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Taxonomic Review of the Genus *Trigonospila* Pokorny (Diptera: Tachinidae: Blondeliini) in Korea

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ABSTRACT

As a result of a taxonomic review of the tachinid genus *Trigonospila* Porkorny in Korea, we recognized two species: *T. ludio* (Zetterstedt) and *T. transvittata* (Pandellé). The former species is reported for the first time in Korea. We here provide a key to the Korean species, redescriptions, photographs and illustrations.

Keywords: Diptera, Tachinidae, Blondeliini, *Trigonospila*, Korea

INTRODUCTION

The genus *Trigonospila* was erected by Pokorny (1886) based on *T. picta* Pokorny in Austria (= *T. ludio* (Zetterstedt)). Since then, similar looking species had been included in *Trigonospila* without clearly demarcating the genus until Mesnil (1965) provided the diagnostic characteristics and the key to six species. This genus currently includes 14 nominal species (3 Palaearctic, 3 Oriental, 5 Australasian, 4 Afrotropical, and 3 Nearctic species).

The biology of *Trigonospila* is poorly known. Crosskey (1973) recorded two Australian lepidopteran species (Oecophoridae and Gelechiidae), as hosts of *T. brevifacies* (Hardy) and Shima (2006) recorded beetle species (*Plesiophthalmus nigrocyaneus nigrocyaneus* Motschulsky, Tenebrionidae) as a host of *T. vittigera* (Coquillett). *Trigonospila brevifacies* was introduced from Australia to northern New Zealand to control the introduced tortricid pest, *Epiphyas postvittana* (Walker) between 1967 and 1973, and re-released in southern New Zealand in 1999 (Shaw et al., 2001). This species is known to lay eggs on the skin of lepidopteran host larva directly between head and thorax. The hatched tachinid larvae penetrate the host beneath the egg shells and start their parasitism (Green, 1984).

In Eastern Palaearctic Region, Mesnil (1965), Shima (1979) and Chao (1996) recognized three species of *Trigonospila* from Japan and China. In Korea, as the first record of this genus, Doi (1938) reported *T. transvittata* (Pandellé). Since then, others workers have recorded the same species in the faunistic studies of several Korean localities (Lee and Kwon, 1981; Kwon et al., 1996; Han et al., 1999). We believe that at least two closely resembling species, *T. ludio* and *T. transvittata*, have been involved in the earlier studies, and, therefore, try to clarify the problem in the present study. We here provide a key to the Korean species, redescriptions, and photographs and illustrations with key characters indicated.

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MATERIALS AND METHODS

The terminology and morphological interpretations used in this study follow McAlpine (1981). In addition, the following eight ratios are used (modified from Han and Norrbom, 2005): frons-head ratio (frons/head width); eye ratio (shortest eye diameter/longest eye diameter); gena-eye ratio (genal height/longest eye diameter)-genal height is the distance between the ventral eye margin and the ventral genal margin anterior to genal seta; arista-antenna ratio (length of arista/length of antenna excluding arista); vein R_{4+5} ratio (distance along vein R_{4+5} between crossvein R-M and vein R_{4+5} apx/distance between crossvein R-M and basal node of vein R_{4+5}); vein M ratio (distance along vein M between crossvein R-M and DM-Cu/distance between corssvein R-M and BM-Cu); subcosta-costa ratio (length of pterostigma/length of costal cell); wing-thorax ratio (wing length/thorax length).

Consecutive digital images in different focal planes (usually 10 or more shots per a specimen) were taken with a digital camera (Panasonic DMC FZ50) and the images were Z-stacked using Helicon Focus® software (Helicon Soft, Ltd.). All the specimens used in this study are deposited in the Division of Biological Science and Technology, Yonsei University, Wonju Campus (YSUW).

SYSTEMATIC ACCOUNTS

Order Diptera Linnaeus, 1758

Family Tachinidae Robineau-Desvoidy, 1830
Tribe Blondeliini Robineau-Desvoidy, 1863
Genus *Trigonospila* Pokorny, 1886

Trigonospila Pokorny, 1886: 191. Type species: *Trigonospila picta* Pokorny [= *Tachina ludio* (Zetterstedt, 1849)].

Zosteromyia Brauer and Bergenstamm, 1891: 376. Type species: *Myobia cingulata* Macquart, 1851 [misid., = *Zosteromyia braueri* Townsend, 1933].

Succingulum Pandellé, 1894: 52. Type species: *Succingulum transvittatum* Pandellé, 1894.

