



RESEARCH ARTICLE

Review of the genus *Doryphorina* Melichar, 1912 (Hemiptera: Fulgoromorpha: Dictyopharidae)

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Abstract: The dictyopharid planthopper genus *Doryphorina* Melichar, 1912 is revised on the base of examination of the type specimens deposited in Museum and Institute of Zoology, Polish Academy of Sciences in Warsaw. The genus includes three known species *D. stali* Melichar, 1912, *D. minor* Fennah, 1978, and *D. subdeflexa* Fennah, 1978. The rank of the two latter is elevated to specific status from subspecies of *D. stali*. Male genitalia of all species are described and illustrated for the first time. A diagnostic key is provided for differentiation of the known species in the genus.

Keywords: Revision, taxonomy, taxonomic rank, male genitalia, Dictyopharini.

Introduction

The dictyopharid planthopper genus *Doryphorina* was established by Melichar based on a single species *Doryphorina stali* Melichar from Sumatra (Melichar 1912). Schmidt (1915) stated that parts of type materials of the species were deposited in the Stettin Museum. Fennah (1978) in his monograph of Fulgoroidea from Vietnam described two subspecies of *D. stali*, *D. stali minor* and *D. stali subdeflexa*. Traditionally, the genus *Doryphorina*, along with most other dictyopharid genera, was placed in Dictyopharini of Dictyopharinae (Melichar 1912, Metcalf 1946, Emeljanov 2011).

While sorting and identifying planthopper materials from the collection of Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland (MIZPAS) which took over partial zoological collection of the Stettin Museum, we found the types of three subspecies of *D. stali*. So we have a chance revise the genus and its species.

Material and Methods

The specimens studied in this work are deposited in Museum and Institute of Zoology, Polish Academy of Sciences, Warsaw, Poland (MIZPAS), and Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, Beijing, China (IZCAS).

Specimens used for dissection were cleared in 10% KOH at room temperature for ca. 6–12 hours, rinsed in distilled H₂O, then transferred to glycerol for examination. Observations, measurements and photography were made under a compound optical stereomicroscope (Zeiss Discovery V12) equipped with a Nikon D7000 digital camera. Final images were compiled from multiple photographs using CombineZM Image Stacking Software, and improved with the Adobe Photoshop CS5 software. Morphological characters were observed with a Zeiss (Stemi SV II) optical stereomicroscope and were illustrated with the aid of a drawing tube attached to the microscope.

The morphological terminology used in this study follows Anufriev & Emeljanov (1988) for external morphology and venation of the forewings, and Bourgoïn & Huang (1990) for male genitalia.

Results

Subfamily Dictyopharinae Spinola, 1839

Tribe Dictyopharini Melichar, 1912

Genus *Doryphorina* Melichar, 1912

Doryphorina Melichar, 1912: 99. Type species: *Doryphorina stali* Melichar, 1912; by original designation.

Doryphorina: Schmidt, 1915: 76; Distant, 1916: 25; Schmidt, 1928: 129; Metcalf, 1946: 87; Fennah, 1978: 254; Emeljanov, 2011: 1125.

Diagnosis: Head produced anteriorly in an elongate cylindrical cephalic process, much longer than pronotum and mesonotum combined, more or less parallel in profile, not distinctly tapering distally; vertex with median carina distinct at base and apex, remaining weakly ridged or indistinct; frons with median carina complete and weakly ridged, and intermediate carinae sub-parallel, nearly approaching frontoclypeal suture. Pronotum with median carina distinct and lateral carinae absent or slightly visible at base; a short carina extending obliquely across lateroventral lobes of pronotum; mesonotum tricarinate, lateral carinae straight and nearly parallel; forewings hyaline, stigma quadrangular, with 3–5 cells; fore femur not flattened and dilated, hind tibiae with 7 apical black-tipped teeth. Inner surface of gonostyles with a relatively compact tuft of setae; aedeagus with a pair of very short endosomal processes, not extended from phallosome; phallobase with paired membranous inflated apical lobes, with long spines.

