

Redescriptions of Two Closely Resembling *Chrysotoxum* Species (Insecta: Diptera: Syrphidae) New to Korea

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ABSTRACT

As a result of ongoing systematic study of the genus *Chrysotoxum*, we have discovered *C. ramphostomus* and *C. tuberculatum* for the first time in Korea. These two species closely resemble each other and need to be identified with caution. We here provide detailed redescrptions and illustrations with their diagnostic characters indicated. *Chrysotoxum tuberculatum* can be readily distinguished from *C. ramphostomus* by the following characteristics: 1) hind trochanter with small tubercle; 2) compound eyes apparently bare; 3) basal 1/5 of hind femora brownish yellow; and 4) male genitalia asymmetrical in caudal view.

Key words: Diptera, Syrphidae, taxonomy, *Chrysotoxum ramphostomus*, *Chrysotoxum tuberculatum*

INTRODUCTION

The hoverfly genus *Chrysotoxum* Meigen includes over 110 recognized species with predominantly Palaearctic distribution. Members of the genus can be distinguished from other syrphid taxa by the combination of the following characteristics (modified from Stubbs and Falk, 2002; Violoovitsh, 1974): 1) antenna usually positioned horizontally, generally longer than head with elongate third antennal segment; 2) wing vein R₄₊₅ dipped posteriorly; and 3) abdomen black with yellow bars or bands or characteristic black arcuate markings.

Okamoto's (1924) report of *C. japonicum* Matsumura (= *C. festivum* (Linnaeus)) was the first recording of the genus *Chrysotoxum* in Korea. Since then, this genus has been treated in a number of studies (e.g., Doi, 1938; Kim, 1980; Kim, 1980; Han et al., 1998). Most recently, Han and Choi (2001) compiled a Korean check list of the family Syrphidae including seven *Chrysotoxum* species.

As a result of ongoing systematic study of the genus *Chrysotoxum*, we have discovered two closely resembling species, *C. ramphostomus* and *C. tuberculatum*, for the first time in Korea. We here provide detailed redescrptions and illustrations with their diagnostic characters indicated.

MATERIALS AND METHODS

The morphological terminology and interpretations follow

Thompson (1999) and McAlpine (1981). The two lengths and seven ratios used in the descriptions were modified from Han and Norrbom (2005): body length (anterior margin of head excluding antenna to posterior margin of abdomen); wing length (anterior margin of tegular to apex of vein R₄₊₅); face-head ratio (width of face/width of head in dorsal view); eye ratio (shortest eye diameter/longest eye diameter); gena-eye ratio (genal height/longest eye diameter); arista-antenna ratio (length of arista/length of antenna excluding arista); wing-mesonotum ratio (wing length/mesonotum length); vein R₄₊₅ ratio (distance along vein R₄₊₅ between crossvein R-M and vein R₄₊₅ apex/distance between crossvein R-M and basal node of vein R₄₊₅); and vein M ratio (distance along vein M between crossveins R+M and DM-Cu/distance between crossveins R-M and BM-Cu).

All the examined Korean specimens are deposited in the Division of Biological Science and Technology, Yonsei University, Wonju Campus, Korea (YSUW). The acronyms of the other institutions mentioned in the text are as follows: Institute of Biology and Soil Sciences, Vladivostok, Russia (IBSS); United States National Museum of Natural History, United States National Entomological Collection, Washington, DC, USA (USNM); Zoological Museum, Academy of Sciences, Russian Academy of Sciences, Universitetskaya, Naberzhnaya B-164, St. Petersburg, Russia (ZISP).

