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Description of *Stepanovia rosaeformis* sp. nov. from Bulgaria

(Hymenoptera, Eulophidae)

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A new species of the genus *Stepanovia* Kostjukov (Hymenoptera, Eulophidae, Tetrastichinae), *Stepanovia rosaeformis* Boyadzhiev & Antov sp. nov., is described and illustrated. It was reared from galls of *Diplolepis rosae* (Linnaeus) (Cynipidae) on *Rosa* spp. (Rosaceae). A key to the species of *Stepanovia* associated with galls of Cynipidae is presented.

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Introduction

Stepanovia Kostjukov, 2004 was erected for the species of *aurantiacus* species group of the genus *Aprostocetus* Westwood, 1833 (Graham 1987), that have a malar sulcus with a moderate-sized triangular fovea which extends about $0.3\text{--}0.5 \times$ length of gena, wider flagellar segments of antenna, at least $1.7 \times$ as wide as pedicellus, and host range of Cynipoidea (Hymenoptera) and Diptera (Kostjukov 2004, Kostjukov & Khomchenko 2004). The genus *Stepanovia* is palearctic and includes ten species: *S. aspectabilis* (Kostjukov, 1995), *S. aurantiaca* (Ratzeburg, 1852), *S. avetjanae* (Kostjukov, 1978), *S. eurytomae* (Nees, 1834), *S. fructirosae* Boyadzhiev, Yefremova & Tozlu, 2017, *S. grandicauda* (Kostjukov, 1995), *S. kubanica* Kostjukov, 2009, *S. longiclava* (Kostjukov, 1995), *S. nigriventris* (Kostjukov, 1995) and *S. rosae* Boyadzhiev & Todorov, 2013 (Kostjukov & Kosheleva 2006, Noyes 2019). Among them, six species are associated with galls of Cynipidae (Hymenoptera) on *Rosa* spp. (Rosaceae) (Noyes 2019).

Here we diagnose, describe and illustrate a new species of *Stepanovia* reared from galls of *Diplolepis rosae* (Linnaeus, 1758) (Cynipidae) on *Rosa* spp.

Material and methods

The species described below was reared in laboratory from galls of *Diplolepis rosae* along with *Periclistus brandtii* (Ratzeburg, 1831) (Cynipidae), *Eurytoma rosae* Nees, 1834 (Eurytomidae), *Orthopelma mediator* (Thunberg, 1824) (Ichneumonidae), *Caenacis inflexa* (Ratzeburg, 1848) and *Pteromalus bedeguaris* (Thomson, 1878) (Pteromalidae), *Glyphomerus stigma* (Fabricius, 1793) and *Torymus bedeguaris* (Linnaeus, 1758) (Torymidae). The host galls were collected from localities at altitudes between 621 and 915 m a.s.l. in Osogovo Mts and Stara Planina Mts, Bulgaria. Reared specimens were fixed in 100 % ethanol, air dried with isopropanol or HMDs, and mounted on card points or slides. The slide mounted specimens were examined under a Leica DM1000 compound microscope and photographed using a Leica DFC-295 digital still camera. The other specimens were examined under an Olympus SZ51 stereomicroscope and equipped with microscope manipulator (Boyadzhiev et al. 2012). Scanning electron micrographs were obtained using a JEOL JSM-5510 microscope, operating at 10 kV. Morphological terminology and abbreviations follow Graham (1987). The examined specimens are deposited in the collections indicated by the following acronyms: IBER, Institute of Biodiversity and Ecosystem Research, Sofia, Bulgaria; PUPB, Depart-

ment of Zoology, University of Plovdiv "Paisii Hilendarski", Plovdiv, Bulgaria; BSCZ, Bavarian State Collection of Zoology, Munich, Germany.

Results

Stepanovia rosaeformis Boyadzhiev & Antov, sp. nov.

