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A NEW SPECIES OF THE GENUS *TEPHRITIS* (DIPTERA, TEPHRITIDAE) FROM IRAN

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A New Species of the Genus *Tephritis* (Diptera, Tephritidae) from Iran. Korneyev, S. V., Mohamadzade Namin, S. — *Tephritis campana* sp. n. collected on flowerheads of *Cirsium* sp. in Iran is described. The new species significantly differs from other known species of the genus by having a combination of unique wing pattern and aculeus structure. A key to the Palearctic species similar to *Tephritis cometa* Loew is given.

Key words: Diptera, Tephritidae, *Tephritis*, new species, *Cirsium*, Iran.

Introduction

Tephritis Latreille, 1804 includes more than 160 described species and is one of the largest genera of the family Tephritidae, its greatest diversity can be found in the Palearctic and Nearctic Regions (Norrbom et al., 1999) and widespread in most temperate climatic zones and altitudes, except the tundra and polar deserts. Larvae of *Tephritis* species usually feed in flower heads of asteraceous plants of the tribes Anthemideae, Astereae, Cardueae, Cichorieae, Inuleae, and Senecioneae.

Tephritis species of North America, Europe and Far East Asia have been revised and keyed by several authors (Freidberg & Kugler, 1989; Foote et al., 1993; Merz, 1994; Freidberg, Kütük, 2002; Korneyev, Ovchinnikova, 2004; Kütük et al., 2012; Korneyev, 2013; Mohamadzade et al., 2015). Central Asia and the Middle East have a particularly high diversity of *Tephritis* and, numerous species have been recently found and described from these regions (Korneyev & Dirlbek, 2001; Kütük, 2005, 2008 a, b; Mohamadzade et al., 2010; Zarghani et al., 2010 a, b; Kütük et al., 2012, Korneyev, 2013, Mohamadzade & Korneyev, 2012, 2017; Korneyev & Mohamadzade, 2013; Mohamadzade et al., 2015, Korneyev et al., 2015 a, b; Korneyev & Korneyev, 2019).

Despite this work, many species in these regions remain undescribed and their biology and host-plant relationships remain unknown.

While identifying material from Iran collected during an expedition in 2014, deposited in the I. I. Schmalhausen Institute of Zoology and the personal collection of Saeed Mohamadzade Namin, a series of an undescribed new species with a distinctive wing pattern was found among untreated specimens. The new species significantly differs from other known species of the genus by having a combination of unique wing pattern and structure of the aculeus.

Material and methods

The material is deposited in the collection of I. I. Schmalhausen Institute of Zoology, National Academy of Science of Ukraine, Kyiv (SIZK); Jalal Afshar Zoological Museum, College of Agriculture, University of Tehran, Karaj, Iran (JAZM) and the personal collection of Saeed Mohamadzade Namin (SMNC).

Specimens shown in fig. 3 are deposited in Museum für Naturkunde, Berlin, Germany (MNKB), Zoological Institute, Saint Petersburg (ZISP) and Zoological Museum, University of Copenhagen, Denmark (ZMUC) as indicated.

Morphological terminology follows that of White et al. (1999). Additional abbreviations used: AL — aculeus length; WL — wing length; BL — body length.

Genitalia were prepared for study using the following procedure: the abdomen was excised from a relaxed specimen, cleared in NaOH solution (10 %) for 2 hours at 90–95 °C, and then washed in distilled water. Genitalia were examined in a drop of glycerine on a microscope slide with a depression or under a glass cover slip. Detached parts are stored in polypropylene microvials containing glycerine pinned together with the remaining specimen.

Structures were measured with an ocular micrometer. Photographs of genitalia were taken using a Nikon Coolpix P50 camera through the eyepiece of Wild M11 light microscope; photographs of wing and habitus were taken using a Canon PowerShot A640 connected to Zeiss Stemi C-2000 (SIZK). Specimens of *T. cometa*, *T. hurvitzii*, *T. divisa* and *T. maccus* are deposited in the Museum für Naturkunde, Berlin (MNKB) and were photographed using a Leica DFC 490 camera on a Leica Z16 APO. Microscope digitized photographs were stacked using CombineZM® (Hadley 2007). Pictures were taken at MNKB under supervision of Joachim Ziegler and Bernhard Schurian, and stacked using Helicon Focus®. The specimen of *T. santolinae* was kindly given as a loan from Zoological Museum — University of Copenhagen (ZMUC).