SYSTEMATIC ACCOUNTS

Order Diptera
Family Syrphidae Rondani, 1856

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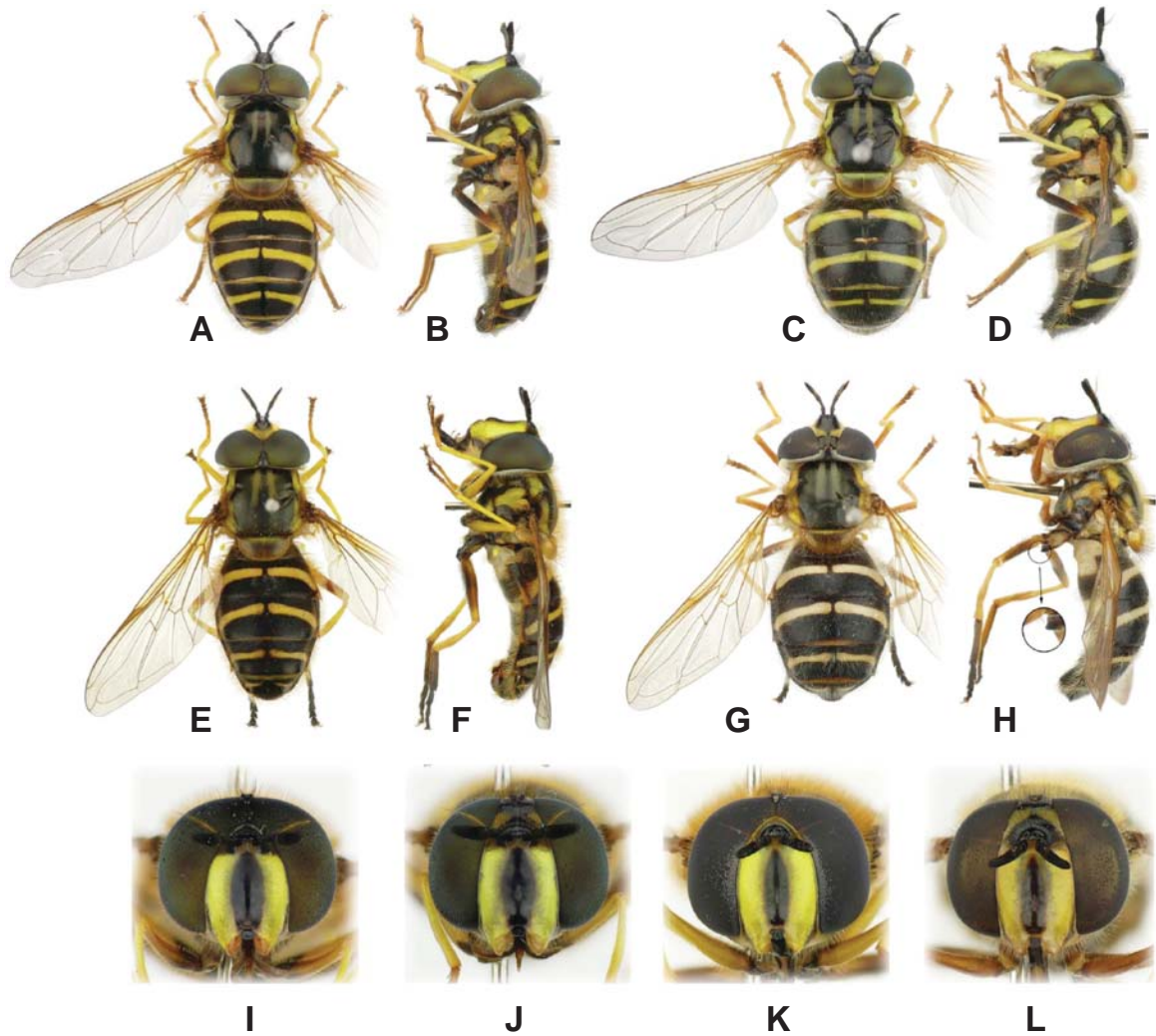


Fig. 1. *Chrysotoxum ramphostomus*. A, B, I, male (11 mm excluding antennae); C, D, J, female (10.8 mm). *C. tuberculatum*. E, F, K, male (13.7 mm); G, H, L, female (13.2 mm).