Figs 1–10

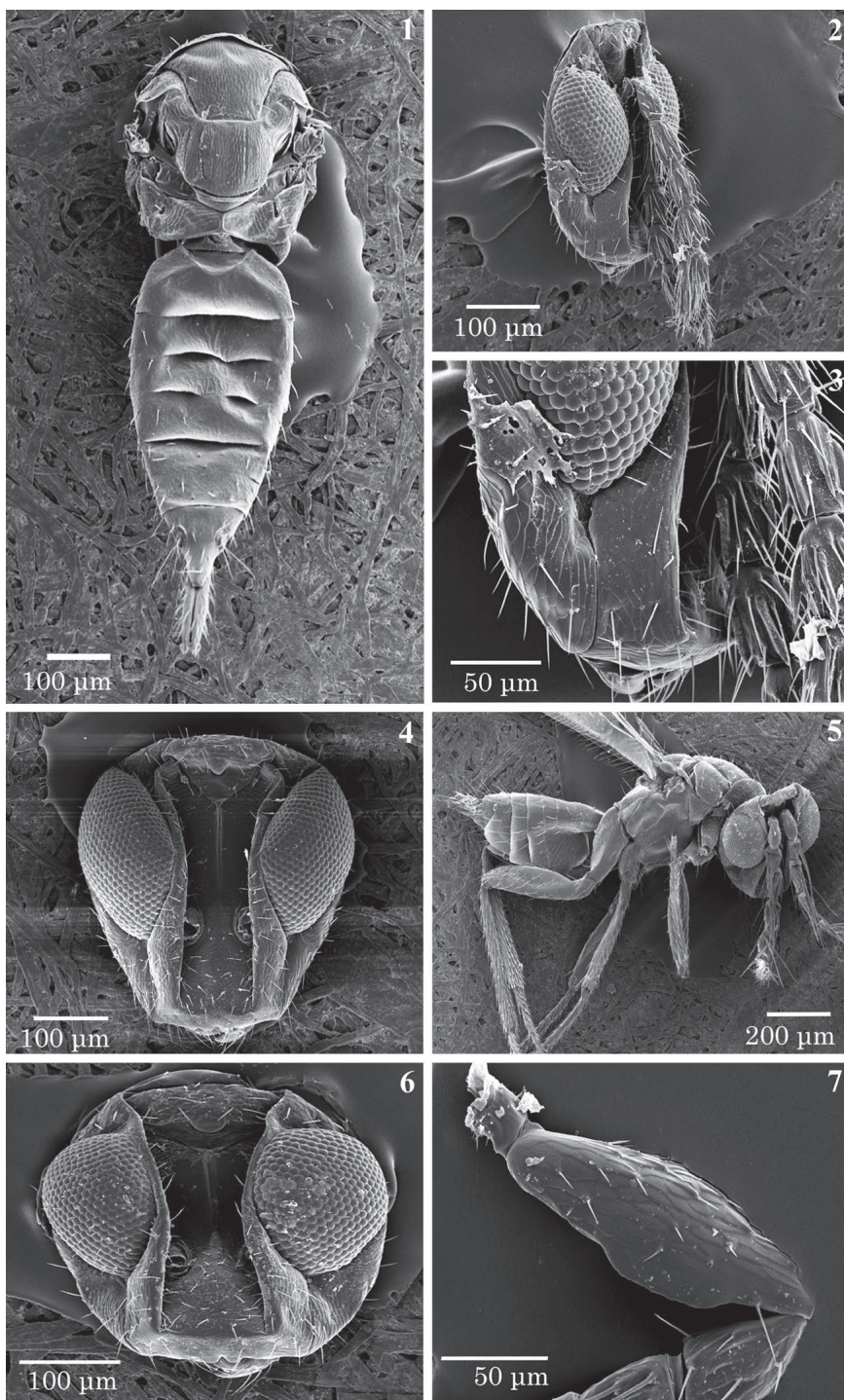
Type material. Holotype, female: Bulgaria, Osogovo Mts, Granitsa vill., 42°13'51" N, 22°43'24" E; 831 m, 22.IV.2014, emerged 12.V.2014, from galls of *Diplolepis rosae* (L.) on *Rosa* sp. (leg. M. Antov) (IBER). – Paratypes: 11 females and 10 males: the same data as holotype (IBER, PUPB, BSCZ); 1 female: Bulgaria, Osogovo Mts., Granitsa vill., 621 m, 42°15'00" N, 22°43'58" E; 13.IV.2015, emerged 22.IV.2015, from galls of *D. rosae* on *Rosa* sp. (leg. M. Antov) (PUPB); 4 females: Bulgaria, Stara Planina Mts, Ponor Mts, E of Breze vill., 915 m, 12.XI.2018, 43°01'25" N, 23°13'32" E, emerged 10.IV.–30.V.2019, from galls of *D. rosae* on *Rosa canina* L. (leg. I. Todorov) (PUPB); 1 female: Bulgaria, Stara Planina Mts, Sofiiska Mts, near Bakyovo vill., 621 m, 13.XI.2018, 43°01'25" N, 23°13'32" E, emerged 10–17.IV.2019 from galls of *D. rosae* on *Rosa* sp. (leg. I. Todorov) (PUPB).

