Three new species and two new records of the genus *Phaenocarpa* Foerster (Hymenoptera, Braconidae, Alysiinae) from South Korea

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Citation: Sohn J-H, van Achterberg C, Lee G, Kim H (2021) Three new species and two new records of the genus *Phaenocarpa* Foerster (Hymenoptera, Braconidae, Alysiinae) from South Korea. Journal of Hymenoptera Research 86: 1–17. https://doi.org/10.3897/jhr.86.69998

Abstract

The species of the genus *Phaenocarpa* Foerster, 1863 (Braconidae: Alysiinae) from South Korea are revised, and the genus is recorded for the first time from South Korea. Three species, *Phaenocarpa artotemoralis* sp. nov., *P. brachyura* sp. nov. and *P. lobata* sp. nov., are new to Science, and two species, *P. masha* Belokobylskij, 1998 and *P. fidelis* Fischer, 1970, are newly recognized in South Korea. They are described and illustrated herein with a provision of the identification key to the Korean species. In addition, the DNA barcode region of the mitochondrial cytochrome c oxidase subunit I (*COI*) has been analyzed for the six species including *P. ruficeps* for genetic comparison.

Keywords

*COI* barcode, cyclostome, koinobiont, natural enemy, parasitoid wasp, systematics, taxonomy

Introduction

The subfamily Alysiinae is a relatively large taxon among the family Braconidae, and is subdivided into two tribes; the tribes Alysiini with 76 genera and Dacnusini with 31

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genera (Yu et al. 2016). The two tribes are distinguished by the presence (or absence) of fore wing vein r-m as a main key character (Shaw and Huddleston 1991). Alysiinae occurs worldwide and contains over 2,440 valid species (Yu et al. 2016), of which 180 species in 21 genera are listed in the National Species List of South Korea (NIBR 2019). This group is known as koinobiont endoparasitoids of dipterous larvae, using their mandible (with three or four teeth, rarely more or less) to break open the puparium of the host. Some of them, such as *Daenusa sibirica* in Dacnusini, are commercially utilized in biological control for *Liriomyza trifolii* (Abd-Rabou 2006).

The genus *Phaenocarpa* Foerster, 1863 is a large and worldwide distributed genus of Alysiinae, which includes 228 species with nine subgenera (Yu et al. 2016; Zhu et al. 2017). *Phaenocarpa* species are known as koinobiont endoparasitoids, mainly in larvae of Dipteran species of Anthomyiidae, Chloropidae, Clusiidae, Drosophilidae, Muscidae, Scathophagidae, Sciomyzidae, Syrphidae and Muscidae (Wharton 1984; van Achterberg 1998, 2009).

In the Korea, Papp (1968, 1994) has recorded four species thus far; *Phaenocarpa* (*Discphaenocarpa*) *angustipera* Papp, 1968, *P. (Phaenocarpa) eunice* (Haliday, 1838), *P. (P.) picinervis* (Haliday, 1838) and *P. (P.) ruficeps* (Nees, 1812). In this study, we present new morphological characters and the barcoding sequences of the COI region of three new species (*P. artotemporalis* sp. nov., *P. brachyura* sp. nov. and *P. lobata* sp. nov.) and two newly recorded species (*P. masha* Belokobylskij, 1998, *P. fidelis* Fischer, 1970) plus one previously recorded species, *P. ruficeps*. Descriptions, diagnoses, an identification key and photographs of the diagnostic characters are also provided.

**Materials and methods**

Samples used in this study were collected with Malaise traps in South Korea at the DMZ Botanical Garden, Mandae-ri, Haean-myeon, Yanggu-gun, Gangwon-do. Sorting and preparation were done at the Animal Systematics Lab. (ASL), Department of Biology, Kunsan National University (KSNU) at Gunsan. For morphological identification, Wharton et al. (1997) and Zhu et al. (2017) were used. Morphological characters were observed with a Leica M205C stereo microscope. The Taxapad database (Yu et al. 2016) was used for references. We followed the terminology of Wharton (2002) and van Achterberg (1993). The type specimens are deposited KNA (Korea National Arboretum).