Genus *Chrysotoxum* Meigen, 1803

¹*1. *Chrysotoxum ramphostomus* Mutin

(Figs. 1A-D, I, J, 2A, B)

Chrysotoxum ramphostomus Mutin, 1999: 379 (type-locality: Primorskiy Kray, Anisimovka, Russia; holotype ♂, IBSS).

Material examined. Paratype female of *C. ramphostomus*: Russia (USNM). In addition, we have examined over 300 specimens (YSUW) from the following seven districts in KOREA: Seoul: 1 ♀; Chungchengbuk-do: 1 ♀; Gangwon-do: 168 ♂♂, 129 ♀♀; Gyeongsangbuk-do: 1 ♂, 3 ♀♀; Gyeongsangnam-do: 14 ♂♂, 18 ♀♀; Jeollabuk-do: 8 ♂♂,

3 ♀♀; Jeollanam-do: 17 ♂♂, 2 ♀♀.

Diagnosis. This species can be distinguished from other members of the *Chrysotoxum* by the combination of the following characteristics (modified from Mutin, 1999): 1) lower portion of face produced forward to level of facial tubercle in lateral view (Fig. 1B, D); 2) dense hairs on compound eyes can be clearly seen under low magnification; and 3) basal half to 2/3 of hind femora dark brown (Fig. 1B, D). This species superficially resembles *C. tuberculatum* but can be readily distinguished by not having a small tubercle on hind trochanter (Fig. 1H) as well as the above characteristics. In addition, male genitalia of *C. tuberculatum* are much larger than those of this species (almost twice as large in similar

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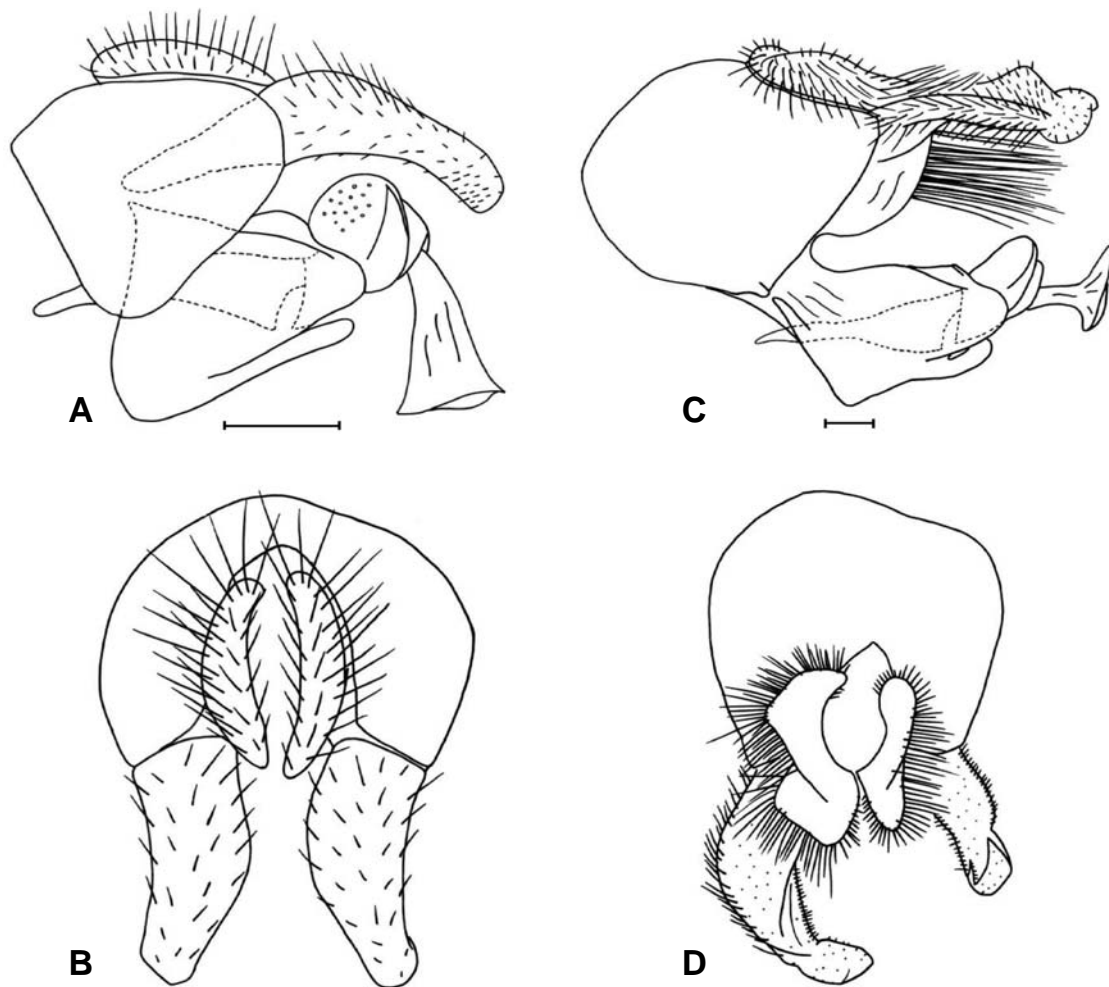


