

First discovery of *Plutarchia* (Hymenoptera, Eurytomidae) in Palearctic region, with description of a new species from South Korea

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Abstract

The genus *Plutarchia* is discovered in the Palearctic region for the first time. In this study, we report a newly described and newly recorded species from South Korea: *P. fuscipennata* **sp. nov.**, and *P. malabarica* Narendran & Padmasenan, 1990, respectively. The host association of *Plutarchia malabarica* reared from leaf-miner flies (Diptera: Agromyzidae) attacking the seeds of *Pueraria lobata* (Willd.) Ohwi (Fabaceae) has been unknown until now. A key to the South Korean species and descriptions of the new species are also provided.

Keywords

Agromyzidae, East Asia, Fabaceae, new species, parasitoid

Introduction

The genus *Plutarchia* is a relatively small group within the family Eurytomidae and comprises 13 known species (Noyes 2019). Girault (1925) described this genus based on *P. bicarinativentris* from Australia. Subsequent species were recorded in the Palaetropical region, with one in the Afrotropical region and the others in the Oriental region. However, this is not known in the Palearctic region.

This genus concept has undergone several morphological revisions, with new species added by Subba Rao (1974), Bouček (1988), Narendran (1994), and Lotfalizadeh et al. (2007). According to Lotfalizadeh et al. (2007), it has been placed within the genus *Philolema* clade based on morphological characters. However, owing to their unique characteristics, such as the projection of the mesopleuron, a procoxa with a large depression, and the fusion of 1st and 2nd gastral tergites with large basal pits, they have maintained an independent generic name.

The host of *Plutarchia* is not well known, but Bouček (1988) suggested that this genus is a parasitoid of dipterous puparia, particularly Agromyzidae. He pointed out that *P. indefensa* (Walker) was reared from *Melanagromyza* sp. (Diptera: Agromyzidae) in India, *P. bicarinativentris* was found in the pods of *Glycine clandestina* (Fabaceae) in Australia, and undescribed species were reared from *Ophiomyia phaseoli* (Diptera: Agromyzidae) in Papua New Guinea.

In this study, we report the genus *Plutarchia* in the Palearctic region for the first time by the new species and new record from South Korea.

Materials and methods

Adult specimens of *Plutarchia fuscipennata*, sp. nov., were collected using sweeping nets, and *P. malabarica* were reared from the puparia of Agromyzidae in the pods of *Pueraria lobata* (Willd.) Ohwi (Fabaceae). Most of the specimens were deposited at the Laboratory of Insect Biosystematics, Seoul National University, and one specimen of each species was deposited at the National Institute of Biological Resources. The abbreviations for the depositories of the specimens used in this study are as follows:

NIBR National Institution of Biological Resources;
SNU Laboratory of Insect Biosystematics, Seoul National University;
ZSIC Zoological Survey of India, Calcutta, India.

Specimens were examined with an Olympus SZ61 stereomicroscope and photographed with a DMC 5400 digital camera attached to a Leica Z16 APO motorized macroscope. Serial images were combined using Zerene Stacker and digitally retouched using Adobe Photoshop CS6. Most morphological terms follow Lotfalizadeh et al. (2007) and Delvare et al. (2019).

Morphological abbreviations used in this paper as follows: **F1–FX**, funiculars 1–X; **MPS**, multiporous plate sensilla(e); **POL**, the distance between posterior ocelli; **LOL**, distance between anterior and posterior ocellus; **OOL**, minimal distance between posterior ocellus and inner orbit; **OD**, maximum diameter of posterior ocellus; **cc**, costal cell; **mv**, marginal vein; **pmv**, postmarginal vein; **stv**, stigmal vein; **GT1–GTX**, gastral tergites 1 to X.

Taxonomy

Plutarchia Girault, 1925

Plutarchia Girault, 1925: 3. Type species: *Plutarchia bicarinativentris* Girault, 1925.