A Leica DMC2900 digital camera and a Leica M205 C microscope (Leica Geosystems AG) were used for photography and several pictures being taken for each height using multi-focusing technology. LAS V4.11 (Leica Geosystems AG) and HeliconFocus 7 (Helicon Soft) software were used for stacking work. After stacking work, illustrations were created using Adobe Photoshop CS6.

Extraction of DNA was done in ASL, KSNU. Whole genomic DNA was extracted from the specimens by using a DNAsy Blood & Tissue kit (QIAGEN Inc., Dusseldorf, Germany) following the manufacturer’s protocol. In order to conserve morphologically complete voucher specimens, DNA extraction method was used slightly modified from
non-destructive method’ by Favret (2005) and ‘freezing method’ by Yaakop et al. (2009). In the original protocol, the sample was crushed or wounded, and then soaked with 180 μl of buffer ATL + 20 μl of proteinase, following by three hours over incubation at 55 °C. In the slightly modified DNA extraction methods, samples were soaked with 180 μl of buffer ATL + 20 μl of proteinase K without destroying the sample, followed by 10 minutes incubation at 55 °C and then kept in a freezer at -22 °C overnight. After that the general protocol was used for the remaining steps. The primer set of LCO-1490 (5’-GGTCAACAAATCATATTATGG-3’) and HCO-2198 (5’-TAAACTTCAGGGTGACCAAATCA-3’) was used to amplify approximately 658 bp as the partial front region of the COI. The polymerase chain reaction (PCR) products were amplified by using AccuPowerH PCR PreMix (BIONEER, Corp., Daejeon) in 20 μl reaction mixtures containing 0.4 μM of each primer, 20 μM of the dNTPs, 20 μM of the MgCl₂, and 0.05 μg of the genomic DNA template. PCR amplification was performed using a GS1 thermo-cycler (Gene Technologies, Ltd., U.K) according to the following procedure: initial denaturation at 95 °C for 5 min, followed by 34 cycles at 94 °C for 35 sec; an annealing temperature of 48 °C for 25 sec; an extension at 72 °C for 45 sec, and a final extension at 72 °C for 5 min. The PCR products were visualized by electrophoresis on a 1.5% agarose gel. A single band was observed, purified using a QIAquick PCR purification kit (QIA-GEN, Inc.), and then sequenced directly using an automated sequencer (ABI Prism 3730 XL DNA Analyzer) at Macrogen Inc. (Seoul, South Korea).

Sequence alignment was performed in MEGA version 7 (Kumar et al. 2016) with ClustalW tool. To estimate the pairwise genetic distances, the P-distance model was conducted using MEGA version 7.

Results

A total of 589 bp of the COI fragments were sequenced from P. fidelis, P. masha, P. lobata sp. nov., P. artotemporalis sp. nov., P. brachyura sp. nov., P. ruficeps, which were deposited in GenBank (accession numbers MZ318083–MZ318088). Pairwise distances were estimated by using the P-distance model with the option for pairwise deletion. As results, the morphologically very similar P. artotemporalis sp. nov. showed a large genetic difference by 12% either from P. brachyura sp. nov. or from P. lobata sp. nov. In addition, P. brachyura sp. nov. differed by 7% from P. lobata sp. nov.

Table 1. COI pairwise genetic distances between the Phaenocarpa species known from South Korea.

| Phaenocarpa species                      | Phaenocarpa fidelis | Phaenocarpa masha | Phaenocarpa lobata | Phaenocarpa artotemporalis | Phaenocarpa brachyura |
|-----------------------------------------|---------------------|-------------------|-------------------|---------------------------|-----------------------|
| Phaenocarpa fidelis                      | 0.00                |                   |                   |                           |                       |
| Phaenocarpa masha                        | 0.122               | 0.00              |                   |                           |                       |
| Phaenocarpa lobata                       | 0.053               | 0.126             | 0.00              |                           |                       |
| Phaenocarpa artotemporalis               | 0.124               | 0.151             | 0.127             | 0.00                      |                       |
| Phaenocarpa brachyura                    | 0.071               | 0.136             | 0.071             | 0.122                     | 0.00                  |
| Phaenocarpa ruficeps                     | 0.097               | 0.121             | 0.087             | 0.139                     | 0.107                 | 0.00
**Phaenocarpa** Foerster, 1863

*Phaenocarpa* Foerster, 1863: 267; Papp 1968: 570; Fischer 1970: 409; Shenefelt 1974: 1003; Wharton 1980: 96; Chen and Wu 1994: 114; Belokobylskij 1998: 233. 