Fig. 2. Male genitalia. A-B, *Chrysotoxum ramphostomus*: (A) lateral view; (B) caudal view. C-D, *C. tuberculatum shannon*: (C) lateral view; (D) caudal view. Scale bars=0.5 mm (A, C).

sized specimens).

Redescription of male. Body length 10.62-13.73 mm; wing length 8.67-11.59 mm. Head (Fig. 1A, B, D) with face-head ratio 0.44-0.46; eye ratio 0.50-0.53; gena-eye ratio 0.06-0.08; arista-antenna ratio 0.57-0.64; vertex brownish black in ground color with ivory white pruinosity posterolaterally, with brownish black and yellow brown hairs mixed; ocellar triangle brownish black with brownish black hairs; ocelli arranged in isosceles triangle; occiput with dense ivory white pruinosity, dorsally with yellow brown and brownish black hairs mixed, laterally only with pale yellow hairs; frons brownish black in ground color with posterior 1/5 to 1/3 pale yellow pruinosity, with brownish black and yellow brown hairs mixed; face yellow in ground color with yellow brown hairs; vertically elliptic brownish black facial mid-stripe shiny and bare, 1/3 as wide as face in middle; gena pale yellow to brownish yellow in ground color with about

anterior 1/3 darker (variable from dark brown to yellow brown), posteriorly with pale yellow to yellow brown hairs; eyes holoptic with short dense hairs; antennal scape and pedicel brownish black with short brownish black hairs; flagellomere 1 brownish black, bare; length ratio of scape : pedicel : flagellomere 1 (measured dorsally) approximately 1 : 1.2 : 2.5. Thorax (Fig. 1A, B): scutum with yellow brown hairs, shiny black with golden tinge; anterior half of scutum with pair of grayish submesal longitudinal stripes; notopleuron and postalar callus brownish yellow with yellow brown hairs; scutellum translucent, yellow brown in ground color with yellow pruinosity marginally, with yellow brown hairs but some individuals with few dark brown hairs mixed posteriorly; postpronotum brown in ground color with lateral 1/4 yellow, bare; anterior anepisternum dark brown, bare; posterior anepisternum anteromarginally brownish black and posteriorly yellow, densely with long yellow brown