Diagnosis. POL about 1.78–2.38 × OOL; scape 3.3–4.0 × as long as broad, not reaching level of median ocellus; pedicellus 0.83–1.1 × as long as Fl; clava 2.41–2.63 × as long as broad, 1.07–1.2 × as long as F2 plus F3; costal cell of fore wing with irregular row of 7–10 setae on lower surface; last tergite of gaster acuminate, 0.8–1.17 × as long as broad and postcercal not elongated proximally; ovipositor sheaths plus postcercal 0.3–0.65 × length of hind tibia; ventral plaque of male antenna situated hardly above middle of scape, 0.33–0.38 × length of scape; head with thin U-shaped yellowish stripe above clypeus up to lateral parts of antennal torulli, gaster brownish to fuscous, sometimes with slightly paler transverse bands.

Description

Female (Figs 1–4, 8). Head 1.13 × as broad as mesoscutum, 2.23 × as broad as long; temples 0.21–0.22 × length of eyes; POL about 1.78–2.38 × OOL, OOL about 2.25–3.5 × OD. Eyes 0.85–1.0 × as long as broad, 1.26 × as high as wide. Malar space 0.82 × length of eye and 0.58 × height of eye, sulcus with triangular fovea extending about 0.31 × length of gena. Mouth 1.33 × malar space. Sides of face near malar sulcus with very small punctures around bases of setae. Vertex with numerous dark setae whose length is