Type species: *Alysia picinervis* Haliday, 1838.

**Synonymy.** *Homophyla* Foerster, 1863 (subgenus); *Mesothesis* Foerster, 1863; *Sathra* Foerster, 1863; *Idiolexis* Foerster, 1863 (subgenus); *Asynaphes* Provancher, 1886; *Kahlia* Ashmead, 1900 (subgenus); *Stiralysia* Cameron, 1910; *Rhopaloneura* Stelfox, 1941; *Discphaenocarpa* Belokobylskij, 1998 (subgenus); *Neophaenocarpa* Belokobylskij, 1998 (subgenus); *Uncphaenocarpa* Belokobylskij, 1998 (subgenus); *Ussurphaenocarpa* Belokobylskij, 1998 (subgenus); *Clistalysia* Zhu, van Achterberg & Chen, 2017 (subgenus).

**Diagnosis.** Third antennal segment shorter than fourth segment; fore wing vein 2–SR shorter than vein 3–SR, vein CU1b longer than vein 3–CU1.

**Biology.** Koinobiont endoparasitoids of larvae of Dipteran species (Wharton 1984).

**Distribution.** Cosmopolitan.

**Identification key to the Korean Phaenocarpa species**

1. Temples distinctly striate ventrally; mesopleuron largely coarsely sculptured; face laterally extensively and finely striate; [wing membrane distinctly infuscate].......................................................................................... *P. angustiptera* Papp, 1968
   – Temples smooth ventrally; mesopleuron largely smooth, except for area of precoxal sulcus; face laterally smooth or nearly so ........................................2

2. Vein r-m of fore wing bordered with blackish setae, resulting in an infuscated patch.................................................................................................................. *P. picinervis* (Haliday, 1838)
   – Vein r-m of fore wing normal, not bordered with blackish setae (Fig. 6C) .........................................................3

3. Mandible very slender, approx. 2.3 times longer than wide .......................................................... *P. eunice* (Haliday, 1838)
   – Mandible more robust, at most 1.9 times longer than wide (Fig. 6L) .........................................................4

4. Scutellar sulcus evenly narrowed medially, 3–5 times wider than its median length (Fig. 6F); head more or less reddish or yellowish brown (Fig. 6D)........... .......................................................... *P. ruficeps* (Nees, 1812)
   – Scutellar sulcus wide medially, 2–3 times wider than long medially (Fig. 4F); head dark brown or black (Fig. 1D) ........................................................................................................5

5. First tooth of mandible gradually connected to second tooth, forming a straight or arcuate connection (Fig. 4L); first metasomal tergite subparallel-sided, 1.7–2.0 times longer than its apical width (Fig. 4H); [ovipositor sheath as long as hind tibia] .................................................................................................................. *P. fidelis* Fischer, 1970
   – First tooth of mandible separated from second tooth by incision (Fig. 1L); first tergite gradually widened posteriorly, 1.1–1.8 times longer than its apical width (Figs 1H, 2H, 3H) ........................................................................................................6
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6 Eye in dorsal view 4.0–4.5 times as long as temple (Fig. 1D); propleuron reddish brown (Fig. 1F); notauli reduced posteriorly (Fig. 1G)..........................P. artotemporalis sp. nov.

– Eye in dorsal view 2.0–3.0 times as long as temple (Fig. 2D); propleuron black or orange brown (Fig. 2F); notauli usually complete (up to medio-posterior depression (Fig. 2G) or nearly so)..........................7

7 Mandible subparallel-sided (Fig. 2L); ovipositor sheath approx. 0.7 times as long as hind tibia (Fig. 2I); first metasomal tergite slenderer, approx. 1.4 times longer than its apical width (Fig. 2H).............P. brachyura sp. nov.