Description

General color viridescent and greenish-ochraceous, marked with bluish green and purplish-red or reddish ochraceous on head and thorax.

Head (Figs. 1–5) more or less upturned, produced anteriorly in an elongate cylindrical cephalic process, much longer than pronotum and mesonotum combined; more or less parallel in lateral view (Fig. 4), not distinctly tapering distally. Vertex (Fig. 3) broadest at base and apex, lateral carinae sub-parallel or more or less narrowing in middle; posterior margin widely concave; median carina distinct at base and apex, remaining weakly ridged or

indistinct. Frons (Fig. 5) elongate, lateral carinate margins nearly parallel, not convex under antennae; posterior margin somewhat concave; intermediate carinae sub-parallel, nearly approaching frontoclypeal suture; median carina complete and weakly ridged. Postclypeus and anteclypeus convex at middle, with distinct median carina. Rostrum moderately long, reaching base of hind femora. Compound eyes oval and large. Ocelli relatively large, reddish. Antennae with very small scape; pedicel large and subglobose, with more than 50 distinct sensory plaque organs distributed over entire surface; flagellum long, setuliform.



Figure 1. *Doryphorina stali* Melichar, 1912, holotype, male.

Pronotum (Fig. 3) distinctly shorter than mesonotum medially, anteriorly slightly narrower than posteriorly; disc broad with anterior margin centrally slightly arched, posterior margin arcuately widely concave, lateral marginal areas straight and sloping with two long longitudinal carinae on each side between compound eyes and tegulae; median carina distinct with a big lateral pit on each side, lateral carinae absent or slightly present at base; a short carina extending obliquely across lateroventral lobes for about two-thirds of its length. Mesonotum (Fig. 3) tricarinate on disc, lateral carinae straight, nearly parallel. Forewings (Fig. 1) hyaline, much longer than tail of abdomen, with ratio of length to width about 3:1; veins without setae; M bifurcating to M_{1+2} and M_{3+4} near middle and beyond CuA forking; number of apical cells between R and CuA with 14–16; stigma quadrangular, with 3–5 cells. Legs moderately elongate, fore femora not flattened and dilated, without spine; hind tibiae

with 4–5 lateral black-tipped spines and 7 apical black-tipped teeth; hind tarsomere I with 14–22 and tarsomere II with 12–18 black-tipped apical teeth.