Results

Tephritis campana sp. n. (figs 1–2)

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Type material: **Holotype** ♀: **Iran**: Iran: Qazvin Province, Khoznan, 36.1222 N, 50.5575 E, h = 1670, 5.06.2014 (S. & V. Korneyev) (SIZK).

Paratypes: 2 ♂, 3 ♀, same label as for the holotype (SIZK); Qazvin Province, Khoznan, Ebrahimabad, 36°11' N, 50°65' E, 1650 m, swept from *Cirsium* sp., 3.06.2014, 2 ♂, 2 ♀ (JAZM, SMNC); same collection data, 7.07.2014, 1 ♂; same collection data, 4.06.2015, 1 ♀ (Mohamadzade) (JAZM).

Diagnosis. *Tephritis campana* sp. n. can be easily differentiated from other known *Tephritis* species by the combination of the “stellar” wing pattern with widely hyaline wing base, narrow and separated dark rays at wing apex, only two hyaline spots in cell r_1 and evenly pointed aculeus (fig. 2, 1–2) in addition to the hyaline spot distal to the apex of vein R_1 forming an connected, wide oblique band with the trapezoidal spot in r_{2+3} cell (as marked by blue arrow in fig. 1, 5), itself often touching or confluent with an 8-shaped hyaline spot at the base of cell r_{4+5} and a ventrally setulose vein R_{2+3} .

Tephritis campana sp. n. has a wing pattern similar to several species from the Western Palearctic Region with a basal hyaline area and narrow apical rays and can be differentiated from these species using the identification key below, and as follows: *T. campana* has two hyaline spots in cell r_1 as opposed to the three hyaline spots in the *T. cometa* (Loew, 1840) species group (including *T. acanthiophilopsis* Hering, 1938 and *T. erdemlii* Kütük, 2008) and *T. oedipus* Hendel, 1927, the latter of which can also be recognized by the numerous tiny yellow or hyaline dots on the dark regions of the apical wing pattern (fig. 3, 12). *Tephritis campana* sp. n. is also similar to species which

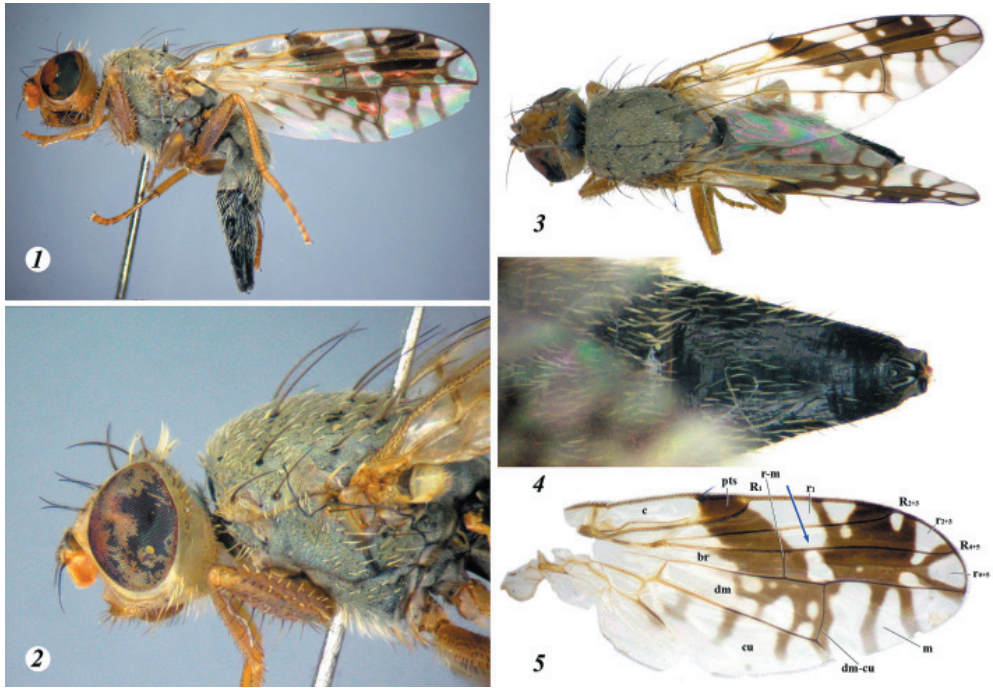


Fig. 1. *Tephritis campana* sp. n. (1-2 — holotype, 3-5 — paratypes): 1 — habitus (left); 2 — head and thorax (left); 3 — habitus (dorsal); 4 — female abdomen, dorsal; 5 — wing.

