emerge along with *Moona spermophaga*, *Quadrastichodella* sp. and *Megastigmus* sp., it was not immediately apparent that this species could indeed induced galls. However, detailed studies showed that the new species sometimes emerged from seed capsules where other species were not present, so that it is assumed to be capable of inducing galls (Mrs. Ottilie Neser, personal communication). Since work on the present paper began, this same new species has been found in Italy, where it also appears to be established and is causing galls on seeds of *Eucalpytus* sp. (L. De Marzo, pers. com.).

In the present paper, this new genus and species is described as *Leprosa milga* Kim & La Salle **gen.** & **sp. nov.** Its relationship with the other two seed-galling genera is discussed, although more detailed phylogenetic studies are still necessary.

Format. A single diagnosis and description are offered for a new genus and species combination. This is done to avoid repetition in the species and genus description because it is not yet clear what are generic or species level characters.

Terminology used in this paper is taken from Gibson (1997) and Graham (1987). OOL, ocellar–ocular distance; POL, post-ocellar distance; CC, costal cell; SMV, submarginal vein; MV, marginal vein; STV, stigmal vein; PMV, postmarginal vein; PDL, pedicel; F1–4, funicular segments; C1–3, claval segments.

Acronyms used in the text are as follows. ANIC, Australian National Insect Collection, CSIRO Entomology, Canberra, Australia; BMNH, The Natural History Museum, London, UK; SANC, South African National Collection of Insects, Pretoria, South Africa; USNM, United States National Museum of Natural History, Washington, D.C., USA.

Leprosa Kim & La Salle gen. nov.

Type species: *Leprosa milga*. Gender feminine.

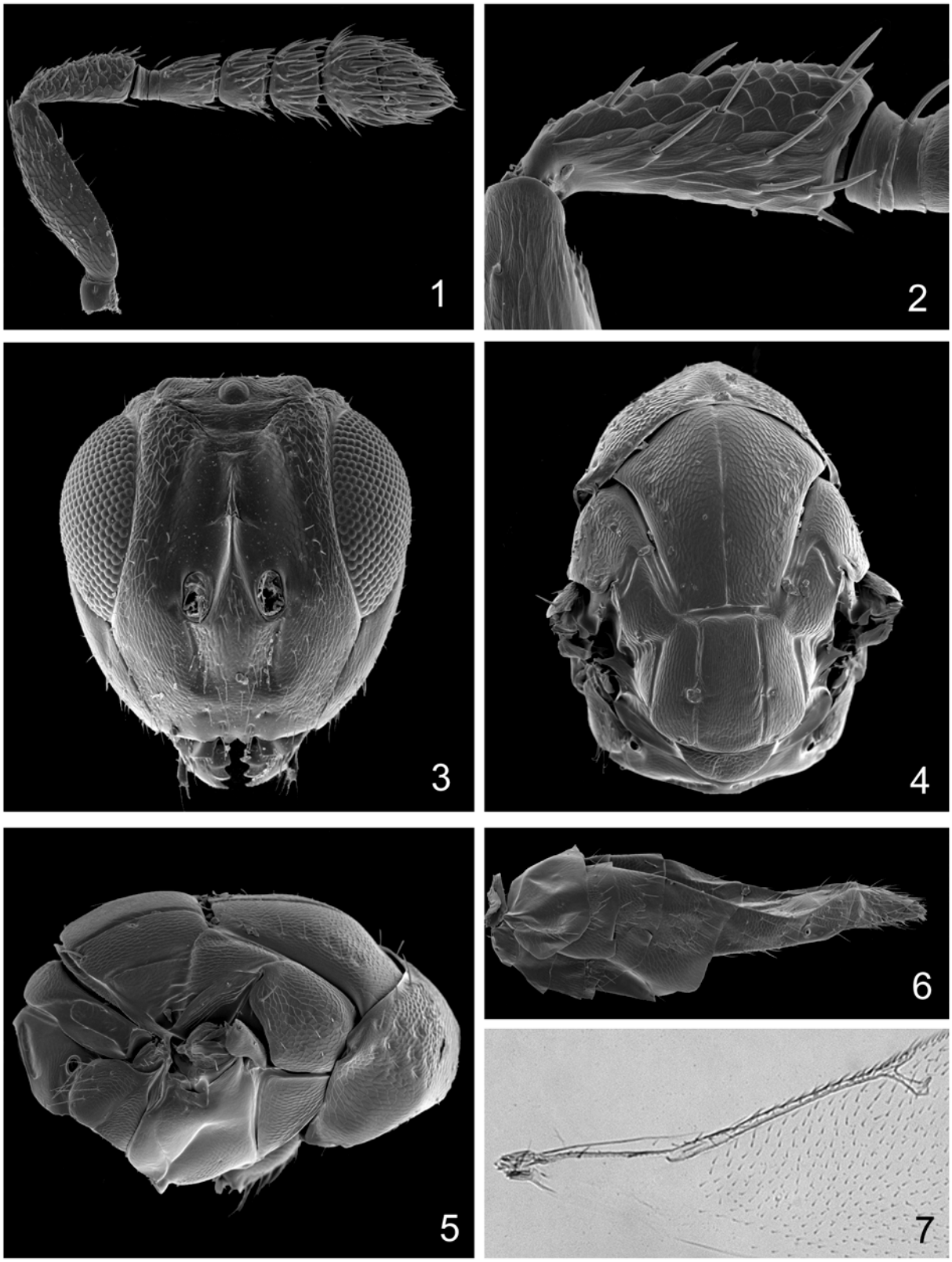
Etymology. The generic name comes from the Greek *lepros*, meaning scaly and/or rough. It refers to the coarse reticulation on the pedicel.