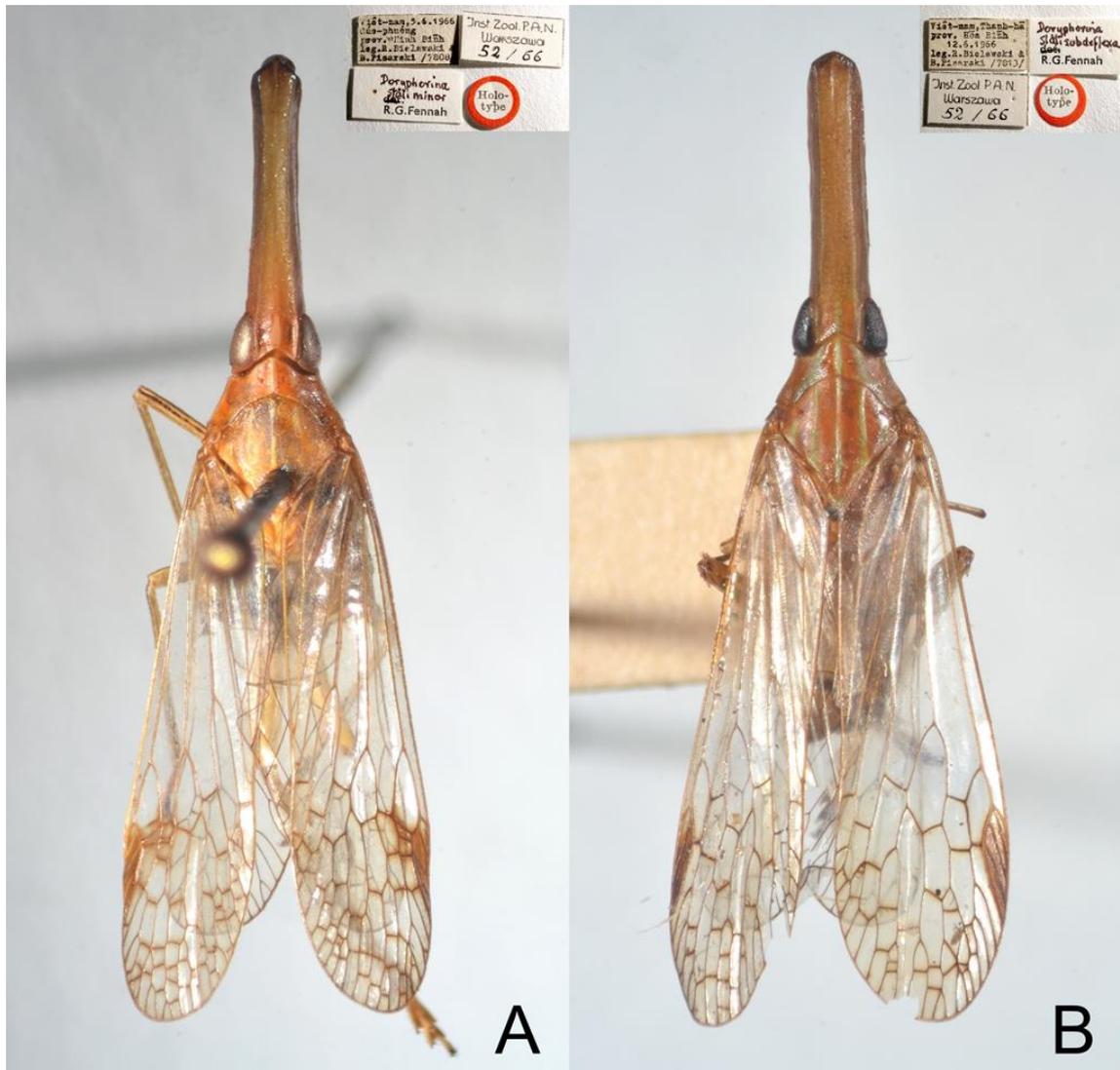


Figure 2. **A**, *Doryphorina minor* Fennah, 1978, holotype, male; **B**, *Doryphorina subdeflexa* Fennah, 1978, holotype, female.

Male genitalia. Pygofer wider ventrally than dorsally, dorsal margin slightly excavated to accommodate anal tube. Gonostyles symmetrical, numerous spiniform setae on inner surfaces in basal half; upper margin with a dorsally directed, black-tipped process at apex, outer upper edge with a ventrally directed, hook-like process near middle. Aedeagus with a pair of very short endosomal processes, but not extended from phallosome, invisible from outside. Phallobase basally sclerotized and pigmented, with paired membranous inflated apical lobes, with long spines.

Anal tube oval, apical dorsal margin excavated to accommodate anal style; anal style short and small.

Distribution: China, Burma, Vietnam, Malaysia, Indonesia.

Remarks: Melichar (1912) stated that this genus was allied to *Lappida* Amyot & Serville, 1843 from South America, but the latter belongs to the tribe Lappidini Emeljanov for its Sc+R and M veins with a long common stem in the forewings (Emeljanov 2011).



Figure 3. Dorsal view of head, pronotum and mesonotum. **A**, *Doryphorina minor* Fennah, 1978; **B**, *Doryphorina stali* Melichar, 1912; **C**, *Doryphorina subdeflexa* Fennah, 1978.

In the tribe Dictyopharini, *Doryphorina* is very similar to the genus *Raivuna* Fennah, 1978, but can be distinguished from the latter by the cephalic process very long and robust, more or less parallel in profile, not tapering distally; and the forewings with relatively more transverse veins.