Panacemyia Townsend, 1919: 164. Type species: *Panacemyia panamensis* Townsend, 1919.

Gymnamedoria Townsend, 1927: 283. Type species: *Gymnamedoria medinoides* Townsend [= *Succingulum transvittatum* Pandellé, 1894].

Zosteromyiopsis Townsend, 1933: 456. Type species: *Myobia cingulata* Macquart, 1851.

Nimiocauda Reinhard, 1943: 78. Type species: *Nimiocauda erilis* Reinhard, 1943.

Diagnosis of Trigonospila. Members of this genus usually have distinct transverse black and white body patterns (i.e., Fig. 1A-H), but such pattern occasionally occur in other blondeliine genera. They may be recognized based on the combination of the following characteristics (modified from Shima, 1979; Wood, 1985): Head with compound eyes bare; proclinate orbital seta absent in male, 2-3 in female; reclinate orbital seta of male indistinguishable from frontal setae, 2-3 in female usually differentiated from uppermost frontal setae; ocellar seta hair-like, short to moderately long, nearly parallel to each other in male, parallel or divergent in female; parafacial bare and narrow; facial ridge with a few small recumbent setae on lower third or less; subvibrissal ridge short, usually with 3 or fewer setae; epistome not beyond vibrissal angle; gena narrow, 0.1-0.3 of eye height; anterior margin of postgena concave anteriorly, sloping anteroventrally toward vibrissal angle, without genal dilation; first flagellomere of male about as long as that of female; arista minutely to short pubescent, thickened on basal fourth to fifth. Thorax with prosternum bare; proepisternum bare; postpronotum with 2 setae, or with 3 (the inner basal, usually small) forming slightly curved row; katepisternum with 3 setae, the anteroventral sometimes small; 1-3+2-3 acrostichal; 2-3+3-4 dorsocentral; 1-2+3 intraalar; 1-2+3 supraalar; lateral scutellar setae shorter than subapical setae curved medially; apical scutellar setae usually lacking; fore tibia with 1 posterior setae; mid tibia with 1 anterodorsal setae and v seta; vein R_{4+5} usually with single seta at base. Abdominal syntergite 1+2 with 1 pair of median marginal setae, mid-dorsal depression not extending to hind margin of syntergite; 3rd and 4th abdominal tergites each with 1 pair, of median discal setae, in males of some species with an extra pair of discal setae in front of main pair; female abdomen bent ventrally, with telescopic ovipositor directed ventrally, telescoped portion heavily sclerotized.

Key to the species of *Trigonospila* Pokorny in Korea

1. Fore tibia with 2-3 posterior setae; frontal setae directed forwards; mid-dorsal excavation of syntergite 1+2 not extending to median marginal setae; posterior margin of male sternite 5 invaginated in 90 degree angle ..... *T. ludio* (Zetterstedt)
– Fore tibia with single posterior seta; frontal setae directed upwards; mid-dorsal excavation of syntergite 1+2 extending to median marginal setae; posterior margin of male sternite 5 invaginated in acute angle ..... *T. transvittata* (Pandellé)

[1]***Trigonospila ludio* (Zetterstedt)**
(Figs. 1A-D, 2A-D, 3A-C)

Tachina ludio Zetterstedt, 1848: 3233 (type locality: Denmark).

Trigonspila picta Pokorny, 1886: 191 (type locality: Wechsel, Austria).

Trigonospila ludio: Mesnil, 1965: 719; Shima, 1979: 300 (redescription); Herting and Dely-Draskovits, 1993: 149 (in Palaearctic Catalog); Chao, 1999: 1717 (redescription).