0.9–1.1 × OD. Head in front view 0.85 × as height as wide. Antenna (Fig. 8) with scape 3.3–4.0 × as long as broad, 1.13 × length of eye and 0.75 × height of eye, not reaching median ocellus; pedicellus plus flagellum 1.2–1.33 × breadth of mesoscutum; with 3 anelli (first discoid, next two laminar); pedicellus 1.71–1.84 × as long as broad and 0.83–1.1 × as long as Fl; funicle proximally hardly stouter than pedicellus, its segments decreasing in length, Fl 1.69–1.86 ×, F2 about 1.4–1.57 ×, F3 1.1–1.4 × as long as broad; clava very slightly broader than F3, 2.41–2.63 × as long as broad, 1.07–1.2 × as long as F2 plus F3, with C1 as long as broad, C2 hardly shorter, C3 as long as C2, spine about 0.3–0.41 × length of C3 and with apical seta about as long as the spine; sensilla not numerous, irregularly uniseriate, moderately long, decumbent. Thorax (Fig. 1) 1.08–1.33 × as long as broad. Pronotum short, 0.1–0.3 × as long as mesoscutum, crescentic, with a row of setae near hind margin, which are 0.54–0.64 × as long as the scutellar setae. Mid lobe of mesoscutum 0.63–0.77 × as long as broad, convex and relatively dull; median line absent; with 3 adnotaular setae on each side, hindmost about as long as first pair of scutellar setae. Scutellum 1.4–1.57 × as broad as long, about 0.76–0.9 × as long as mesoscutum; submedian lines slightly nearer to sublateral lines than to each other, enclosing a space 1.45–2.3 × as long as broad; setae subequal, hindmost setae as long as distance between submedian lines, anterior pair placed in the middle. Dorsellum 2.91–3.4 × as broad as long, hind edge curved; about 3.94–5.3 × shorter than scutellum. Propodeum inclined to about 45° towards the scutellum plain, medially about 1.45 × as long as dorsellum, moderately shiny, with fine, very slightly raised reticulation; median carina thin; callosus with 2 setae. Legs of medium length; hind coxae oblique, 1.9 × as long as broad, with slightly curved hind edge; hind femora about 3.57 × as long as broad; spur of mid tibia about as long as basitarsus, fourth tarsomere 1.25 × longer than basitarsus. Fore wing 2.08–2.78 × as long as broad; costal cell shorter than M, 13 × as long as broad, with irregular row of 7–10 setae on lower surface; SM with 3 dorsal setae; M rather thin, 4.25 × length of ST, its front edge with 9 setae; ST at about 45°, thin proximally and expanding a little distally; PM a distinct stub; speculum small, hardly extended below parastigma, closed below; wing beyond it moderately thickly pilose, more so distad; cilia 0.33 × length of ST. Hind wing narrowly rounded at apex; cilia 0.3 × breadth of wing. Gaster (Fig. 1) lanceolate, acuminate, 1.33–2.0 × longer than thorax; 1.48–1.54 × longer than head plus thorax, 0.8–1.0 × as broad as thorax, 1.8–3.27 × as long as broad; last tergite acuminate, 0.8–1.17 × as long as broad, not forming sublinear postcercal; ovipositor sheaths plus postcercal 0.3–0.65 × length



Figs 1–7. *Stepanovia rosaeformis* sp. nov. Female: 1. Dorsal view of thorax and gaster; 2. lateral view of head; 3. malar fovea and gena; 4. frontal view of head. Male: 5. Lateral view of body; 6. frontal view of head; 7. lateral view of scape.

of hind tibia, sheaths $0.6\text{--}1.56 \times$ length of postcercal; longest seta of each cercus about $1.66\text{--}1.71 \times$ length of next longest, slightly sinuate or kinked; tip of hypopygium situated distinctly before middle of gaster.

Coloration. Head and thorax brownish to dark brown with hardly perceptible metallic tinge; gaster brownish to fuscous, sometimes with slightly paler transverse bands. Head with thin U-shaped yellowish stripe above clypeus up to lateral parts of antennal torulli. Dorsellum and sometimes upper parts of the mesopleuron yellowish. Legs yellowish or very lightly fuscous, coxae brownish; dorsolateral surface of basal third of fore femur, dorsolateral surface of basal half of mid femur and up to two thirds of hind femur brownish to fuscous; fore tarsi yellowish, fourth segment of mid and hind tarsi brownish or dark fuscous. Wings hyaline, venation light brown to fuscous. Length $1.3\text{--}1.57$ mm.