Melichar (1912) erected this genus mainly due to the very long and robust cephalic process of *D. stali*. However, the length, thickness and general shape of cephalic process are likely to be variable in the same genus, such as *Dictyophara* Germar, and should be considered as subgeneric features. Emeljanov (2003) proposed that *Dictyophara* could be subdivided to five subgenera mainly based on the different characters on cephalic process. Our study also supported Emeljanov's classification about *Dictyophara* in China (Song & Liang 2008). Therefore, like *Dictyophara*, *Doryphorina* and *Raivuna* are inferred more probably to be congeneric and need to be revised further in future.

Key to the species of the genus *Doryphorina* Melichar

1. Vertex broad, lateral carinae nearly parallel; forewings without dull ochraceous spot near stigma *D. subdeflexa* Fennah
- Vertex relatively narrow, broadest at base and apex, lateral carinae more or less narrowing and convergent before compound eyes and then gradually widening towards apex; forewings with dull ochraceous spot near stigma 2

2. Cephalic process relatively short, with length ratio to pronotum and mesonotum combined about 1.9:1; gonostyles with upper process relatively short and broad; aedeagus with two pairs of apical lobes in ventral part *D. minor* Fennah
- Cephalic process long, with length ratio to pronotum and mesonotum combined about 2.0:1; gonostyles with upper process distinctly slender and long; aedeagus with a pair of apical lobes in ventral part *D. stali* Melichar



Figure 4. Lateral view of head and pronotum. **A**, *Doryphorina minor* Fennah, 1978; **B**, *Doryphorina stali* Melichar, 1912; **C**, *Doryphorina subdeflexa* Fennah, 1978.

Doryphorina minor Fennah, 1978 stat. nov. (Figs. 2A, 3A, 4A, 5A, 6)

Doryphorina stali minor Fennah, 1978: 254. Holotype ♂, VIETNAM (MIZPAS).

Redescription

Body length (from apex of cephalic process to tip of forewings): ♂ 16.8–17.5 mm, ♀ 17.1–17.3 mm; length of head: ♂ 5.4–5.7 mm, ♀ 5.4–5.5 mm; width of head (including compound eyes): ♂ 1.6–1.7 mm, ♀ 1.5–1.6 mm; length of forewings: ♂ 10.3–10.6 mm, ♀ 10.4–10.5 mm.

Cephalic process relatively slender, a little upturned, longer than pronotum and mesonotum combined (about 1.9:1). Vertex broadest at base and apex, lateral carinae more or less narrowing and convergent before compound eyes and then gradually widening towards apex. Forewings with Sc+R, M, and CuA branched apically, respectively; generally numerous netted veins on apical area; transverse veins, stigma and an irregular macula near stigma dull ochraceous. Hind tarsomere I with 22–24 and tarsomere II with 15–20 apical teeth.