Material examined. KOREA: Chungcheongbuk-do: 2♂, Cheongwon-gun, Miwon-myeon, Mt. Ingyeongsan, 15.VIII. 1997 (H.-Y. Han et al.); 1♂, Chungju-si, Jongmin-dong, from recreation forest to Mt. Gyemyeongsan (775 m) peak, 21.VIII.2006 (H.-W. Byun and J.-S. Lim); 2♂, Youngdong-gun, Hwanggan-myeon, Mt. Poseongbong (H.-Y. Han et al.). Chungcheongnam-do: 1♂, Boryeong-si, Cheongso-myeon, Mt. Oseosan, 20.VII.1999 (H.-Y. Han et al.); 1♂, Cheongwon-gun, Daechi-myeon, Mt. Chilgapsan, 23.VIII.2000 (Park and Kang). Gangwon-do: 4♂, Hoengseong-gun, Dunnae-myeon, Mt. Cheongtaesan, 18.VIII.2001 (H.-Y. Han and K.-E. Ro); 1♂, ditto, 27.VII.2002; 2♂, 1♀, ditto, 5.VI.2003 (D.-S. Choi and H.-S. Lee); 1♂, ditto, 13.VI.2003 (D.-S. Choi et al.); 9♂, ditto, 17.VI.2003 (D.-S. Choi and H.-W. Byun); 5♂, ditto, 15.VII.2003 (D.-S. Choi and H.-S. Lee); 1♂, ditto (H.-W. Byun and S.-W. Suk); 1♀, ditto, 25.V.2004 (H.-W. Byun et al.); 4♂, ditto, 18.VI.2005 (H.-Y. Han et al.); 1♀, ditto, 18.VII.2005 (H.-Y. Han et al.); 1♂, ditto, 1.VIII. 2006; 1♂, Inju-gun, Girin-myeon Mt. Jeombongsan, 4.VIII. 2006 (D.-S. Choi et al.); 1♂, Jeongseon-gun, Nam-myeon,

[1]*큰검정띠기생파리 (신칭)