– Mandible distinctly widened dorsally (Fig. 5L); ovipositor sheath 1.2–1.3 times as long as hind tibia (Fig. 5I); first tergite very robust, 1.1–1.2 times longer than its apical width (Fig. 5H)..............................8

8 Tarsal claws slender (Fig. 5J); third and fourth antennal segments dark brown and slender (Fig. 5B); metanotum more or less tooth-shaped protruding dorsally in lateral view (Fig. 5G); pterostigma approx. 4.2 times longer than wide (Fig. 5C); middle tooth of mandible not widened dorsally (Fig. 5L)..........................P. masha Belokobylskij, 1998

– Tarsal claws robust (Fig. 3J); third and fourth antennal segments yellow and robust (Fig. 3B); metanotum obtuse dorsally in lateral view (Fig. 3F); pterostigma approx. 5.5 times longer than wide (Fig. 3C); middle tooth of mandible widened dorsally (Fig. 3L).............................P. lobata sp. nov.

Phaenocarpa artotemporalis Sohn & van Achterberg, sp. nov.
http://zoobank.org/D973E619-5FB8-4956-A043-0574073C41EB
Figure 1A–L

Type material. Holotype, ♀ (KNA), South Korea, DMZ Botanical Garden, Mandae-ri, Haen-myento, Yanggu-gun, Gangwon-do, 38°15′09.3″N, 128°06′40.6″E, 08–21. VIII.2017, Shin, Kim. GenBank accession no. MZ318086 for the barcoding sequence of the COI region

Comparative diagnosis. Differs from other species in the group of Phaenocarpa species by notauli reduced posteriorly by having the eye in dorsal view 4.0–4.5 times as long as temple (2.0–3.0 times in other species). Closely related to P. brachyura sp. nov., for differences see key above.

Description. Holotype, ♀: length of body in lateral view 2.0 mm, length of antenna 3.2 mm, and length of fore wing 2.6 mm.

Colour. Body (Fig. 1A) entirely reddish brown; antenna brown basally, medially dark brown, Mandible pale orange.

Head. Head (Fig. 1D) width 1.9 times median length in dorsal view. Antenna (Fig. 1B) 1.6 times longer than body in female, 25-segmented. Fourth segment 1.5 times longer than third segment, 1.2 times longer than fifth segment. Eye slightly oval, 1.1 times as long as wide in lateral view. Width of face (Fig. 1E) 1.6 times its
height from ventral rim of antennal sockets to upper margin of clypeus; face with long setae. Eye in dorsal view 4.2 times as long as temple. Ocello-ocular line (OOL) 3.4 times longer than diameter of anterior ocellus; OOL:antero-posterior ocellar line (AOL):postero-ocellar line (POL) = 15:4:6. Stemmaticum concave. Vertex smooth and polish with fine groove. Mandible with three teeth (Fig. 1L); second tooth narrow and sharp with dark brown tip and separated from first tooth by incision. Labrum 2.5 times longer than wide. Maxillary palp 0.7 times longer than mesosoma.
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**Mesosoma.** Mesosoma 1.9 times longer than wide in dorsal view. Mesosoma (Fig. 1G) with medio-posterior depression; notauli reduced posteriorly; scutellar sulcus with two carinae; small basal bump on hind coxa. Propodeum (Fig. 1H) entirely smooth, propodeal areola with bumpy sculpture; precoxal sulcus (Fig. 1F) distinct, with about five crenulae. Fore wing (Fig. 1C) 2.3 times as long as wide; pterostigma long and narrow, 4.4 times longer than wide; vein r of fore wing 2.0 times longer than wide; vein 1-SR+M slightly bent; 2-SR+M sclerotized; 1-SR+M:2-SR+M = 10:4; vein 2-SR:vein r:vein 3-SR = 12:3:24; first subdiscal cell of fore wing ca 0.9 times longer than wide.

**Leg.** Hind coxa compressed, grooved and 1.4 times longer than hind trochanter; hind femur 0.8 times longer than hind tibia; hind tibia 1.2 times longer than hind tarsus.