Male (Figs 5–7, 9–10). Differs from female as follows: POL $2.36\text{--}2.38 \times$ OOL. Antenna (Figs 7, 9) with scape $2.66\text{--}2.75 \times$ as long as broad, its ventral plaque about $0.38\text{--}0.41$ length of scape and placed hardly above middle; pedicellus plus flagellum $1.71 \times$ breadth of mesoscutum; with two anelli (first discoid, second laminar); pedicellus $1.5\text{--}1.54 \times$ as long as broad, $1.1\text{--}1.3 \times$ longer than Fl; funicle proximally as wide as pedicellus; Fl $0.52\text{--}0.55 \times$ as long as F2, $1.15\text{--}1.25 \times$ as long as broad; F2 to F4 subequal in length, $2.2\text{--}3.31 \times$ as long as broad; clava $6\text{--}7 \times$ as long as broad, $1.1\text{--}1.2 \times$ longer than F3 plus F4; whorled setae moderately long, decreasing in length distally, those of Fl reaching base of F3. Propodeum $1.22 \times$ longer than dorsellum. Fore wing about $2.1 \times$ as long as broad. Gaster elliptic, $0.9\text{--}1.1 \times$ as long as thorax, $0.69\text{--}0.81 \times$ shorter than head plus thorax, $0.71\text{--}0.77 \times$ narrower than thorax, with ventral plica. Genitalia usually with two digital spines (Fig. 10). Length $1.05\text{--}1.37$ mm.

Host. Probably *Diplolepis rosae* (Hymenoptera, Cynipidae).

Etymology. Named after the close related species *S. rosae* Boyadzhiev & Todorov, 2013 (Boyadzhiev & Todorov 2013).

Discussion

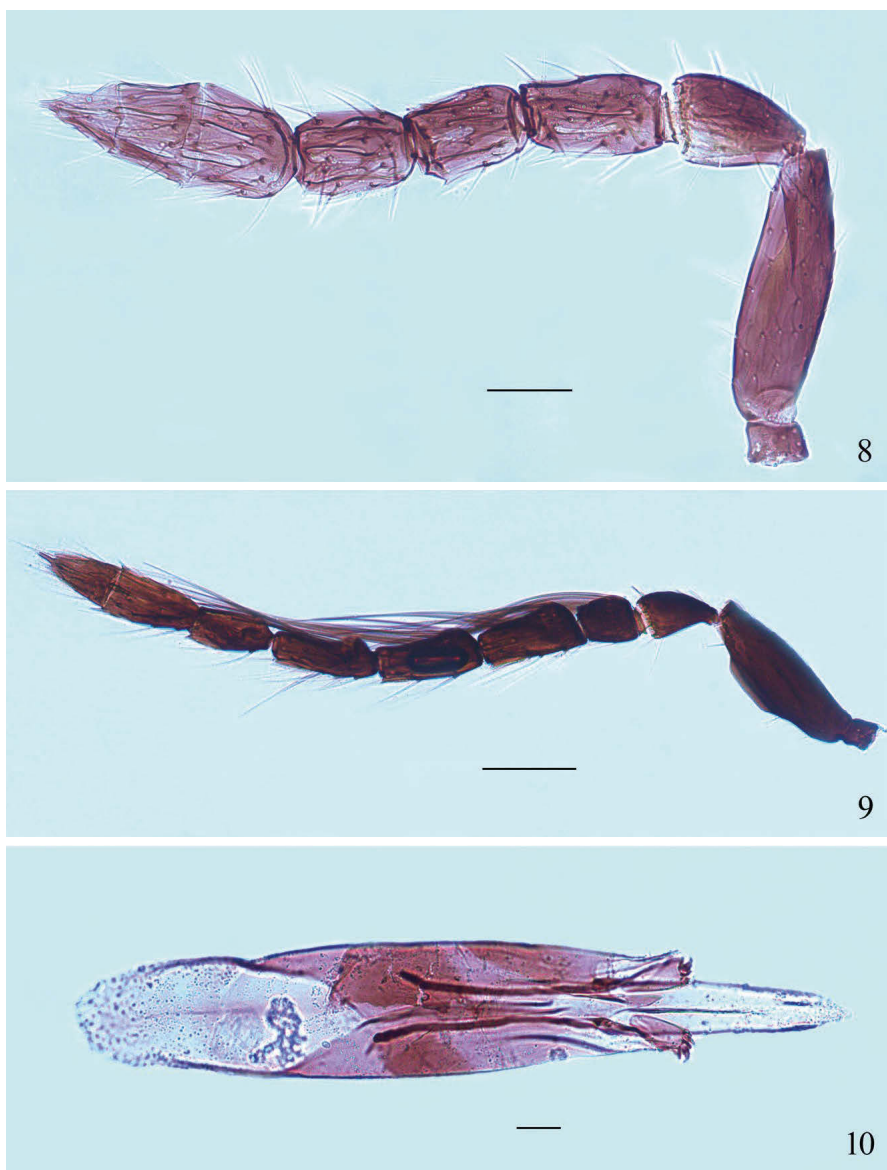
The newly described species belongs to the genus *Stepanovia*, having the following combination of characteristics: a subtriangular fovea below eye, flagellar segments of antenna proximally wider than pedicellus, propodeum medially slightly longer than dorsellum, callus with two setae, ventral plaque of male antenna situated hardly above middle of scape, second tooth of male digitus very small, and host associated with galls of Cynipidae (Hymenoptera).