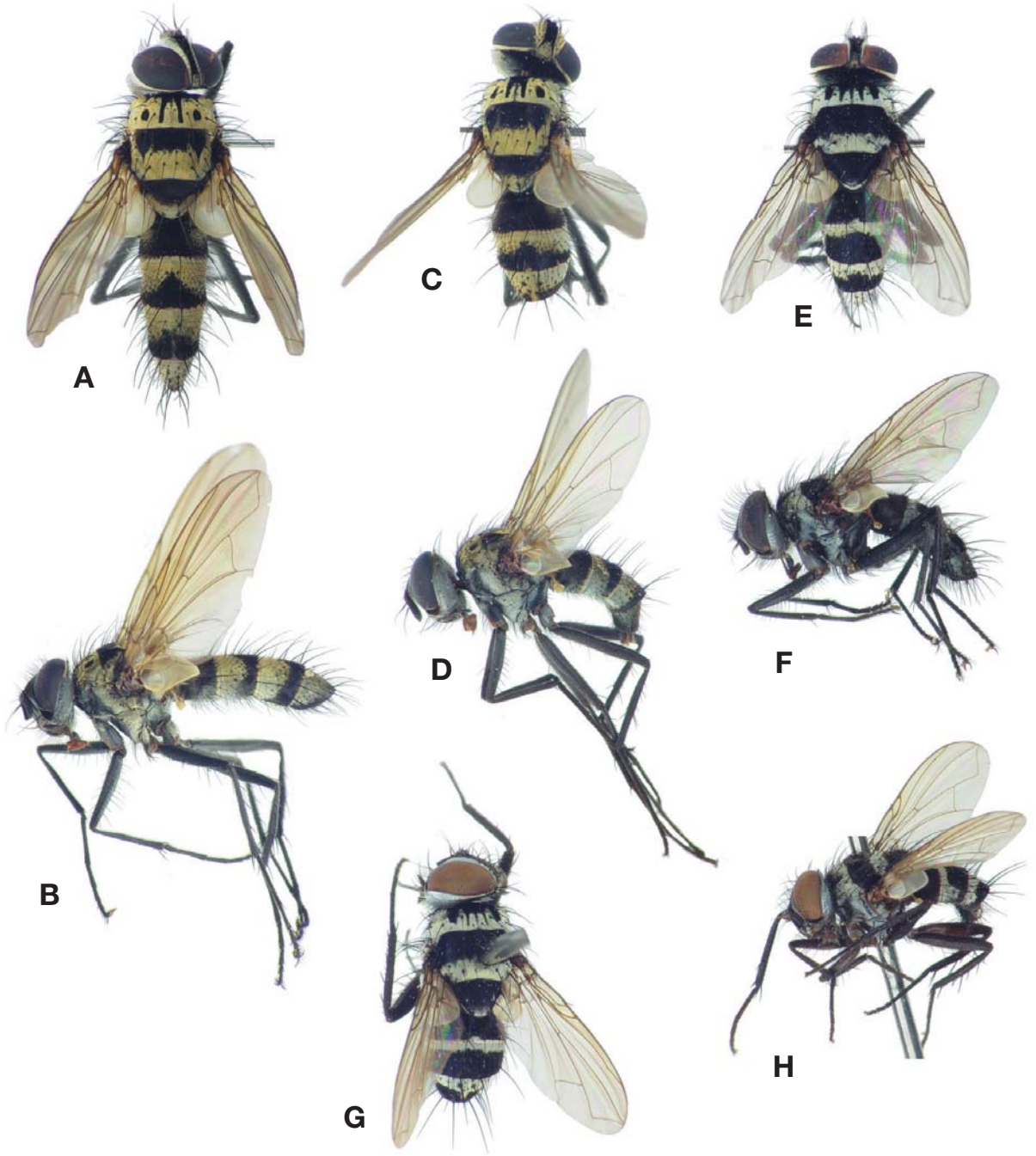

Fig. 1. A, B, *Trigonospila ludio* (Zetterstedt), male; C, D, same, female; E, F, *T. transvittata* (Pandellé), male; G, H, same, female.

Mt. Mindungsan, 31.V.2002 (D.-S. Choi and H.-W. Byun); 1♂, 1♀, ditto, 24.VI.2005 (H.-Y. Han et al.); 1♂, ditto, 16. VII.2005; 1♂, ditto, 4.VIII.2005; 1♂, 2♀, ditto, 13.VIII. 2005; 1♀, ditto, 29.VIII.2005; 1♂, ditto, 13.VI.2006; 1♂, ditto, 28.VI.2006; 1♂, Jeongseon-eup, Mt. Gariwangsan, 24. VIII.2001 (H.-Y. Han and K.-E. Ro); 1♂, Pyeongchang-gun, Jinbu-myeon, Mt. Gyebangsan, 3.IX.2000 (S.-K. Kim and C.-H. Park); 2♂, ditto, 25.VIII.2002 (H.-W. Byun and O.-Y. Lim); 14♂, ditto, 12.VIII.2003 (H.-W. Byun et al.); 2♂, 1♀, ditto, 7.VIII.2004; 2♂, ditto, 23.VI.2005 (D.-S. Choi et al.); 3♂, ditto, 5.VIII.2005; 1♂, Pyeongchang-gun, Jinbu-myeon, Mt. Odaesan, 11.IX.1982 (H.-Y. Han); 2♂, ditto, 11.VIII.1984 (H.-Y. Han and K.-E. Ro); 2♂, Wonju-si, Heung-eop-myeon, Yonsei Univ. Campus, 10.VII.2004 (H.-S. Lee);