Leprosa milga Kim & La Salle sp. nov.

Diagnosis. Pedicel with coarse and raised reticulation; this reticulation absent on the scape. Frons with very weak frontofacial suture. Median carina with a small transverse split. Gena strongly swollen and malar sulcus strongly curved. Pronotum about 0.3 length of mid lobe of mesoscutum. Dorsellum about 2.3 times as long as propodeum. Propodeum smooth without median carina. The entire rim of propodeal spiracle exposed. Submarginal vein with 2 setae. Postmarginal vein about half the length of stigmal vein.

Description. ***Female*** (Fig. 1–8). Body 1.3–1.9 mm.

Body mainly brownish yellow with some dark brown areas and stripes. Head brownish yellow except back of the head and ocellar triangle dark brown. Antenna brown; scape mainly brownish yellow, brown apically. Pronotum with small dark area anteriorly. Scapula with dark area apically. Scutellum in anterior half with small dark area medially; the remainder brownish yellow. Mesopleuron with a dark spot ventrally. Propodeum mainly dark except callus and postero-lateral end. Gaster with transverse brown stripes on every segment. Legs mainly pale brown.



FIGURES 1–7. *Leprosa milga* ♀. 1. Antenna, inner side; 2. Pedicel, outer side; 3. Face, frontal view; 4. Mesosoma, dorsal view; 5. Mesosoma, lateral view; 6. Gaster, lateral view; 7. Forewing.

Head (Fig. 3). POL approximately 8 times as long as OOL. Frons with very weak frontofacial suture; with distinctive median carina. Median carina with a small transverse crack-like suture which can be seen more clearly on a dried specimen. Antennal torulus placed lower than middle of face; slightly above the ventral line of eyes. Gena strongly swollen and malar sulcus strongly curved. Face with longitudinal furrow extending from torulus to clypeus. Clypeal margin bilobed.

Antenna (Fig. 1–2) with 3 anelli and 3 funicular segments. The second anellus shorter than others and asymmetrical in lateral view, becoming thinner dorsally. The third anellus with one seta situated dorso-laterally on the outer side. F1 (F1/pdl = 0.54–0.57) the longest; F2 very slightly shorter than F3 (F1: F2: F3 = 1.0: 0.85–0.87: 0.89–0.92). F1 longer than broad; F2 almost quadrate; F3 broader than long. Each successive segment slightly broader than preceding one (F1: F2: F3 = 1.0: 1.12–1.15: 1.35–1.39). Clava three segmented and each claval segment slightly asymmetrical with its sutures rather oblique; C3 very short and with a terminal spine which is so short that it can hardly be distinguishable from other sensillae. Pedicel with some coarse and raised reticulations, but not as coarse as seen in Q*uadrastichodella*. Scape flattened and expanded anteriorly; not extending above the vertex.

Thorax (Figs 4–5). Pronotum about 0.3 length of mid lobe of mesoscutum in dorsal view. Mesoscutum with a distinct medlian line; with 5–7 adnotaular setae. Transscutal articulation normal; not deep and wide. Scutellum with 2 dorsal setae; anterior pair situated slightly beyond the middle. Dorsellum about 2.3 times as long as propodeum, in dorsal view. Propodeum smoth without distinct median carina; the whole rim of propodeal spiracle exposed. Callus with 8–10 setae. Mesosternum nearly flat and without precoxal suture in front of trochantinal lobe.