Key to South Korean species of *Plutarchia* Girault

- 1 Female 2
- Male 3
- 2 Head (Fig. 1D) with OOL more than $1.5\times$ OD. Antenna with F2–5 slightly longer than wide and F6 almost square (Fig. 1B). Propodeum (Fig. 1E) areolate-rugose to reticulate medially with shallow medial depression. Fore wing (Fig. 1G) dark infusate basal half; vein dark brown..... *P. fuscipennata* sp. nov.
- Head (Fig. 3D) with OOL less than $1.5\times$ OD. Antenna with F2–F5 distinctly longer than wide and F6 slightly longer than wide. Propodeum (Fig. 3G) areolate without medial depression. Fore wing (Fig. 3H) hyaline; vein pale brown *P. malabarica* Narendran & Padmasenan
- 3 Head (Fig. 2C) with POL less than $3.5\times$ as long as OD. Antenna (Fig. 2B) stout having funicle with short petiole; clava at most $3.0\times$ as long as wide. Propodeum (Fig. 2D) simply carinate to areolate-rugose with interspace somewhat reticulate. Petiole (Fig. 2D) almost smooth with inconspicuous sculpture; $3.2\text{--}3.4\times$ as long as wide. Fore wing dark infusate basal half; vein dark brown *P. fuscipennata* sp. nov.
- Head (Fig. 4C) with POL more than $3.5\times$ as long as OD. Antenna (Fig. 4B) slender having funicle with distinctly long petiole; clava at least $4.0\times$ as long as wide. Propodeum (Fig. 4D) mixed with areolate-rugose and carinate-punctate. Petiole (Fig. 4D) reticulate-imbricate; $3.09\text{--}3.11\times$ as long as wide. Fore wing hyaline; vein pale brown *P. malabarica* Narendran & Padmasenan

Plutarchia fuscipennata sp. nov.

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Figs 1A–H, 2A–D

Etymology. The species is named after the Latin *fusci* (dark) and *pennata* (wing), from the basally infusate wing of the new species.

Type material. *Holotype* SOUTH KOREA: ♀, San 1-6, Sujeom-dong, Gumi-si, Gyeongsangbuk-do, $36^{\circ}07'40.6''\text{N}$, $128^{\circ}18'05.1''\text{E}$, 23.vi.2015, Duk-Young Park (deposited in SNU). *Paratypes* SOUTH KOREA: 2♂, Irwolsan-gil, Galsan-ri, Jaesan-myeon, Bonghwa-gun, Gyeongsangbuk-do, $36^{\circ}49'21.7''\text{N}$, $129^{\circ}05'05.3''\text{E}$, 14.vii.2015, Duk-Young Park (each 1♂ in SNU and NIBR).