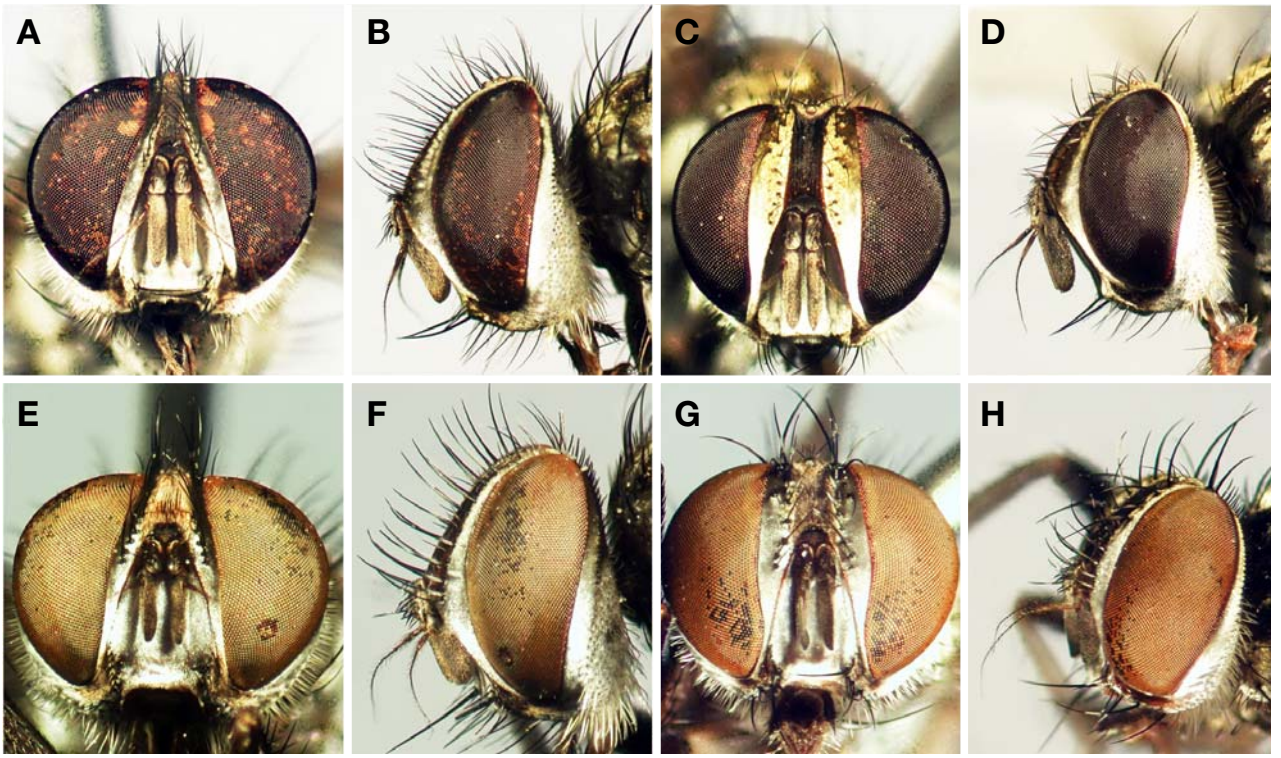

Fig. 2. Head. A-B, *Trigonospila ludio* (Zetterstedt), male; C-D, same, female; E-F, *T. transvittata* (Pandellé), male; G-H, same, female.

1♂, ditto, 20.V.2005 (H.-W. Byun); 1♂, ditto, 11.V.2006 (H.-S. Lee et al.); 3♂, ditto, 16.V.2005 (S. Hwang); 7♂, ditto, 18.V.2006 (H.-S. Lee et al.); 2♂, Panbu-myeon, Mt. Baegunsan, 5.VIII.1999 (D.-S. Choi et al.); 1♂, ditto, 2.VII. 2000 (H.-Y. Han and D.-S. Choi); 1♂, ditto, 7.VI.2003 (H.-Y. Han and K.-E. Ro); 2♀, ditto, 11.VI.2003 (D.-S. Choi and H.-W. Byun); 1♂, ditto, 24.VI.2006 (H.-S. Lee and S.-W. Suk).

Diagnosis. *Trigonospila ludio* is similar to *T. transvittata*, but can be distinguished by the following characteristics: 1) ground color pale yellow; 2) black thoracic transverse band not reaching wing base (Fig. 1A, B) frontal setae proclinate; 4) fore tibia with 2-3 posterior setae; and 5) syntergite 1+2 not extending to median marginal seta.

Redescription. Male. Body pale yellowish with black transverse band on scutum and abdomen; wing length 7.3-9.0 mm; thorax length 3.0-3.9 mm. Head (Fig. 2A, B) dark brown with frons-head ratio 0.14-0.18, eye ratio 0.58-0.61, gena-eye ratio 0.17-0.23, arista-antenna ratio 1.00-1.28; compound eye bare; inner vertical seta 0.25-0.30× as long as longest diameter of eye; outer vertical seta absent; ocellar seta 1.10-1.30× as long as inner vertical seta; postocellar seta about 0.85× as long as inner vertical seta; paravertical seta short but clearly discernible, about 0.70-0.90× as long as inner vertical setae; ocellar triangle with black setulae; lunule bare; orbital plate with dense yellowish pruinosity and strong orbital setae, without any setulae; 13-15 frontal setae, above level of aristal sockets; orbital seta indistinguishable from nearby frontal setae; frontal vitta black, bare; arista dark brown, plumose; pedicel, scape and flgellomere 1 dark brown with yellowish brown pruinosity; aristomere 1 as long as wide, aristomere 2 twice longer than wide; basal 1/4 of aristomere 3 thickened; flagellomere 1 slender, about 3.3-4.0× longer than wide; facial carina weak; parafacial with dense whitish pruinosity, bare, 0.75-0.85× as wide as flagellomere 1; postgena moderately swollen with relatively long whitish yellow setulae; vibrissa well developed, arising above level of epistome; 1-2 strong supravibrissal setae; 6-8 subvibrissal setae; mouthparts with slightly clavate palpus with short black setulae; prementum dark brown with yellow brown setulae posteriorly; labella with yellow brown setulae; palpi dark brown with dark brown setulae; postocular setae extend fully from upper eye margin to lower eye margin; occiput densely with whitish brown setulae; genal seta strong and genal dilation weakly developed; postcranium with 1 row of black hairs behind postocular row, rest of postcranium covered with whitish hairs. Thorax (Fig. 1A, B) almost yellowish brown with wide black bands on scutum and scutellum; pro-