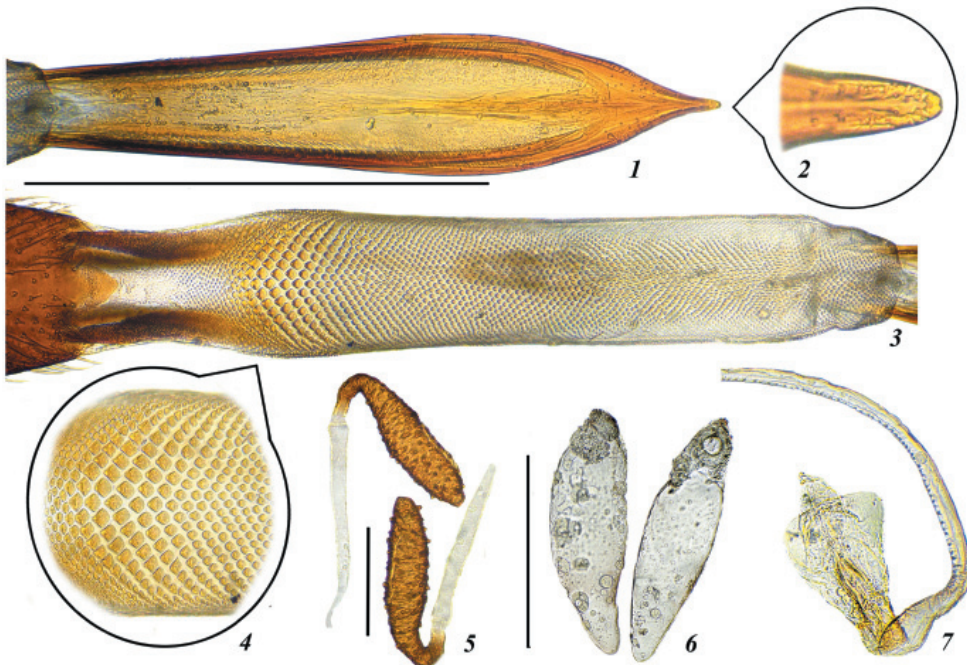


Fig. 2. Terminalia of *Tephritis campana* sp. n. (paratypes, 1-6 — ♀, 7 — ♂): 1 — aculeus, ventral view, bar = 1 mm; 2 — aculeus tip, ventral view; 3 — eversible membrane, ventral view; 4 — scales on eversible membrane, ventral view, enlarged; 5 — spermathecae, scale bar = 0,1 mm; 6 — eggs; 7 — glans of phallus. Scale bar = 1 mm (1, 2) and 0.5 mm (6).

often or always have two hyaline spots in cell r_1 ; *T. separata* Rondani, 1871 and *T. divisa* Rondani, 1871 (fig. 3, 7) can both be differentiated by the presence of a dark spot in cell c, and cell dm with dark bars in the basal half. Species in the *T. hurvitzii* species group (fig. 3, 2) (*T. crinita* Hering, 1961, *T. hurvitzii* Freidberg, 1981, *T. recurrens* Loew, 1869 and *T. merzi* Freidberg and Kütük, 2002) differ from *T. campana* sp. n. by having a tail-like, complete dark band through cells dm and cu running towards the anal cell (some specimens of *T. hurvitzii* in addition differ by having three hyaline spots in r_1). *Tephritis santolinae* Hering, 1934 and *T. maccus* Hering, 1937 can be easily differentiated from *Tephritis campana* sp. n. by their entirely dark medial portion of cell r_{2+3} , which never features a hyaline spot connecting the hyaline regions of cells r_1 and r_{4+5} (figs 3, 5, 9), in addition to the shape and form of the distal aculeus (figs 3, 6, 10). The evenly pointed apex of the aculeus of *Tephritis campana* sp. n. (fig. 2, 2) also clearly differs from all species of the *T. hurvitzii* group (fig. 3, 4), *T. separata*, and *T. divisa* (fig. 3, 8), which each have either steps or incisions in the apex of the aculeus.