It is closely related to *S. rosae* and the main morphological features for distinguish both of the species are given in the following key.

Key to the species of *Stepanovia* associated with galls of Cynipidae

(Males of *avetjanae* are unknown.)

1. Gaster $1.25\text{--}1.7 \times$ as long as broad, short ovate, acute but not acuminate, from about as long as thorax, to nearly as long as head plus thorax. Callus with 4–6 setae. Body black, with extremely weak bluish tinge, tibiae yellowish. Body length $1.1\text{--}1.6$ mm (♀♀) *Stepanovia aurantiaca* (Ratzeburg, 1852)
- Gaster $1.8\text{--}4.0 \times$ as long as broad, acuminate, longer than head plus thorax. Callus with 2–3 setae. Body usually with more pale or yellowish parts 2
2. Scape reaching at least level of median ocellus 3
- Scape not quite reaching level of median ocellus 4
3. POL $1.05\text{--}1.15 \times$ OOL; propodeum medially about as long as dorsellum. Femora yellow or fuscous; body with following parts yellow or yellowish: mouth edge, genae, face and frons, vertex, tegulae proximally, anterior angle and posterior part of mid lobe of mesoscutum *Stepanovia kubanica* Kostjukov, 2009
- POL $1.31\text{--}1.44 \times$ OOL; propodeum medially $1.2\text{--}1.44 \times$ longer than dorsellum. Femora narrowly to broadly brownish or blackish proximally; body with following parts usually yellow or fuscous: mouth edge, clypeus, distal $\frac{1}{2}$ to $\frac{1}{5}$ of genae, U-shaped stripe above clypeus up to lateral parts of antennal torulli, median carina of frons, suture towards median ocellus and inner orbit of eyes *Stepanovia fructirosae* Boyadzhiev, Yefremova & Tozlu, 2017
4. POL about equal OOL. Scutellum as long as broad. Fore wing $2.1 \times$ as long as broad. Body length $2.2\text{--}2.6$ mm (♀♀) ... *Stepanovia avetjanae* (Kostjukov, 1978)
- POL $1.3\text{--}2.4 \times$ OOL. Scutellum $1.1\text{--}1.6 \times$ as broad as long. Fore wing $2.1\text{--}2.8 \times$ as long as broad. Body length $1.1\text{--}2.5$ mm (♀♀) 5



Figs 8–10. *Stepanovia roseeformis* sp. nov. Female: 8. Antenna. Male: 9. Antenna; 10. genitalia. Scale lines: 0.1 mm for Figs 8–9, 0.02 mm for Fig. 10.