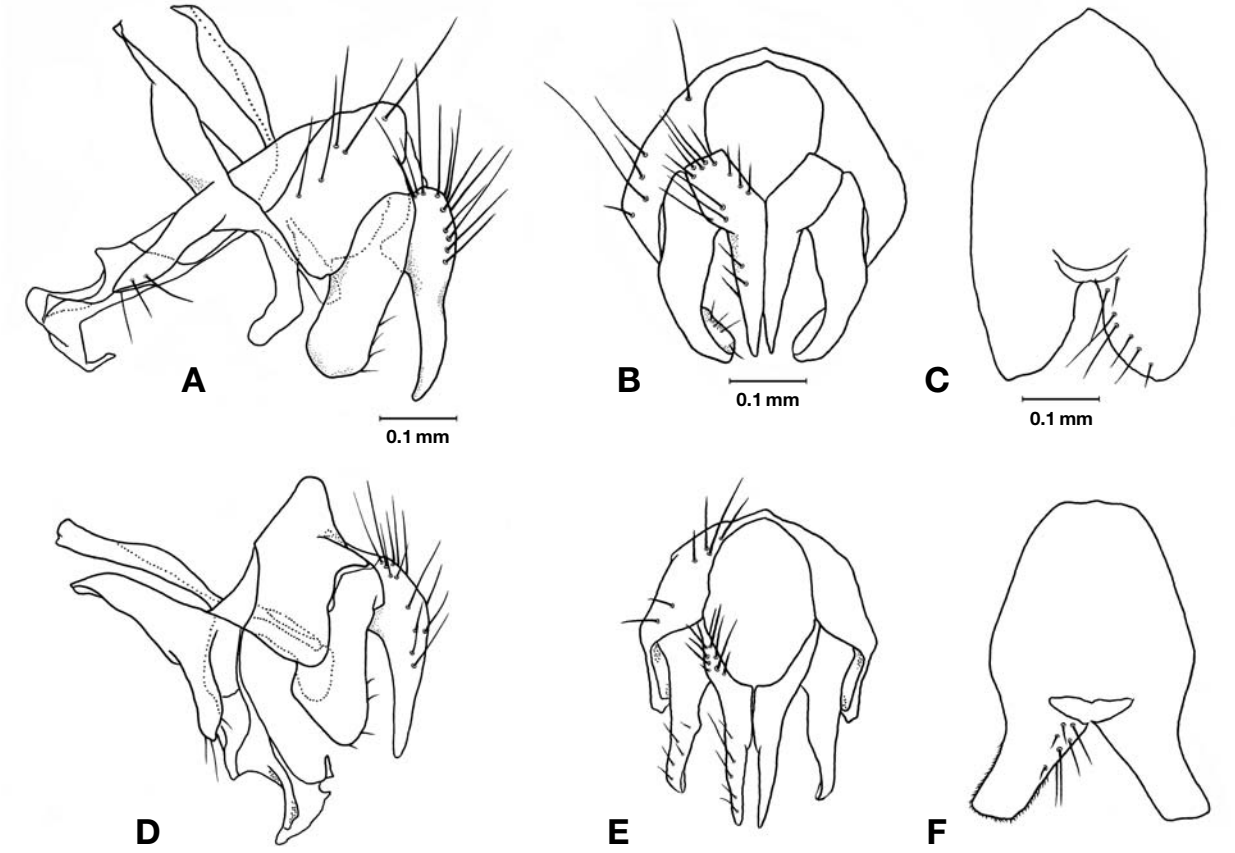

Fig. 3. Lateral and caudal views of epandrial complex and ventral view of sternite 5 in male. A-C, *Trigonospila ludio* (Zetterstedt); D-F, *T. transvittata* (Pandellé).