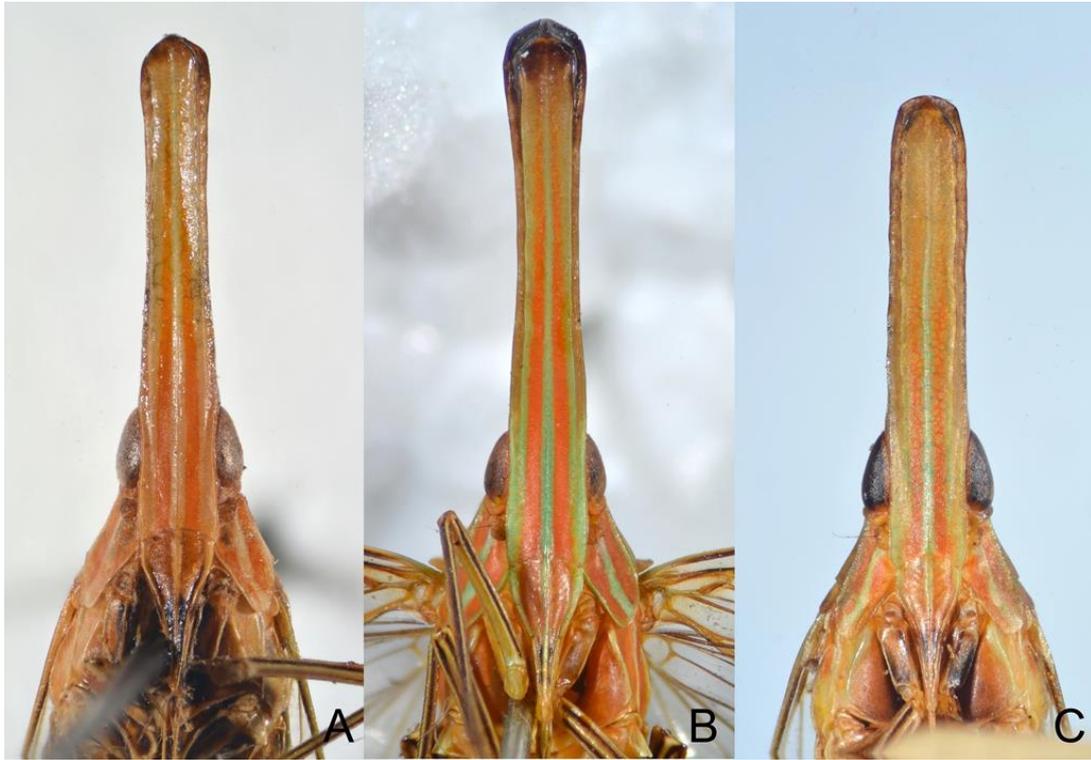


Figure 5. Ventral view of head and pronotum. **A**, *Doryphorina minor* Fennah, 1978; **B**, *Doryphorina stali* Melichar, 1912; **C**, *Doryphorina subdeflexa* Fennah, 1978.

Male genitalia. Pygofer large and broad, ventrally distinctly wider than dorsally (about 1.6:1); posterior margin more or less protruded near upper middle in lateral view (Fig. 6B). Gonostyles with upper process relatively short and broad, somewhat incurved and acute apically. Aedeagus large and robust, bases of dorsal and lateral parts and most portion of ventral part of phallobase sclerotized and pigmented, the remaining part membranous; a pair of dorsolateral apical lobes with 4–5 long spines in dorsal view (Fig. 6D); ventral part with two pairs of V-shaped elongate apical lobes, directed laterally and ventrally, each with 4–5 long spines in ventral view (Fig. 6F).

Anal tube long oval, with ratio of the longest length to width near middle about 1.6:1 in dorsal view (Fig. 6A).

Type material examined: Holotype ♂, VIETNAM: Cuo-phuong Province, Ninh Binh, 5.VI.1966, R. Bielawski & B. Pisarski; Holotype; *Doryphorina stali minor* R. G. Fennah (Inst. Zool. P.A.N., Warszawa, 52/66; MIZPAS).

Other material examined: CHINA: 1♂, Guangxi, Yangsuo, 150 m, 21.VII.1963, Y. S. Shi; 2♂♂, Guangxi, Longsheng, Mt. Tianping, 26.VIII.1964, L. C. Wang; 1♀, Guangxi, Shanglin,

17.IX.1964; 1♀, Guangxi, Longsheng, Sanmen, 20.VIII.1964, S. L. Liu; 1♂, Guangxi, Pingxiang, 17.VI.1967, B. L. Zhang; 1♀, Hainan, Yinggen, 200 m, 6.VII.1960, X. Z. Zhang; 1♀, Hainan, Tongshi, 340 m, 24.VI.1960, X. Z. Zhang; 1♀, Giangdong, Boluo, Xiangshui, 30.V.1965, Y. W. Zhang. VIETNAM: 1♀, Tonkin, Hoa Binh, VII.1940, A. de Cooman (IZCAS).

Distribution: China, Vietnam.

Remarks: The species can be distinguished from *D. stali* Melichar by the relatively shorter cephalic process; the gonostyles with upper process distinctly short and robust; and the aedeagus with two pairs of ventral apical lobes, so it should be elevated to specific status from subspecies of *D. stali*.