hairs except on lower 1/2 of dark brown area; proepimeron yellow to brown with yellow brown hairs; katapisternum brownish black in ground color with small longitudinally elliptic yellow spot dorsally, mostly bare except for yellow hairs on yellow spot and posterior 1/4; anepimeron brownish black with yellow brown hairs; katapimeron brown with yellow brown hairs; meron brownish black, bare; katatergite pale yellow with yellow brown hairs. Wing (Fig. 1A) entirely microtrichose, mostly hyaline except for cells bc, c and sc brownish yellow and pterostigma yellow brown; wing-mesonotum ratio 2.27-2.56; vein R_{4+5} ratio 3.13-3.61; vein M ratio 2.04-2.30; calypter pale yellow, marginally with yellow brown hairs; halter yellow. Legs (Fig. 1A, B) predominantly brownish yellow with some darker areas, with yellow brown hairs; fore coxa dark brown, bare except for apical area, anteriorly with long yellow brown hairs, posteriorly bare; fore trochanter dark brown; basal 1/5 to 1/4 of fore femur dark brown; fore tarsus yellow brown; mid coxa dark brown, bare except for apical area, anteriorly with long yellow brown hairs, posteriorly bare; mid trochanter dark brown; basal 1/5 to 1/4 of midfemur dark brown; mid tarsus yellow brown; hind coxa dark brown; hind trochanter dark brown; basal 2/3 of hind femur dark brown, with yellow brown hairs except for anteroventral brownish black hairs (some individuals have few brownish black hairs or only yellow brown hairs); hind tarsus brown. Abdomen (Fig. 1A, B) with preabdominal tergites brownish black in ground color with yellow bands; tergite 1 with lateral and anteromarginal areas pale yellow, entirely covered with yellow brown hairs; tergites 2-5 each with very narrow posteromarginal yellow area, and yellow crescent-shaped transverse discal band narrowly interrupted in middle (widely interrupted in tergite 5) and slightly apart from lateral margins; each tergite also anteriorly with yellow brown hairs and posteriorly (1/4-1/2) with short brownish black hairs; preabdominal sternites each covered with yellow brown hairs except for posteromarginal area (1/5-1/2) with short brownish black hairs; sternite 1 translucent, pale yellow in ground color with single brownish black anteromarginal spot, with yellow brown hairs; sternites 2-3 brownish black in ground color, each with anteromarginal transverse pale yellow band; sternite 4 brownish black in ground color with pair of pale yellow transversely elliptic anterior spots. Genitalia (Fig. 2A, B) dark brown in ground color; epandrium more or less reverse triangular in lateral view; cercus yellow brown with yellow brown hairs, slightly asymmetric crescent shape in caudal view; sustylus with yellow brown hairs, apically curved toward aedeagus in lateral view; hypandrium medioventrally with long blunt process; aedeagus curved downward in right angle, apically swollen.

Female. Similar to male except for the following non-genital characters: ocelli arranged in equilateral triangle; frons brownish black in ground color with pair of triangular spots in pale yellow pruinosity; eyes dichoptic. Lengths and ratios: body length 10.42-14.03 mm; wing length 8.47-11.69 mm; face-head ratio 0.43-0.47; eye ratio 0.46-0.54; gena-eye ratio 0.07-0.09; arista-antenna ratio 0.56-0.63; wing-mesonotum ratio 0.22-2.37; vein R_{4+5} ratio 2.74-3.26; vein M ratio 2.12-2.22. Length ratio of scape : pedicel : flagellomere 1 (measured dorsally) approximately 1 : 1.1 : 2.6.

Distribution. Korea, Russian Far East.

Remarks. According to the collection records in Korea, this species appears widespread in South Korea. Freshly collected specimens of this species show greenish tinge on yellow areas especially in females (Fig. 1C, D, J), but tinge disappears as the specimens age.

¹*2. *Chrysotoxum tuberculatum* Shannon

(Figs. 1E-H, K, L, 2C, D)

Chrysotoxum tuberculatum Shannon, 1926: 14 (type-locality: Uen Chaun Shien, Szechuen, China; holotype ♂, Cat. No. 28316, USNM); Violovitsh, 1974: 147 (in Palaearctic key); Peck, 1988: 63 (in Palaearctic catalog); Mutin, 1999: 378 (in Russian Far East key; synonymized *C. amurense* with *C. tuberculatum*); Huo et al., 2007: 62 (fauna of Mt. Qinling-Bashan in China, redescription).

Chrysotoxum amurense Violovitsh, 1973: 926 (type-locality: Klimoutsy, 40 km Eastern Svobodnyy, Amur region, Russia; holotype ♀, ZISP); Violovitsh, 1974: 140 (in Palaearctic key); Violovitsh, 1983: 61 (in Siberian key); Peck, 1988: 56 (in Palaearctic catalog).