Description. Medium-sized grey flies with two hyaline spots in cell r_1 and oblique band formed with hyaline spots from cell r_1 through r_{2+3} to r_{4+5} . Hyaline spot at base of r_{4+5} variable. Oviscape black, as long as the rest of abdomen; basal part of oviscape covered with white setulae, distal part with black setulae.

Head: shape in profile as in most other *Tephritis* species (fig. 1, 2). Length: height: width ratio = 1: 1.1: 1.4. Gena 0.55 times as high as length of flagellomere 1. Frons matte yellow, with grey dorsal and lateral margins, ocellar tubercle black, grey microtrichose. Occiput triangle black, white microtrichose. Ocellar, medial vertical, anterior orbital and frontal setae dark brown and acuminate; genal seta pale brown, acuminate; other setae including posterior orbital seta lanceolate, whitish or yellowish. Postocular row with longer white setae, setulae among them black. Genal setulae whitish yellow, brownish on anterior part. Setulae on distal part of palp and on pedicel black. Antenna yellow; flagellomere 1 rounded apically; arista black.

Thorax: ground color predominantly black, white microtrichose; postpronotal lobe, dorsal part of anepisternum and scutellum laterally dark yellow; mesonotum back, densely white microtrichose; mediotergite entirely black and sparsely white microtrichose without shining areas. Setae dark brown (posterior anepisternal and anepimeral setae brown); posterior notopleural seta white; apical scutellar seta half as long as basal scutellar seta. Setulae white; scutellum with five to six white marginal setulae on each side. Calypteres white. Halter yellow.

Legs: dark yellow; fore femur with two rows of white posterodorsal and one row of brown posteroventral setae; mid and hind legs with brown setae and setulae.

Wing (fig. 1, 5): basal cells bc, bm and bcu hyaline; cell c entirely hyaline. Pterostigma dark brown with tiny hyaline anteroapical area. Cell r_1 hyaline at base, posterior to pterostigma brown, at middle with two trapeziform hyaline spots separated by narrow brown bar; the apical spot half as long as basal. Cell r_{2+3} hyaline at base, with dark area posterior to pterostigma; two hyaline spots posterior to spots of r_1 separated by dark bars, the proximal spot as wide as cell and merged with spot in r_1 , the distal spot small, rarely connecting to hyaline spot anterior of it in r_1 ; preapical brown area with only one isolated hyaline spot posterior to vein R_{2+3} apex. Cell br hyaline in basal half and entirely dark in apical half, without hyaline dots at crossvein r-m. Cell r_{4+5} brown at base, without dots aligned to r-m, at dm-cu level with hyaline spot of variable shape, from oval or 8-shaped to subrectangular. Rest of dark area with only one tiny round hyaline spot. Wing apex with three subtriangular hyaline spots separated by two narrow brown rays forming the "apical fork" connected with wide dark area. Cell dm with basal one-third to one-half hyaline, apically dark brown, with four to six large hyaline spots, posteriorly almost entirely hyaline. Cell m with three large hyaline spots, as wide as cell, separated by two narrow dark rays.