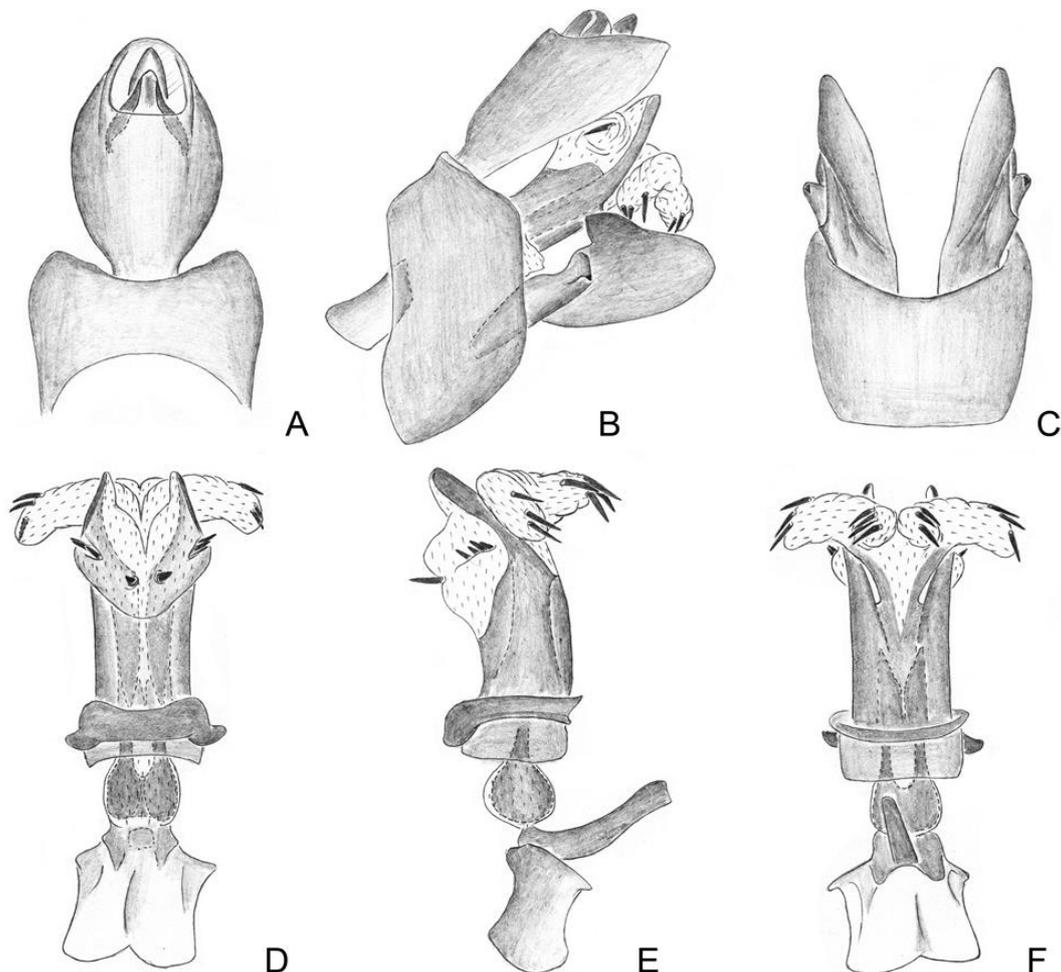


Figure 6. *Doryphorina minor* Fennah, 1978. **A**, pygofer and anal tube, dorsal view; **B**, pygofer, gonostyles and anal tube, lateral view; **C**, pygofer and gonostyles, ventral view; **D**, aedeagus, dorsal view; **E**, aedeagus, lateral view; **F**, aedeagus, ventral view.

***Doryphorina stali* Melichar, 1912** (Figs. 1, 3B, 4B, 5B, 7)

Doryphorina stali Melichar, 1912:100. Holotype ♂, INDONESIA (MIZPAS).

Doryphorina stali: Schmidt, 1915: 76; Distant, 1916: 25; Schmidt, 1928: 129; Metcalf, 1946: 87.