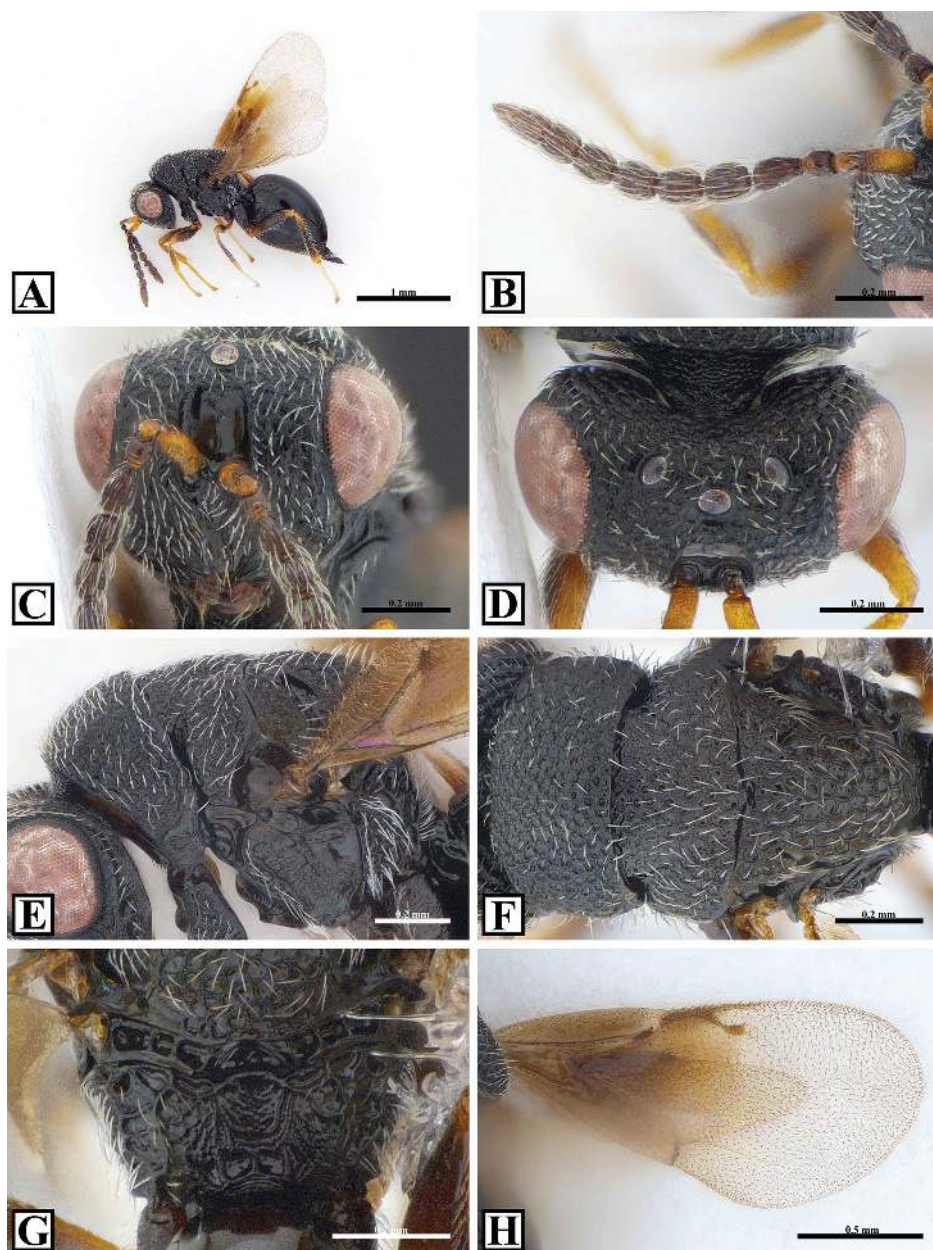


Figure 1. *Plutarchia fuscipennata*, holotype female **A** habitus, lateral view **B** antenna, dorsal view **C** head, frontal view **D** head, dorsal view **E** mesosoma, lateral view **F** mesosoma, dorsal view **G** propodeum, dorsal view **H** forewing.

Diagnosis. *Plutarchia fuscipennata* is easily distinguished from others by dark infusate anterior half of the fore wing.

Description. **Holotype female** (habitus: Fig. 1A). Body length 2.49 mm, including ovipositor sheath. Body black except as follows: radicle and scape brownish-yellow with