episternum with 1 strong upward seta; proepimeron with 2 upward setae; katepisternum with 3 setae and weak dark brown setulae; katepimeron bare; katatergite bare; anatergite bare; meron bare, except for strong vertical row; 2+2-3 acrostichal; 2-3+3-4 dorsocental; 1+3 intraalar; 1-2+3 supraalar; postpronotum with 2 setae; scutellum with 3 scutellar setae without apical setae; subapical scutellar seta 1.5-1.7× as long as scutellum length, lateral scutellar seta 0.5-0.7× as long as subapical scutellar seta, basal scutellar seta almost as long as subapical scutellar seta; anepisternum with 1-2 small setae antero-dorsally; anepimeron transversely hairy in middle; mediotergite dark brown with whitish yellow pruinosity; lappet of posterior spiracle densely covered with dark brown hairs; prosternum bare. Legs (Fig. 1B) entirely blackish brown with dark brown setae and setulae; fore coxa anterodorsally with 8-12 strong setae; fore tibia with 2-3 posterior setae; tarsal claws as long as 5th tarsomere; fore femur with rows of anterodorsal and posterodorsal setae; mid tibia with 1-3 anterodorsal, 2 posterodorsal, and 1 ventral setae; hind tibia with 2-3 posterodorsal setae; hind tibia without posteroventral apical seta. Wing (Fig. 1A, B) hyaline with slightly dark brown tinge; wing-thorax ratio 2.31-2.34, vein R_{4+5} ratio 2.50-3.33, vein M ratio 0.94-1.24, subcosta-costa ratio 0.48-0.53; fork of R_{2+3} and R_{4+5} dorsally and ventrally with 1 tiny seta each; tegular and basicosta blackish brown; C beyond subcostal break ventrally bare; costal spine 3× as long as costal setulae; corssvein DM-Cu oblique; wing cell r_{4+5} open; calypters bare. Abdomen yellowish brown in ground color with black triangular band posteriorly; with black setae and setulae except for yellow brown ventral setulae; middorsal depression extending to middle of tergite 1+2; tergite 3-5 with discernible but irregular discal setae. Genitalia (Fig. 3A, B) yellow brown to dark brown; sternite 5 (Fig. 3C) posteriorly with V-shaped median cleft, 0.3× as deep as sternite length; cercus apically pointed in posterior view; surstylus apically bent inward in posterior view.

Female. (Figs. 1C, D, 2C, D) similar to males except for the following non-genitalic characters: Wing length 4.8-7.0 mm; thorax length 2.2-3.0 mm. Head with frons-head ratio 0.26-0.28; gena-eye ratio 0.14-0.17; 9-10 frontal setae; 3 proclinate orbital setae, 0.5-0.8× as long as inner vertical seta; 1 recli-

nate orbital seta, 0.5-0.8× as long as inner vertical seta.
Host. Unknown.
Distribution. Korea, Japan, China.
Remark. This species is here reported for the first time in Korea.

[1]**Trigonospila transvittata* (Pandellé) (Figs. 1E-H, 2E-H, 3D-F)

Succingulum transvittatum Pandellé, 1896: 148 (type locality: Hyéres, Var, France).
Hypostena signifera Coquillett, 1898: 331 (type locality: Gifu, Honshu, Japan).
Leskia fasciata Matsumura, 1916: 393 (type locality: Komaba, Tokyo, Japan).
Trigonospila transvittata: Mesnil, 1965: 720 (redescription); Shima, 1979: 299 (redescription); Herting and Dely-Draskovits, 1993: 149 (in Palaearctic Catalog); Chao, 1999: 1717 (redescription).
Korean Records. Leskia fasciata: Doi, 1938: 5 (in Korean Diptera list). *Trigonospila transvittata*: Lee and Kwon, 1981: 163 (in fauna of Ullungdo and Dokdo); ESK and KSAE, 1994: 309 (in Korean checklist); Kwon et al., 1996: 504 (in fauna of Ullungdo and Dokdo); Han et al., 1999: 149 (in fauna of Mts. Seondal and Eorae). We suspect that some of the above Korean records include the closely resembling and equally common species, *T. ludio*.