**Metasoma.** First tergite widened posteriorly, striate, and 1.8 times longer than its apical width; T1:T2 = 32:36. Setose part of ovipositor sheath (Fig. 1I) 1.4 times longer than mesosoma, 1.3 times as long as hind tibia and with long setae.

**Male.** Unknown.

**Distribution.** South Korea.

**Etymology.** From “artus/arctus” (Latin for narrow) and “tempus” (Latin for area behind eyes) because of the enlarged temples.

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*Phaenocarpa brachyura* Sohn & van Achterberg, sp. nov.

http://zoobank.org/5E43A497-EC93-4868-AF70-09603EE830F7

Figure 2A–L

**Type material.** Holotype, ♀ (KNA), South Korea, DMZ Botanical Garden, Mandae-ri, Haean-myeon, Yanggu-gun, Gangwon-do, 38°15′09.3″N, 128°06′40.6″E, 21.VIII–05.IX.2017, Shin, Kim. GenBank accession no. MZ318087 for the barcoding sequence of the COI region

**Comparative diagnosis.** Runs to the East Palaearctic *P. basarukini* Belokobylskij, 1998 and to the West Palaearctic *P. curticauda* van Achterberg, 1998 because of the short ovipositor sheath (approx. 0.7 times as long as hind tibia). The new species differs from *P. basarukini* by the slightly longer ovipositor sheath (0.5–0.6 times as long as hind tibia in *P. basarukini*), first mandibular tooth distinctly lobe-shaped and middle tooth slenderer, pterostigma and hind femur wider. Differs from *P. curticauda* by the wider pterostigma, longer 1r-m of hind wing and 1-CU1 of fore wing, second tooth less widened dorsally, complete notauli, first tergite 1.4 times longer than its apical width and areola of propodeum wider.

**Colour.** Head black, around eye brown; antenna yellowish brown; mandible brown and apically dark brown. First tergite dark brown and mesonotum entirely black.

**Head.** Head (Fig. 2D) width 1.6 times median length in dorsal view. Antenna (Fig. 2B) twice as long as body, 41 segmented. Fourth segment 1.4 times longer than third segment and 1.2 times longer than fifth segment. Eye slightly oval, 1.2 times as long as wide in lateral view. Width of face (Fig. 2E) 1.6 times its height from ventral rim of antennal sockets to upper margin of clypeus; face with long setae. Eye in dorsal view 2.4 times as long as temple. Ocello-ocular line 3.0 times longer than diameter...
of anterior ocellus; OOL:AOL:POL = 21:5:7. Stemmaticum concave. Mandible with three teeth (2L), subparallel-sided, first mandibular tooth distinctly lobe-shaped and separated from second tooth by incision. Labrum 2.9 times longer than wide. Maxillary palp 0.4 times longer than mesosoma.

**Mesosoma.** Mesosoma (Fig. 2G) 2.1 times longer than wide in dorsal view. Notauli crenulated, reaching medio-posterior depression; scutellar sulcus with two cari-
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Leg. Hind coxa compressed, grooved and 1.3 times longer than hind trochantor; hind femur 0.7 times longer than hind tibia; hind tibia 0.8 times longer than hind tarsus.

Metasoma. First tergite widened posteriorly, striate and narrow, 1.4 times longer than its apical width; T1:T2 = 48:37. Setose part of ovipositor sheath (Fig. 2I) 0.6 times as long as mesosoma, 0.7 times as long as hind tibia and with setae.

Male. Unknown.

Distribution. South Korea.

Etymology. From “brachys” (Greek for short) and “oura” (Greek for tail) because of the comparatively short ovipositor sheath.

*Phaenocarpa lobata* Sohn & van Achterberg, sp. nov.

http://zoobank.org/39495B6E-B87D-4947-99BF-1B8C768A8320

Figure 3A–L

Type material. Holotype, ♀ (KNA), South Korea, DMZ Botanical Garden, Mandae-ri, Haen-myene, Yanggu-gun, Gangwon-do, 38°15'09.3"N, 128°06'40.6"E, 19.IX–10.X.2017, Shin, Kim. GenBank accession no. MZ318085 for the barcoding sequence of the COI region.