Material examined. Holotype of *C. tuberculatum*: CHINA: Uen Chaun Shien, Szechuen. 7-VIII-1924 (D.C. Graham) (USNM). RUSSIA: Southern Primorskiy Kray, Vityaz Bay, 21-VII-1982 (V.A. Mutin) (YSUW). KOREA: Gangwon-do: 6♂♂, Wonju-si, Panbu-myeon, Seogok, Mt. Baegunsan from Yongsu-gol to 1,087.1 m peak, 27-VII-1998 (H.W. Byun, D.S. Choi and S.K. Kim); 1♂, ditto, 29-VII-1998 (D.S. Choi and S.K. Kim); 1♀, ditto, 04-IX-1999 (D.S. Choi and C.H. Park); 1♀, ditto, 17-VIII-1999 (H.Y. Han, D.S. Choi and S.K. Kim); 1♂, ditto, 09-VII-2000 (D.S. Choi, S.K. Kim and C.H. Park); 12♂♂, ditto, 02-VIII-2000 (D.S. Choi, C.H. Park and D.W. Kim); 5♂♂, ditto, 04-VIII-2003 (O.Y. Lim et al.); 3♂♂, ditto, 15-VIII-2003 (H.W. Byun); 2♂♂, ditto, 13-VIII-2004 (O.Y. Lim and H.S. Lee); 1♂, ditto, 20-VII-2005 (H.S. Lee and S.M.R. Hwang); 1♂, Wonju-si, Sillim, Mt. Chiaksan, Seongnam-ri to 1,181.5 m, Namdaebong peak, 08-VII-2000 (D.S. Choi, S.K. Kim and

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C.H. Park); 3♂♂, ditto, 13-VIII-2000 (D.S. Choi et al.); 1♂, ditto, 20-VIII-2001 (D.S. Choi and O.Y. Lim); 1♂, ditto, 30-VII-2003 (O.Y. Lim and H.S. Lee); 4♂♂, Taebaek-si, Hyeol-dong, Mt. Taebaeksan, from Yuilsa to 1,560.6 m peak, 12-VIII-2000 (D.S. Choi, S.K. Kim and C.H. Park); 1♂, Inje-gun, Girin-myeon, Mt. Jeombongsan, from Jindong-ri to 1,424 m peak, 07-VIII-1997 (H.Y. Han, H.W. Byun and D.S. Choi); 10♂♂, 2♀♀, Jeongseon-gun, Gohan-eup, Mt. Hambaeksan, From Manhang-jae to 1,573 m peak, 14-VIII-1999 (H.Y. Han et al.); 1♂, ditto, 01-VIII-2003 (D.S. Choi et al.); 4♂♂, Jeongseon-gun, Jeongseon-eup, Mt. Gariwangsan, from Mahangchi to 1,561 m peak, 24-VIII-2001 (H.Y. Han and K.E. Ro); 11♂♂, Jeongseon-gun, Nam-myeon, Mt. Mindungsan, form Yupyong-ri to 1,119 m peak, 02-VIII-2001 (H.Y. Han and K.E. Ro); 1♂, ditto, 09-VIII-2001 (H.Y. Han and K.E. Ro); 1♂, ditto, 18-VIII-2001 (D.S. Choi, O.Y. Lim and H.S. Lee); 1♀, ditto, 13-VIII-2005 (H.Y. Han et al.); 1♂, Hongcheon-gun, Nae-myeon, Mt. Gachilbong, 24-VIII-1997 (H.W. Byun and D.S. Choi); 4♂♂, Hongcheon-gun, Nae-myeon, Mt. Gyeongbangsan, Unduryeong, 06-VIII-1997 (H.Y. Han, H.W. Byun and D.S. Choi); 1♂, ditto, 12-VIII-1997 (H.W. Byun and D.S. Choi); 7♂♂, ditto, 12-VIII-2003 (H.W. Byun, O.Y. Lim and H.S. Lee); 7♂♂, ditto, 07-VIII-2004 (H.W. Byun, O.Y. Lim and H.S. Lee); 7♂♂, ditto, 05-VIII-2005 (D.S. Choi et al.); 6♂♂, Hwacheon-gun, Sanae-myeon, Gwangdeokdong, Mt. Gwangdeoksan, 20-VII-1997 (H.Y. Han, H.W. Byun and D.S. Choi); 1♂, Hoengseong-gun, Anheung-myeon, Mt. Chiaksan, Gangrim 4-ri to Cheonjibong (1,086 m), 10-VIII-1999 (D.S. Choi, S.K. Kim and C.H. Park); 2♂♂, Hoengseong-gun, Dunnae-myeon, Mt. Cheongtaesan, Sapyo-ri to 1,200 m peak, 07-VII-2001 (D.S. Choi, S.K. Kim and D.S. Kang); 7♂♂, ditto, 27-VII-2002 (D.S. Choi, O.Y. Lim and H.S. Lee); 1♂, ditto, 09-VIII-2003 (O.Y. Lim and H.S. Lee); 1♂, ditto, 01-VIII-2006 (H.W. Byun, J.S. Lim and D.J. Cha). All the above Korean specimens are deposited in YSUW.