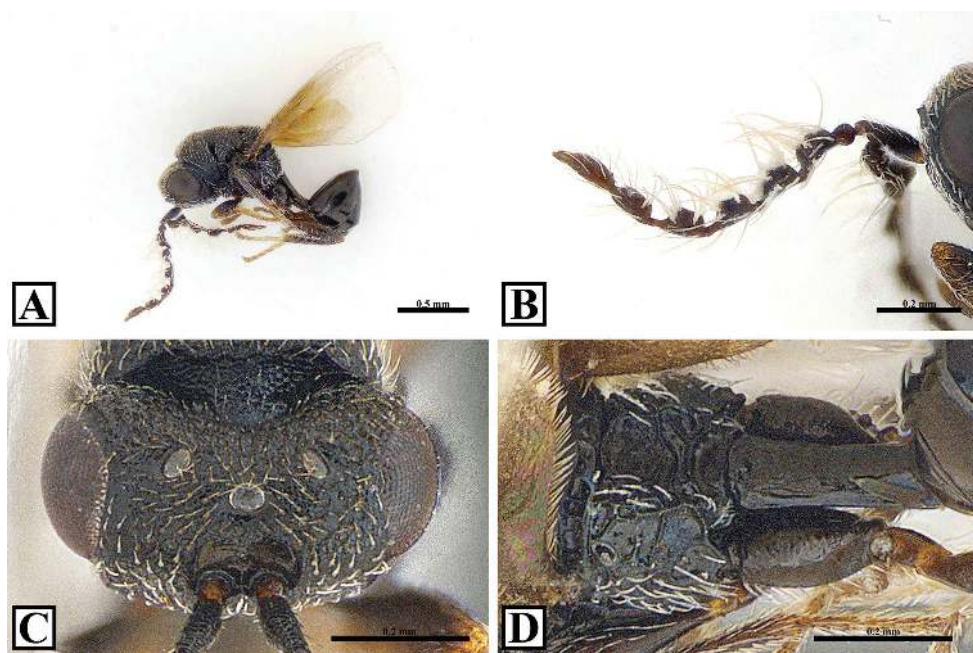


Figure 2. *Plutarchia fuscipennata*, paratype male **A** habitus, lateral view **B** antenna, lateral view **C** head, dorsal view **D** propodeum and petiole, dorsal view.

dark spot on dorsoapical region, funicle and clava dark brown except tip of clava slightly brightened; trochanter, basal and apical region of femora and tibiae, protarsus brownish-yellow, meso- and metatarsus whitish-yellow; fore wing with dark infuscate on basal half; vein and setae dark brown; ovipositor sheath dark with extreme apex reddish-brown.

Head (Fig. 1C–D) $1.3\times$ as wide as high in frontal view, $1.7\times$ as wide as long in dorsal view. Vertex areolate-reticulate to occiput regularly areolate; frons similar with vertex in sculpture, but lower face carinate gathered to lower margin; with lanceolate white setae. OOL: POL: LOL: OD = 1.6: 3.1: 1.4: 1.0. Preorbital carina weakly presented. Scrobal depression smooth with distinct carina laterally; scrobe not reaching to anterior ocellus. Malar space $0.47\times$ as long as height of eye; malar sulcus deep and oviform connected with malar depression. Gena with two deep puncture groove lines, lower punctures larger than the ones above; lateral outline of gena almost straight in frontal view; genal carina present.

Antenna (Fig. 1B) with scape minutely swollen anteromedially; $3.4\times$ as long as wide. Pedicel square. Anellus thin and smoothly connected with pedicel. Flagellum with six funiculars; F1 $1.7\times$ as long as wide; F2–F5 slightly longer than wide and F6 square; each funicular with single row of MPS; all setae subdecumbent. Clava with two visible clavomeres; $1.8\times$ as long as wide.

Mesosoma (Fig. 1E–G) $1.6\times$ as long as wide and $1.4\times$ as long as high; pronotum $2.2\times$ and mesoscutum $2.0\times$ as wide as long respectively; mesoscutellum $1.3\times$ as long as wide. Dorsal surface of mesosoma punctate with interspace reticulate, except medial region of pronotum with smaller punctures and mesoscutellum with larger

punctures. Notauli shallow. Anterior half of axilla fused with mesoscutellum, but distinguished by deep axillar groove posteriorly. Prepectus smooth with deep groove transversely. Tegula shallowly imbricate except smooth medially. Epicnemium well developed and double-hump shaped; adscrobal region areolate with interspace fine reticulate; femoral depression and mesepimeron variously carinate-areolate, but medial region of mesepimeron smooth. Metepimeron areolate with bearing long and lanceolate setae. Propodeum in approximately 95° angle to the plane of mesoscutellum; with median depression forming a single large square delimited by double carina, and two smaller squares attached at the bottom; fine reticulate submedially to areolate-rugose laterally. **Legs.** Procoxa with distinct S-shaped carina on anterior surface; with sparsely foveate-reticulate anteriorly to reticulate posteriorly. Mesocoxa somewhat smooth. Metacoxa shallowly imbricate; comparatively narrow and long, 2.1× as long as width; with two rows of setae. **Fore wing** (Fig. 1H). 2.33× as long as wide; cc: mv: pmv: stv = 3.1: 1.4: 1.2: 1.0; with basal half dark infusate and vein dark brown; with dense dark setation on membrane.

Metasoma. Petiole wider than long in dorsal view. Gaster slightly longer than head+mesosoma; 1.6× as long as high. GT4 the longest; with inconspicuous sculpture on ventral half area. Syntergum slightly upturned.