Comparative diagnosis. Differs from other species treated in this paper by the long pterostigma of the fore wing (approx. 5.5 times as long as wide; 2.9–4.4 times in other species). The orange antenna and the yellow and robust third and fourth antennal segments distinguish it from other *Phaenocarpa* species. Closely related to *P. masha* Belokobylskij, 1998, for differences see key above.

Description. Holotype, ♀; length of body in lateral view 3.3 mm (Fig. 3A), length of antenna 6.1 mm and length of fore wing 3.6 mm.

Colour. Head (Fig. 3D) black; antenna orange (third and fourth antennal segments yellow); mandible orange brown. First tergite dark brown and mesonotum entirely reddish brown, area around of medio-posterior depression orangish brown.

Head. Width 1.9 times median length in dorsal view. Antenna (Fig. 3B) twice as long as body, 39 segmented. Fourth segment 1.5 times longer than third segment and 1.3 times longer than fifth; third and fourth segments robust. Eye slightly oval, 1.3 times as long as wide in lateral view. Width of face (Fig. 3E) 1.6 times its height from ventral rim of antennal sockets to upper margin of clypeus. Eye in dorsal view 2.6 times as long as temple. Ocello-ocular line 4.1 times longer than diameter of anterior ocellus;
OOL:AOL:POL = 25:6:9. Stemmaticum concave. Vertex smooth, glossy. Mandible with three teeth and first tooth separated from second tooth by incision (Fig. 3L); middle tooth of mandible widened dorsally, with black tip. Labrum 2.0 times longer than wide. Maxillary palp 0.8 times longer than mesosoma.

**Mesosoma.** Mesosoma (Fig. 3G) 1.8 times longer than wide in dorsal view. Notauli comparatively coarsely crenulate near middle of mesoscutum and reaching
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Leg. Hind coxa compressed, grooved and 1.2 times longer than hind trochanter; hind femur 0.6 times longer than hind tibia; hind tibia 1.2 times longer than hind tarsus; tarsal claws robust.

Metasoma. First tergite very robust, 1.2 times longer than its apical width; T1:T2 = 44:54. Setose part of ovipositor sheath (Fig. 3I) 1.2 times longer than mesosoma, as long as hind tibia and with long setae (Fig. 3I).

Male. Unknown.

Distribution. South Korea.

Etymology. From “lobus” (Latin for lobe), because of the lobe-shaped third mandibular tooth.

*Phaenocarpa fidelis* Fischer, 1970

Figure 4A–L

Examined material. 1♀ (KNA), **South Korea**, DMZ Botanical Garden, Mandae-ri, Haean-myeon, Yanggu-gun, Gangwon-do, 38°15’09.3”N, 128°06’40.6”E, 20.VI.–4.VII.2017, H.T. Shin, S.J. Kim. GenBank accession no. **MZ318083** for the barcoding sequence of the COI region.

Description. ♀; length of body in lateral view 2.9 mm (Fig. 4A), length of antenna 4.7 mm, length of fore wing 3.1 mm.

Colour. Head (Fig. 4D) entirely black; mandible yellowish brown. Antenna entirely brown (first and second segments orangish brown). First tergite dark brown.

Head. Width 1.9 times median length in dorsal view. Antenna (Fig. 4B) 1.6 times longer than body, 28 segmented. Fourth segment 1.6 times longer than third segment, 1.1 times longer than fifth. Eye slightly oval, 1.2 times longer than wide in lateral view. Width of face (Fig. 4E) 1.3 times its height from ventral rim of antennal sockets to upper margin of clypeus. Face with dense setae. Eye in dorsal view 2.6 times longer than temple. Ocello-ocular line 2.6 times longer than diameter of anterior ocellus; OOL:AOL:POL = 17:5:7. Stemmaticum concave. Mandible robust with three teeth (Fig. 4L) and first tooth gradually connected to second tooth, forming a straight or arcuate connection. Labrum 1.8 times longer than wide. Maxillary palp 0.7 times longer than mesosoma.