Diagnosis. This species can be distinguished from the other members of *Chrysotoxum* by the combination of the following characteristics: 1) hind trochanter with small tubercle (Fig. 1H); 2) compound eyes apparently bare; 3) basal 1/5 and apical 1/5 of hind femora brownish yellow (Fig. 1F, H); 4) lateral margin of tergites 2 to 3 brownish black, alternating with yellow (Fig. 1E-G); and 5) male genitalia asymmetrical in caudal view (Fig. 2D). *Chrysotoxum tuberculatum* is very similar to *C. maershanicum*, *C. tiantaiensis* and *C. zibaiensis* from China but distinguished by the following characteristics (modified from Li and He, 1994; Huo et al., 2007): 1) flagellomere 1 longer than scape and pedicel combined; and 2) lateral margins of tergite 2 anteriorly brownish black and posteriorly yellow (same in tergite 3).

Redescription of male. Body length 11.7-14.8 mm; wing length 10.2-12.5 mm. Head (Fig. 1E, F, K) with face-head ratio 0.41-0.44; eye ratio 0.47-0.52; gena-eye ratio 0.07-0.08; arista-antenna ratio 0.63-0.74; vertex brownish black in ground color with ivory white pruinosity posterolaterally, with brownish black and yellow brown hairs mixed; ocellar triangle brownish black with brownish black hairs; occiput with dense ivory white pruinosity, dorsally with yellow brown and brownish black hairs mixed, laterally only with pale yellow hairs; frons brownish black in ground color with posterior 1/2 pale yellow pruinosity, anterior 1/2 with brownish black hairs and posterior 1/2 with yellow brown hairs; face yellow in ground color with yellow brown hairs; vertically elliptic brownish black facial mid-stripe shiny and bare, 1/3 as wide as face in middle; gena pale yellow to brownish yellow in ground color with about anterior 1/3 darker (variable from dark brown to yellow brown), posteriorly with pale yellow to yellow brown hairs; eyes holoptic, bare; antennal scape and pedicel brownish black with short brownish black hairs; flagellomere 1 brownish black, bare; length ratio of scape : pedicel : flagellomere 1 (measured dorsally) approximately 1 : 1.2 : 3. Thorax (Fig. 1E, F): scutum with yellow brown hairs, shiny black with golden tinge; anterior half of scutum with pair of grayish submesal longitudinal stripes; notopleuron and postalar callus yellow with yellow brown hairs; scutellum translucent, yellow brown in ground color with yellow brown hairs, but some individuals have few dark brown hairs mixed posteriorly; postpronotum brown in ground color with lateral 1/4 yellow, bare; anterior anepisternum dark brown, bare; posterior anepisternum anteromarginally brownish black and posteriorly yellow, densely with long yellow brown hairs except on lower 1/2 of dark brown area; proepimeron yellow to brown with yellow brown hairs; katapisternum brownish black in ground color with small longitudinally elliptic yellow spot dorsally, mostly bare except for yellow hairs on yellow spot and posterior 1/4; katepimeron brown with yellow brown hairs; meron dark brown to brownish black, bare; katatergite pale yellow with yellow brown hairs. Wing (Fig. 1C) entirely microtrichose, mostly hyaline except for cells bc, c and sc brownish yellow and pterostigma yellow brown; wing-mesonotum ratio 2.27-2.49; vein R_{4+5} ratio 3.03-3.48; vein M ratio 1.83-2.20; calypter pale yellow, marginally with yellow brown hairs; halter yellow. Legs (Fig. 1E, F) predominantly brownish yellow with some darker areas, with yellow brown hairs; fore coxa dark brown, bare except for apical area; fore trochanter dark brown; fore tarsomere 2-5 darker than brownish yellow tarsomere 1; mid coxa bare except for apical area; mid trochanter dark brown; basal 1/5 of midfemur dark brown; mid tarsomere 2-5 darker than brownish yellow tarsomere 1; hind coxa dark brown, anteriorly with long yellow