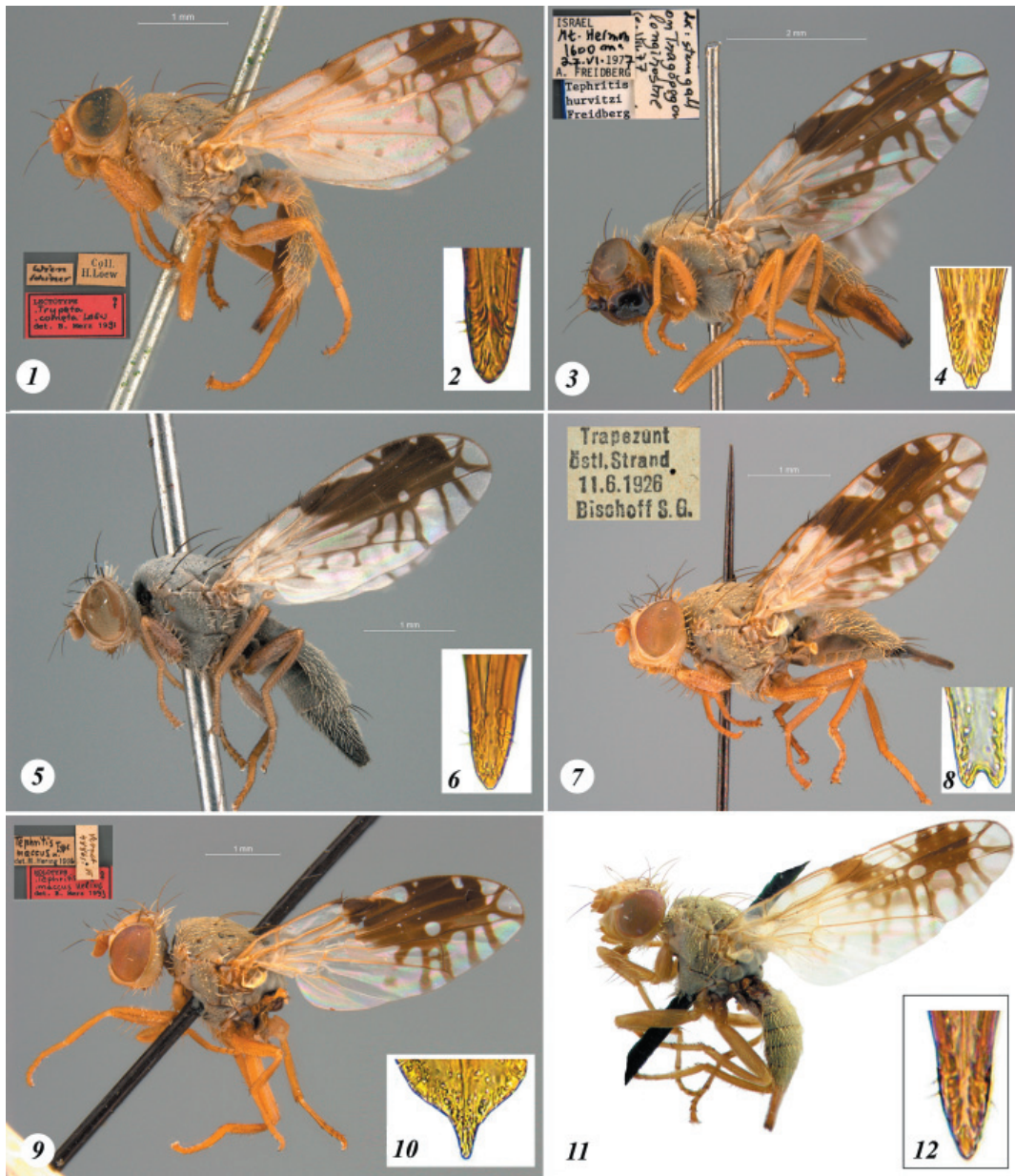


Fig. 3. Habitus (♀) and aculeus tip: 1 — *T. cometa*: syntype, Austria, “Wien, Schiner” (MNKB); 2— *T. cometa* (non-type specimen); 3 — *T. hurvitzii*: paratype: Israel, Mt. Hermon, 1600 m, 27.06.1977, ex stem gall on *Tragopogon longirostre*, ♀ (A. Freidberg) (MNKB); 4 — same, non-type specimen; 5–6 — *T. santolinae*: Morocco, 1900 m, Tizi-n-Talrhemt pass, 15.04.1989 (ZMUC); 7–8 — *T. divisa*: Trapezunt, östl. Strand, 11.6.1926 (Bischoff S. G.) (MNKB); 9–10 — *T. maccus*: holotype: France, Pyrenees-Orientales: Vernety [Vernet] (MNKB); 11–12 — *T. oedipus*: non-type, topotypic specimen (ZISP).

Cell cu hyaline with three thin dark bars, not reaching the posterior part of cell. Anal cell and lobe hyaline. Alula hyaline.

Abdomen (fig. 1, 4): black, entirely white microtrichose, white setulose. Oviscape as long as rest of abdomen, shiny black, white setulose in basal half, black setulose in apical half.

Terminalia. Male. Epandrium similar to that of other *Tephritis* species. Glans of phallus as in fig. 2, 7. Ejaculatory apodeme as in other species of the genus.

Female. Eversible membrane with two pairs of taeniae 0.25× as long as membrane itself; ventral side of membrane with blunt dentate scales, moderately large in anteromedial portion (figs 2, 3–4). Aculeus 6× as long as wide, pointed to apex, with slightly rounded top (figs 2, 1–2). Two papillose short spermathecae 4.5× as long as wide (fig. 2, 5).