Male (habitus Fig. 2A). Body length 1.39–1.43 mm. Morphologically similar to female except as following. Antenna (Fig. 2B) with scape dark to pedicel and flagellum dark brown; five funiculars and two clavomeres; funicle with short petiole; clava at most 3.0× as long as wide. Head (Fig. 2C) 1.68–1.70× as wide as long in dorsal view; OOL: POL: LOL: OD = 1.5–1.6: 3.2–3.4: 1.4–1.5: 1.0. Propodeum (Fig. 2D) simply carinate to areolate-rugose with interspace somewhat reticulate. Petiole (Fig. 2D) almost smooth with inconspicuous sculpture; 3.2–3.4× as long as wide.

Distribution. South Korea.

Biology. Unknown.

Remarks. Only one female and two males were collected using sweeping nets. The biology of this species has not been confirmed, but it would be similar to that of other species associated with Agromyzidae that attack Fabaceae.

Plutarchia malabarica Narendran & Padmasenan, 1990

Figs 3A–H, 4A–H

Plutarchia malabarica Narendran & Padmasenan, 1990: 115. Holotype ♀. Type locality: India (Kerala). Type depository: ZSIC, examined.

Material examined. SOUTH KOREA: 1♀1♂, Bunori Fortification, Hwado-myeon, Ganghwa-gun, Incheon, 37°35'28.1"N, 126°27'43.3"E, 20.ii.2021, Duk-Young Park, emerged from pupae of Agromyzidae sp. at 01.vi.2022 (1♀ in SNU and 1♂ in NIBR); 1♂, Ganghwa Island, San 185-3, Sagi-ri, Hwado-myeon, Ganghwa-gun, Incheon, 37°35'28.1"N, 126°27'43.3"E, 15.iii.2018, Jongwoo Kim (in SNU); 1♂, Dok moun-

tain fortress, Jigot-dong, Osan-si, Gyeonggi-do, 37°11'10.0"N, 127°01'17.9"E, 13.ix.2021, Duk-Young Park, emerged at 24.iv.2022 (in SNU).

Redescription. Female (habitus: Fig. 3A). Body length 2.08 mm, including ovipositor sheath. Body black except as follows: tip of scape, anterior half of pedicel, anellus and anterior half of clava dark brown; protibia, trochanters and trochantellus brownish-yellow; basal and apical tip of meso- and metatibia, and protarsus brown; meso- and metatarsus whitish-yellow; fore wing hyaline with vein pale brown; ovipositor sheath dark with apex yellowish-brown.

Head (Fig. 3C, D) 1.3× as wide as high in frontal view, 1.6× as wide as long in dorsal view. Vertex to occiput regularly areolate; frons areolate to lower face carinate gathered to lower margin; with linear to oblong white setae. OOL: POL: LOL: OD = 1.3: 3.4: 1.6: 1.0. Preorbital carina inconspicuous. Scrobal depression smooth with inconspicuous carina laterally; scrobe not reaching to anterior ocellus. Malar space 0.44× as long as height of eye in lateral view; malar sulcus indistinct; malar depression absent. Gena with two deep and narrow puncture groove lines; lateral outline of gena distinctly convex in frontal view; genal carina present.

Antenna (Fig. 3B). Scape minutely swollen anteromedially; 3.3× as long as wide. Pedicel 1.4× as long as wide. Anellus transverse. Six funiculars, but F6 almost combined with clava; F1 1.6× as long as wide; F2–F5 distinctly but F6 slightly longer than wide; each funicular with single row of MPS; all setae subdecumbent. Clava with two vague clavomeres; twice as long as wide.

Mesosoma (Fig. 3E–G) 1.5× as long as wide and 1.2× as long as high; pronotum, and mesoscutum 2.8× and 2.0× as wide as long respectively; mesoscutellum 1.4× as long as wide. Dorsal surface of mesosoma densely punctate except mesoscutellum with slightly larger punctures than mesoscutum. Notauli distinct and narrow. Anterior half of axilla fused with mesoscutellum, but distinguished by shallow and broad axillar groove posteriorly. Prepectus smooth with deep groove on ventral submarginal area. Tegula smooth medially to imbricate posteriorly. Epicnemium developed and one-hump shaped; adscrobal region areolate with interspace shallowly rough; femoral depression variously carinate-areolate and mesepimeron substrigulate. Metepimeron areolate-rugose with bearing long and linear erect white setae. Propodeum approximately 90° angle to the plane of mesoscutellum; with broad median area delimited by carina; callus areolate anteriorly to reticulate-rugose posteriorly. **Legs.** Procoxa with ambiguous S-shaped carina on anterior surface; with surface imbricate. Mesocoxa shallowly imbricate. Metacoxa imbricate; comparatively broad, 1.6× as long as width; with three rows of setae. **Fore wing** (Fig. 3H). 2.15× as long as wide; cc: mv: pmv: stv = 5.3: 1.3: 1.4: 1.0; with entirely hyaline and vein pale brown; with sparse dark setation on membrane.