brown hairs, posteriorly bare; hind trochanter dark brown with small tubercle, densely with dark brown hairs except on tubercle with short hairs; hind femur with darker area on about middle 1/5 to 4/5, with yellow brown hairs except for anteroventral brownish black hairs (some individuals have few brownish black hairs or only yellow brown hairs); hind tarsus brown with brown hairs except for anteroventral brownish black hairs. Abdomen (Fig. 1E, F) with preabdominal tergites brownish black in ground color with yellow bands; tergite 1 with lateral and anteromarginal areas pale yellow, entirely covered with yellow brown hairs; tergites 2-5 each with very narrow posteromarginal yellow area, and yellow crescent-shaped transverse discal band narrowly interrupted in middle (widely interrupted in tergite 5) and slightly apart from lateral margins; each tergite also anteriorly with yellow brown hairs and posteriorly (1/4-1/2) with short brownish black hairs; preabdominal sternites each covered with yellow brown hairs except for posteromarginal area (1/4-2/3) with short brownish black hairs; sternite 1 translucent, pale yellow in ground color with single brownish black anteromarginal spot, with yellow brown hairs; sternites 2-4 each with very narrow posteromarginal yellow area and anteromarginal transverse pale yellow band except for sternite 4 with pair of pale yellow tranversely elliptic anterior spots. Genitalia (Fig. 2C, D) dark brown in ground color; epandrium more or less rhombic in lateral view; cercus yellow brown with apical 1/3 darker, densely with yellow brown hairs; genitalia in caudal view distinctly asymmetrical with left cercus and sustylus much larger than right ones (Fig. 2D); hypandrium well separated from epandrium, medioventrally with blunt process; aedeagus apically trumpet-shaped (Fig. 2C).

Female. Similar to males except for the following non-genital characters: ocelli arranged in equilateral triangle; frons brownish black in ground color with pair of triangular spots in pale yellow pruinosity; eyes dichoptic. Lengths and ratios: body length 13.0-14.1 mm; wing length 10.7-12.3 mm; face-head ratio 0.40-0.42; eye ratio 0.48-0.52; gena-eye ratio 0.07-0.11; arista-antenna ratio 0.58-0.67; wing-mesonotum ratio 2.34-2.51; vein R_{4+5} ratio 3.14-3.53; vein M ratio 2.04-2.39. Length ratio of scape : pedicel : flagellomere 1 (measured dorsally) approximately 1 : 1.3 : 3.

Distribution. China, Korea, Russian Far East, Tajikistan, Turkmenistan, Uzbekistan.

Remarks. Collection records of this species in Korea are restricted to Gangwon-do, which is northernmost province in South Korea.

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