Mesosoma. Mesosoma (Fig. 4G) 2.3 times longer than wide in dorsal view, with medio-posterior depression and setae near it; notauli narrowly crenulate near middle
of mesoscutum, not reaching medio-posterior depression; scutellar sulcus with two carinae, 2.4 times wider than long medially; metanotum sculptured; with small bump on hind coxa adjacent to metapleuron; metapleuron with long setae; in lateral view mesoscutum with anterior bump. Propodeum (Fig. 4H) extensively rugose medially and in lateral view not bent; precoxal sulcus (Fig. 4F) complete and with 12 crenulae;
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**Phaenocarpa masha** Belokobylskij, 1998

Figure 5A–L

**Examined material.** 1♀ (KNA), South Korea, DMZ Botanical Garden, Mandae-ri, Haean-myeon, Yanggu-gun, Gangwon-do, 38°15’09.3”N, 128°06’40.6”E, 20.VI.–4.VII.2017, H.T. Shin, S.J. Kim. GenBank accession no. MW376066 for the barcoding sequence of the COI region.

**Description.** ♀; length of body in lateral view 2.8 mm (Fig. 5A), length of antenna 4.7 mm and length of fore wing 3.3 mm.

**Colour.** Head (Fig. 5D) entirely black; mandible orangish brown. Antenna entirely brown (third and fourth segments dark brown). First tergite reddish brown and mesonotum orangish brown.

**Head.** Width 1.7 times median length in dorsal view. Antenna (Fig. 5B) 1.6 times longer than body, 27-segmented. Fourth segment 1.6 times longer than third segment and 1.2 times longer than fifth, third and fourth segments dark brown and slender. Eye slightly oval, 1.2 times as long as wide in lateral view. Width of face (Fig. 5E) 1.5 times its height from ventral rim of antennal sockets to upper margin of clypeus. Face with dense setae. Eye in dorsal view 3.0 times as long as temple. Ocellar-ocular line 4.1 times longer than diameter of anterior ocellus; OOL:AOL:POL = 21:5:7. Stemmaticum concave. Mandible with three teeth (Fig. 5L) and first tooth separated from second tooth by incision; third tooth bent outside, middle tooth not widened dorsally. Labrum 2.4 times longer than wide. Maxillary palp 0.9 times longer than mesosoma.

**Mesosoma.** Mesosoma (Fig. 5G) 1.9 times longer than wide in dorsal view, with medio-posterior depression and setae near it; notauli line-shape, reaching medio-posterior depression; scutellar sulcus with two carinae; metanotum more or less tooth-shaped protruding dorsally in lateral view; small bump on hind coxa adjacent to
metapleuron. Propodeum (Fig. 5H) 0.7 times longer than width, more extensively rugose medially; lateral view of propodeum not bent; precoxal sulcus (Fig. 5F) completed with 11 crenulae; scutellum with setae partially. Fore wing (Fig. 5C) 2.5 times as long as wide; pterostigma long and narrow, 4.2 times longer than wide; vein r of fore wing 3.0 times longer than wide; vein r-m not sclerotized; vein 2-SR:vein r:vein 3-SR = 10:2:14; first subdiscal cell of fore wing ca 0.7 times longer than wide; second submarginal cell robust.
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**Leg.** Hind coxa compressed, grooved and 1.4 times longer than hind trochanter; hind femur 0.6 times longer than hind tibia; hind tibia 1.2 times longer than hind tarsus; tarsal claws slender.

**Metasoma.** First tergite robust, widened posteriorly, 1.2 times longer than apical width; T1:T2 = 32:30. Setose part of ovipositor sheath (Fig. 5I) 1.2 times longer than mesosoma, 1.1 times longer than hind tibia and with long setae.

**Male.** Unknown.

**Distribution.** Eastern Palaearctic; South Korea (new record).

*Figure 6. Phaenocarpa ruficeps* (Nees, 1812), ♀ A body B antennae C wings D head, dorsal E head, anterior F mesosoma, lateral G mesosoma, dorsal H propodeum and metasoma, dorsal I metasoma, ovipositor and its sheaths, lateral J tarsus, lateral K tarsus, dorsal L mandible, lateral.
Acknowledgements

This work was supported by the Korean National Arboretum (KNA1-1-20) and a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202130203). This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202102204).

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