Eggs short spindle-like (fig. 2, 6).

Measurements. WL = 4.2–4.3 (♂, n=2), 4.2–4.5 (♀, n=4); AL = 1.3–1.4 mm (n = 2); BL = 5.2–5.5 mm (♀, n = 4); 4.0–4.5 mm (♂, n = 2).

Host plants: Specimens were swept from *Cirsium* sp., which possibly is its host plant.

Distribution. Iran.

Etymology. The species name is derived from Latin *campana* (“bell”), reflecting the pattern of hyaline spots at anteromedial part of the wing resembling a bell with handle.

Key to *Tephritis* species similar to *T. campana* sp. n. from the Western Palearctic Region

1. Wing apex with narrow, stripe-like, dark rays connected to dark wing pattern as in figs 1, 5; 3, 1; 3, 3; 3, 5; 3, 7; 3, 9; 3, 11. 2
- Wing apex either with wide subtriangular dark spots/rays or entire apical crossband, either connected or isolated from the remaining dark pattern, but not with narrow “rays”. ther *Tephritis* species (not discussed in this paper)
2. One or two hyaline spots in cell r_1 ; cell r_{2+3} entirely brown in its medial portion: only base and apex with hyaline areas (figs 3,5; 3,9). 3
- Two or three hyaline spots in cell r_1 ; cell r_{2+3} with hyaline spots in its medial portion (figs 1, 5; 3, 1; 3, 3; 3, 7; 3, 11). 4
3. Cell cu with one or two dark rays. Cell r_1 as a rule with one hyaline spot; if with two then aculeus strongly narrowed subapically to short, pointed apex (figs 3, 9–10).
- Cell cu with three dark rays. Cell r_1 usually with two hyaline spots; if with one; then aculeus evenly pointed to its apex (figs 3, 5–6). *T. maccus* group (*T. maccus* and *T. azari*)
4. Preapical dark pattern of wing with numerous light yellow or hyaline dots. Aculeus dorsally with a keel. Associated with *Lactuca tatarica* (figs 3, 11–12). *T. santoliniae*
- Preapical dark pattern of wing entirely brown without dots. 5
5. Cell cu with widespread pattern of connected dark spots (as in figs 3, 3; 3, 7). Cell c either with dark spot in the middle or hyaline. 6
- Cell cu at most with several narrow dark bars or completely hyaline (as in figs 1, 5; 3, 1). Cell c entirely hyaline. 7
6. Wing pattern with horizontal dark “tail” in cells dm and cu connected to the rest of wing pattern (fig. 3, 3). Aculeus tip with a pair of subapical steps laterally and barely incised apically (fig. 3, 4).
- Wing pattern with dark pattern in cells dm and cu (fig. 3, 7). Aculeus tip laterally smooth and apically deeply incised (fig. 3, 8). *T. hurvitzii* group (*T. crinita*, *T. hurvitzii*, *T. merzi*, and *T. recurrens*)
7. Cell r_1 with 3 hyaline spots, if very rarely with two then crossvein r-m surrounded by two hyaline spots (fig. 3, 1) and cell dm mostly hyaline, at most with subapical narrow dark bars.
- Cell r_1 with 2 hyaline spots. Crossvein r-m in an entirely dark field and cell dm in apical half with several connected areas and partly confluent hyaline spots (as in figs 1, 1; 1, 3). *T. cometa* group (*T. cometa*, *T. acanthiophilopsis*, and *T. erdemlii*)
- Cell r_1 with 2 hyaline spots. Crossvein r-m in an entirely dark field and cell dm in apical half with several connected areas and partly confluent hyaline spots (as in figs 1, 1; 1, 3). *T. campana* sp. n.

Conclusion

Tephritis campana sp. n. has a significantly different wing pattern and aculeus structure from all other known species of the genus. The phylogenetic position of *T. campana* is currently unclear, although it is assumed to be closely related to other

Cardueae infesting species. A forthcoming analysis of DNA data acquired from 70 species of *Tephritis* (Korneyev et al., in prep.) gave evidences that species with similar host preferences are related and that all Cardueae infesting species belong to the same clade. This results require further confirmation but we currently are not able to do so. Further molecular studies could be useful.

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