Gaster (Fig. 6) almost as long as head plus thorax. Apex of hypopygium extending about 0.27–0.28 length of gaster and reaching almost up to the posterior margin of G3. Cercus with 3 setae, all subequal in length.

Wing (Fig. 7) veins light brown and without hyaline breaks. Submarginal vein with 2 dorsal setae; tapering apically and joining parastigma distal to proximal end of parastigma.. Marginal vein not swollen. Postmarginal vein about 0.5 length of stigmal vein. CC: MV: STV: PMV = 3.8–4.3: 3.8–6.0: 1.0: 0.5–0.6. Basal line of setae absent and cubital line of setae not extending past base of speculum. Speculum very small; area distal to speculum densely setose.

Male unknown.

Type material. Holotype ♀: SOUTH AFRICA WCAPE, Stellenbosch, 33.56S, 18.51E, 30.ix.2004, S. Neser. ex. galls in locules of ripe seed capsules of *Eucalyptus ?camaldulensis*. (ANIC) .

FIGURES 8–9. *Leprosa milga* and galled seeds of *Eucalyptus ?camaldulensis*. 8. *L. milga* ♀; 9. seeds with emergence hole in a seed capsule.

28 ♀ Paratypes: Same collection date as Holotype (1♀, SANC; 4♀, ANIC); SOUTH AFRICA NCAPE, Colesberg, 30.42S, 25.07E, xi. 2003, A. Witt. ex. seed capsules of *E.* ?*camaldulensis* (2♀, SANC; 15♀, ANIC; 2♀, USNM; 2♀, BMNH); SOUTH AFRICA NCAPE, 26km SW Hanover, 31.14S, 24.15E, xi. 2003, A. Witt, ex. seed capsules of *E.* ?*camaldulensis* (2♀, ANIC).

Non-type material: 6♀ (ANIC), SOUTH AFRICA, Rietondale Exp. Stn., Pretoria, 25.43S 28.14E, 9.ix. 2005, H. Klein, ex. seed capsules of *E. camaldulensis*; 14♀ (ANIC), SOUTH AFRICA, WCape, Stellenbosch, 33.56S 18.51E, 4.xi.2005, M. Alsopp, ex. seed capsules of *E. camaldulensis*; 5♀ (ANIC), ITALY, Valenzano, Bari prov., 2.ix.2006, ex. seed capsules of *E. camaldulensis*; 10♀ (ANIC), ITALY, Valenzano, Bari prov., 18.xii.2006, ex. seed capsules of *E. camaldulensis*; 6♀ (ANIC), ITALY, Valenzano, Bari prov., 2.xii.2007, from flowers of *E. camaldulensis*.

Etymology. The species name *milga* comes from an Australian aboriginal word, meaning of seed. It denotes the seed-galling biology of the species.

Biology. Emerged from seed capsules of *E. ?camadulensis*.

Distribution. Described from specimens from South Africa and Italy. Although we have yet to obtain specimens from Australia, we are assuming from its relationship to the endemic Australian genera *Quadrastichodella* and *Moona* that it is Australian in origin.

Discussion

With the description of *Leprosa*, three seed-galling genera of tetrastichines are now known: *Leprosa*, *Quadrastichodella* and *Moona*. *Leprosa milga* appears related to *Quadrastichodella* and *Moona* based on the following shared characters: the postmarginal vein about half length of stigmal vein; the pronotum about 0.3 the length of the mesoscutum; the gena strongly swollen and the malar sulcus strongly curved; the propodeum smooth and shorter than or as long as the dorsellum; gall inducers in eucalypt seeds.

Leprosa differs from *Quadrastichodella* and *Moona* as follows: median carina on the scrobal depression with a small transverse suture (*Quadrastichodella* with such a suture but *Moona* without it), antenna with 3 anelli (*Quadrastichodella* and *Moona* with 4 anelli), the third anellus with a large, dorsal seta (*Quadrastichodella* and *Moona* without a seta on anelli), submarginal vein with 2 setae (*Quadrastichodella* and *Moona* with more than 3 setae), the whole rim of the propodeal spiracle exposed (*Quadrastichodella* and *Moona* with a spiracle at least partially covered by the raised lobe of the callus), the mesosternum in front of the trochantinal lobe flat.

One interesting feature is that this new species has coarse reticulation on the pedicel, but not on the scape. *Quadrastichodella* has coarse reticulation on both pedicel and scape, while *Moona* lacks coarse reticulation on either structure.

The relationship of *Leprosa* to *Quadrastichodella* and *Moona* still remains ambiguous. Further intensive phylogenetic study is required for better hypotheses on the relationships among these seed gall-inducing tetrastichine genera.

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