Materials examined. KOREA: Chungcheongbuk-do: 2♂, Chungju-si, Jongmin-dong, from recreation forest to Mt. Gyemyeongsan (775 m) peak, 2.VII.2003 (D.-S. Choi and H.-W. Byun); 1♂, ditto, 30.VII.2003. Chungcheongnam-do: 1♀, Taean-gun, 8.VIII.2006 (D.-S. Choi et al.). Gangwon-do: 1♂, Wonju-si, Heungeop-myeon, Yonsei Univ. Campus, 19.V.2004 (H.-S. Lee); 1♂, ditto, 6.IX.2006 (H.-W. Byun). Gyeonggi-do: 2♂, Cheonggyesan, 10.VI.1984 (H.-Y. Han and K.-E. Ro); 4♂, ditto, 17.VII.1984; 2♂, ditto, 18.VIII. 1984; 2♂, ditto, 8.IX.1984; 2♂, ditto, 15.IX.1984; 2♂, ditto, 15.IX.1984; 2♂, ditto, 23.IX.23; 1♂, Icheon, 16.IX.1984 (H.-Y. Han); 5♂, 1♀, Jingwan-ri, 10.IX.1983 (H.-Y. Han); 2♂, ditto, 18.IX.1983; 13♂, ditto, 21.IX.1984; 6♂, Mt. Surisan, 24.V.1984 (H.-Y. Han and K.-E. Ro); 1♂, Yangsu-ri, 29.V.1984 (H.-Y. Han). Seoul: 1♂, Jamsil, 13.IX.1984 (H.-Y. Han).
Diagnosis. *Trigonosila transvittata* is similar to *T. ludio*, but can be distinguished from the latter by the following characteristics: 1) ground color white; 2) black thoracic transverse band reaching wing base (Fig. 1E, F) frontal setae upright; 4) fore tibia with singe posterior seta; and 5) syntergite 1+2 extending to median marginal seta.
Redescription. Male. Body white with black transverse band on scutum and abdomen; wing length 4.2-6.2 mm; thorax length 1.8-3.0 mm. Head (Fig. 2E, F) with frons-head ratio 0.13-0.19, eye ratio 0.52-0.61, gena-eye ratio 0.12-0.15, arista-antenna ratio 1.20-1.43; compound eye bare; inner vertical seta, 0.20-0.26× as long as longest diameter of eye; outer vertical seta absent; ocellar seta 1.10-1.15× as long as inner vertical seta; postocellar seta 0.8× as long as inner vertical seta; paravertical seta short but clearly discernible, about 0.4-0.5× as long as inner vertical setae; ocellar triangle with black setulae; orbital plate with whitish brown pruinosity; 12-14 frontal setae, above level of aristal sockets; orbital seta indistinguishable from nearby frontal setae; frontal vitta black, bare; pedicel, scape and flgellomere 1 dark brown with yellow brown pruinosity; aristomere 1 as long as wide, aristomere 2 twice longer than wide and basal 1/6 of aristomere 3 thickened; flagellomere 1 slender, about 2.8-3.8× longer than wide; facial carina weak; parafacial with densely whitish pruinosity, bare, 0.5-0.8× as wide as flagellomere 1; postgena moderately swollen with relatively long whitish yellow setulae; labella with dark brown setulae; palpi blackish brown with dark brown setulae. Thorax (Fig. 1E, F) almost whitish pruinosity with transverse bands on scutum and scutellum; postpronotum with 3 setae arranged irregularly; 3+3 acrostichal; 2+3-4 dorsocental; 1-2+3 intraalar; 1-2+3 supraalar; scutellum with 3 scutellar setae without apical setae, subapical scutellar seta 1.5-1.7× as long as scutellum length, lateral scutella seta 0.3-0.5× as long as subapical scutellar seta, basal scutellar seta 0.78-0.85× as long as subapical scutellar seta, with 2 weak discal setae; anepisternum with 1-2 small setae antero-dorsally; anepimeron transversely hairy in middle; mediotergite dark brown with whitish yellow pruinosity; posterior spiracle with reddish brown hairy lappet; prosternum bare. Legs (Fig. 1F) almost blackish brown with dark brown setae and setulae; fore tibia with 1 posterior setae; mid tibia 3-4 posterior setae; tarsal claws, at least as long as length of 5th tarsomere. Wing (Fig. 1E, F) hyaline with slightly dark brown tinge; wing-thorax ratio 1.90-2.33, vein R_{4+5} ratio 2.91-3.50, vein M ratio 1.10-1.29, subcosta-costa ratio 0.30-0.43; fork of R_{2+3} and R_{4+5} dorsally and ventrally with 1 tiny seta each; tegular and basicosta blackish brown. Abdomen whitish pruinosity with transverse bands posteriorly. Genitalia (Fig. 3D, E) yellow brown to dark brown; sternite 5 (Fig. 3F) posteriorly with V-shaped median cleft, 0.3× as deep as sternite length making about 90 degree; cercus apically pointed in posterior view; surstylus almost straight in posterior view.
Female. (Figs. 1G, H, 2G, H) similar to males except for the following non-genitalic characters: Wing length 4.3-5.0 mm;

[1]*검정띠기생파리

thorax length 2.1-2.6 mm. Head with frons-head ratio 0.23-0.24; gena-eye ratio 0.11-0.12; 7-10 frontal setae; 2-3 proclinate orbital setae, 0.8× as long as inner vertical seta; 1 reclinate orbital seta, 0.68× as long as inner vertical seta.
Host. Unknown.
Distribution. Korea, Japan, China.

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