Metasoma. Petiole wider than long in dorsal view. Gaster 1.5× as long as height; 1.1× as long as head+mesosoma. GT4 with entirely reticulate-imbricate except antero-dorsally one-fourth area smooth. Syntergum not upturned.

Male (habitus Fig. 4A). Body length 1.57–1.76 mm. Morphologically similar to female except as following: antenna (Fig. 4B) with five funiculars and two clavomeres; funicle with distinctly long petiole; clava at least 4.0× as long as wide.

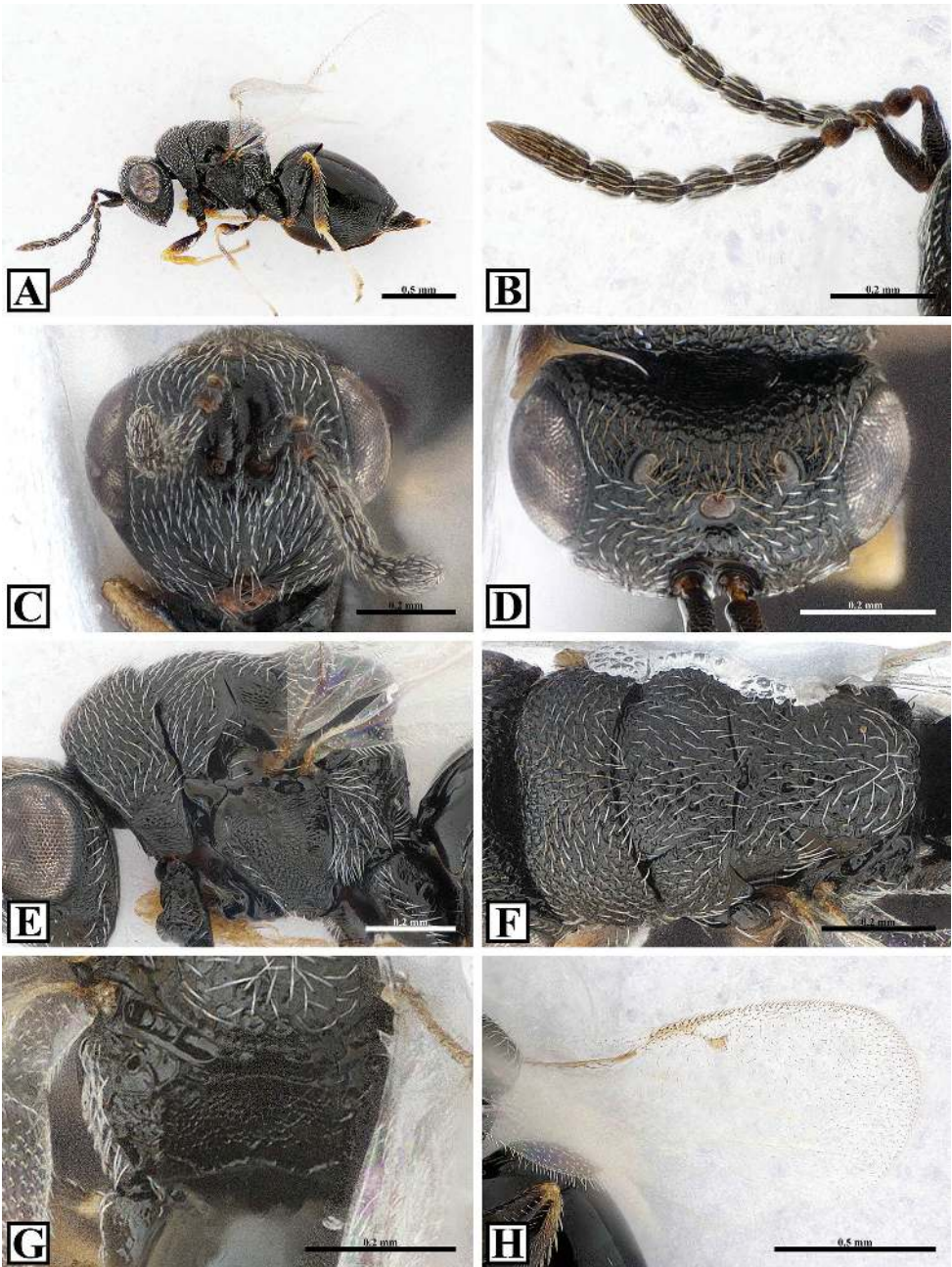


Figure 3. *Plutarchia malabarica*, female **A** habitus, lateral view **B** antenna, lateral view **C** head, frontal view **D** head, dorsal view **E** mesosoma, lateral view **F** mesosoma, dorsal view **G** propodeum, dorsal view **H** wing.