5. Female: pedicellus $2.1\text{--}2.4\times$ as long as broad; ovipositor sheaths $0.5\text{--}0.8\times$ length of postcercal. Male: antenna with ventral plaque $0.4\text{--}0.6\times$ length of scape. Head blackish with at most mouth edge pale; gaster dorsally reddish at base (sometimes up to the middle of its length), ventrally more or less yellowish. Body length: $1.1\text{--}2.5$ mm (♀♀), $1.0\text{--}1.5$ mm (♂♂) *Stepanovia eurytomae* (Nees, 1834)
- Female: pedicellus $1.7\text{--}2.0\times$ as long as broad; ovipositor sheaths $0.6\text{--}1.56\times$ length of postcercal. Male: antenna with ventral plaque $0.3\text{--}0.4\times$ length of scape. Head black or brownish with following parts usually yellow or fuscous: mouth edge, U-shaped stripe above clypeus up to lateral parts of antennal toruli and inner orbit of eyes; gaster entirely black or brownish, rarely with slightly paler transverse bands .. 6

6. Female: OOL 1.75–2.0 × OD; pedicellus 1.9–2.0 × as long as broad; costal cell of fore wing with irregular row of 12–14 setae on lower surface, dense basally and broken medially; ovipositor sheaths 0.51–0.69 × length of postcercalae. Male: antennal scape reaching level of vertex. Pale spot on lower head extends $\frac{1}{2}$ to $\frac{1}{5}$ of genae. Body length: 1.73–2.47 mm (♀♀), 1.25–1.73 mm (♂♂) *Stepanovia fructirosae* Boyadzhiev, Yefremova & Tozlu, 2017
- Female: OOL 2.0–3.5 × OD; pedicellus 1.7–1.84 × as long as broad; costal cell of fore wing at most with irregular row of 7–10 setae on lower surface; ovipositor sheaths 0.6–1.56 length of postcercalae. Male: antennal scape at most reaching level of median ocellus. Pale spot on lower head extends less than $\frac{1}{5}$ of genae or mouth edge brownish. Body length: 1.5–2.2 mm (♀♀), 1.2–1.5 mm (♂♂) 7
7. Female: POL about 1.31–1.43 × OOL; scape 3.13–3.5 × as long as broad, nearly reaching level of median ocellus; pedicellus 0.79–0.82 × as long as Fl; clava 2.14–2.4 × as long as broad, about as long as F2 plus F3; costal cell of fore wing distally with sparse row of 4–5 setae on lower surface; last tergite of gaster acuminate, 1.15–1.21 × as long as broad, proximally forming a sublinear postcercalae; ovipositor sheaths plus postcercalae 0.66–0.69 × length of hind tibia; head with wider U-shaped yellowish stripe above clypeus up to lateral parts of antennal toruli, face and mouth edge brownish testaceous, suture towards median ocellus and inner orbit of eyes, rarely yellow or fuscous, gaster entirely brownish. Male: POL 1.67 × OOL; ventral plaque situated about in the middle third of scape, 0.3 × length of scape. Body length: 1.5–2.2 mm (♀♀), 1.2–1.5 mm (♂♂) *Stepanovia rosae* Boyadzhiev & Todorov, 2013
- Female: POL about 1.45–2.38 × OOL; scape 3.3–4.0 × as long as broad, not reaching level of median ocellus; pedicellus 0.83–1.1 × as long as Fl; clava 2.41–2.63 × as long as broad, 1.07–1.2 × as long as F2 plus F3; costal cell of fore wing with irregular row of 7–10 setae on lower surface; last tergite acuminate, 0.8–1.17 × as long as broad, proximally not forming sublinear postcercalae; ovipositor sheaths plus postcercalae 0.3–0.65 × length of hind tibia; U-shaped yellowish stripe on lower face thin, gaster brownish to fuscous, sometimes with slightly paler transverse bands. Male: POL 2.36–2.38 × OOL; ventral plaque situated hardly above middle of scape, 0.33–0.38 × length of scape. Body length: 1.3–1.57 mm (♀♀), 1.05–1.37 mm (♂♂) *Stepanovia rosaeformis* Boyadzhiev & Antov sp. nov.

Acknowledgements

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