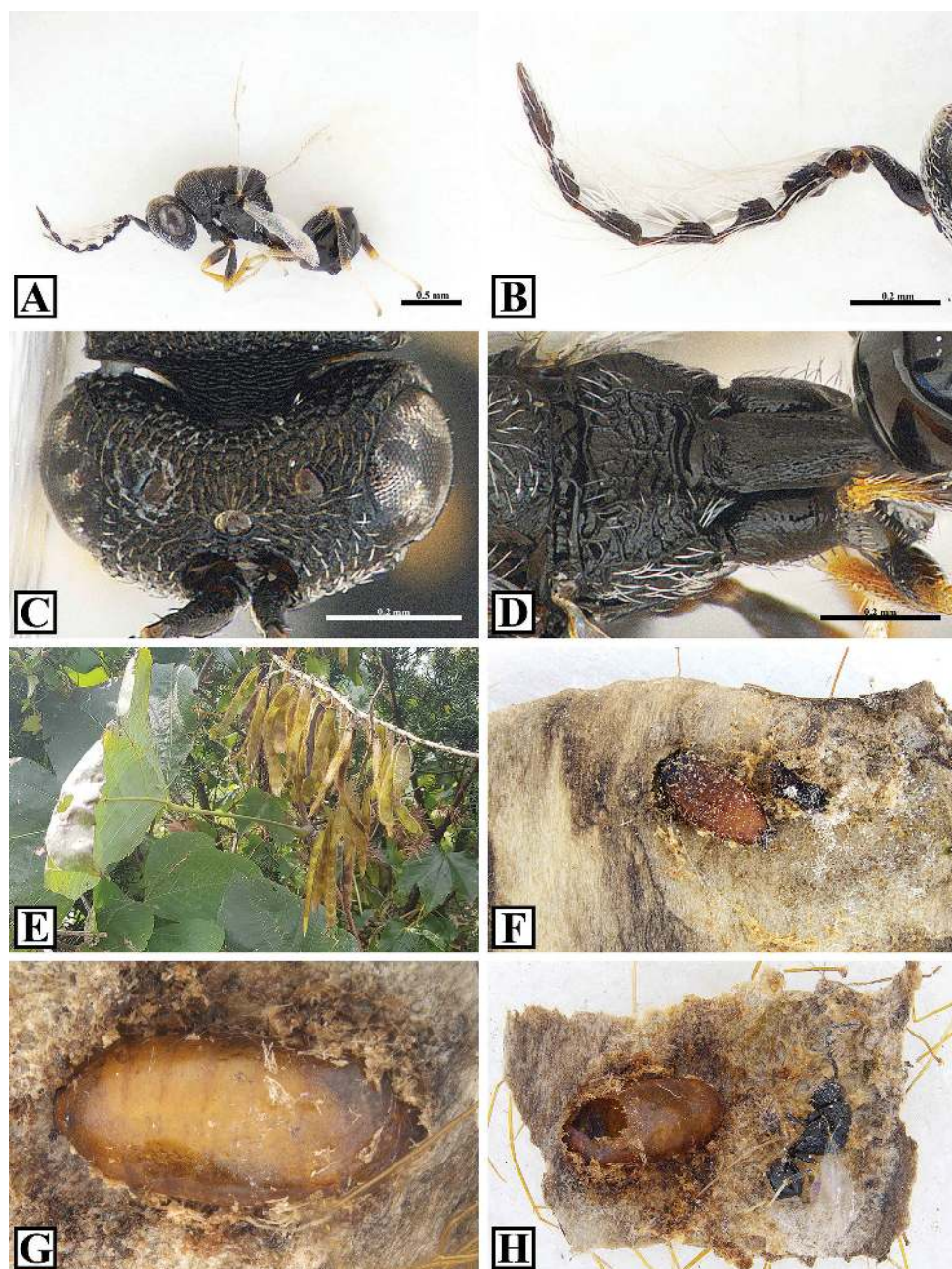


Figure 4. A–D *Plutarchia malabarica*, male A habitus, lateral view B antenna, lateral view C head, dorsal view D propodeum and petiole, dorsal view E leaves and pods of *Pueraria lobata* F pupa of Agromyzidae in pod of *Pu. lobata* G larva of *P. malabarica* in pupa of Agromyzidae H male habitus emerged from pupa of Agromyzidae.

Head (Fig. 4C) 1.77–1.80× as wide as length in dorsal view; OOL: POL: LOL: OD = 1.2–1.3: 3.7–3.8: 1.5–1.7: 1.0. Propodeum (Fig. 4D) mixed with areolate-rugose and carinate-punctate. Petiole (Fig. 4D) reticulate-imbricate; 3.09–3.11× as long as wide.

Variation. The length of the redescribed specimen (2.08 mm) in this study is slightly longer than that of the types (1.39–1.93 mm). Additionally, the POL/OOL ratio (2.62) is shorter compared to that of the holotype (3.22).

Distribution. South Korea (new record), India (Kerala).

Biology. We observed this species emerging from the cocoons of an unknown leaf-miner species (Diptera: Agromyzidae), which attacked the seeds of *Pueraria lobata* (Fabaceae). Seeds were collected during winter and subsequently stored under laboratory conditions. Owing to the controlled environment, adults of *P. malabarica* emerged earlier than expected from the pupae of Agromyzidae. However, their emergence is associated with oviposition by Agromyzidae on the seeds of *Pu. lobata*, which occurred from September to October, when *Pu. lobata* seed ripening process. The host record for *P. malabarica* is the first discovery of a host association for this species.

Discussion

Up to recently, *Plutarchia* was known to be distributed throughout the tropical (Oriental: Cambodia, India, Sri Lanka, Southern China; Australasian: Northern Australia; Afrotropical: Nigeria) to subtropical (Oriental: Nepal) zones of the Old World. Although this genus is mainly distributed in the Oriental region, its type species, *P. bicarinativentris*, was first discovered in Australia by Girault (1925). Another species, *P. giraulti*, was further identified in the Afrotropical region by Subba Rao (1974). However, the recent discovery of *P. fuscipennata* sp. nov., and *P. malabarica* in South Korea suggests that this genus may occupy a broader range across the Old World, including the temperate zone of the Palearctic region.

The biology of most *Plutarchia* species remains unknown; however, information exists for a few species. For example, *P. bicarinativentris* was reared from the pods of *Glycine clandestina* J. C. Wendl. (Fabaceae) in Australia (Bouček 1988) and is associated with *Ophiomyia* sp. (Agromyzidae) on *Tephrosia purpurea* (L.) Pers. (Fabaceae) in Cambodia (Lotfalizadeh et al. 2007). Additionally, *P. indefensa* was associated with *Melanagromyza* sp. (Agromyzidae), and *P. giraulti* was reared from an unidentified dipterous pupa on *Vigna unguiculata* (L.) Walp. (Fabaceae) (Subba Rao 1974). In this study, *P. malabarica* was reared from the pupae of Agromyzidae that attacked the seeds of *Pueraria lobata* (Fabaceae). Given the circumstances, *Plutarchia* may be a main parasitoid of Agromyzidae species associated with Fabaceae, as proposed by Bouček (1988).

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