Redescription

Body length (from apex of cephalic process to tip of forewings): ♂ 16.8 mm, ♀ 17.4–18.4 mm; length of head: ♂ 6.1 mm, ♀ 6.2–6.4 mm; width of head (including compound eyes): ♂ 1.5 mm, ♀ 1.6–1.7 mm; length of forewings: ♂ 9.5 mm, ♀ 10.4–11.2 mm.

Cephalic process elongate and upturned, longer than pronotum and mesonotum combined (about 2.0:1). Vertex broadest at base and apex, lateral carinae more or less narrowing and convergent before compound eyes and then gradually widening towards apex. Forewing with transverse veins, stigma and an irregular macula near stigma dull ochraceous (Fig. 1). Hind tarsomere I with 14–16 and tarsomere II with 14–15 apical teeth.

Male genitalia. Pygofer large and broad, ventrally distinctly wider than dorsally (about 1.5:1); posterior margin more or less protruded near upper middle in lateral view (Fig. 7B). Gonostyles with upper process distinctly slender and long, acute apically. Aedeagus narrow and long, bases of dorsal and lateral parts and most portion of ventral part of phallobase sclerotized and pigmented, the remaining part membranous; a small dorsal apical lobe with 2–3 long spines in base in dorsal view (Fig. 7D); ventral part with a pair of V-shaped apical lobes directed posteriorly, each with 5–7 long spines from base to subapex of lateral part in ventral view (Fig. 7F).

Anal tube long oval, with ratio of the longest length to width near middle about 1.3:1 in dorsal view (Fig. 7A).

Type material examined: Holotype ♂ (MIZ 313201), Soekaranda, January 1894, Dohrn; Type [red label]; *Doryphorina stali* Mel [Schmidt's handwriting], ♂, Edm. Schmidt, determ. 1915. Allotype ♀ (MIZ 313202), Soekaranda, January 1894, Dohrn; Type [red label]; *Doryphorina stali* Mel [Schmidt's handwriting], ♀, Edm. Schmidt, determ. 1915. Paratype: 1♀ (MIZ 313203), Sumatra, Liangagas, Dohrn; Cotype [yellow label]; *Doryphorina stali* Mel [Schmidt's handwriting], ♀, Edm. Schmidt, determ. 1915 (Mus. Zool. Polonicum, Warszawa, 12/45; MIZPAS).

Other material examined: INDONESIA: 1♀ (MIZ 313204), Soekaranda, January 1894, Dohrn; *Doryphorina stali* Mel [Schmidt's handwriting], ♀, Edm. Schmidt, determ. 1915 (Mus. Zool. Polonicum, Warszawa, 12/45; MIZPAS).

Distribution: Burma, Malaysia, Indonesia.

Remarks: The species can be easily separated from *D. minor* Fennah and *D. subdeflexa* Fennah by the longer cephalic process and the different male genitalia. It was also recorded in Burma and Perak, Malaysia (Melichar 1912, Distant 1916, Metcalf 1946), but we failed to examine the related materials.

***Doryphorina subdeflexa* Fennah, 1978 stat. nov.** (Figs. 2B, 3C, 4C, 5C, 8)

Doryphorina stali subdeflexa Fennah, 1978: 254. Holotype ♂, VIETNAM (MIZPAS).

Redescription

Body length (from apex of cephalic process to tip of forewings): ♂ 14.7–15.1 mm, ♀ 16.2–18.8 mm; length of head: ♂ 4.5–4.7 mm, ♀ 5.1–5.4 mm; width of head (including compound eyes): ♂ 1.5 mm, ♀ 1.5–1.6 mm; length of forewings: ♂ 9.2–9.8 mm, ♀ 9.8–11.8 mm.

Cephalic process robust, longer than pronotum and mesonotum combined (about 1.7–1.8:1); slightly ascending distad in basal two-thirds, then upper margin becoming horizontal in distal third. Vertex broad, lateral carinae nearly parallel. Forewings without dull ochraceous spot near stigma. Hind tarsomere I with 17–21 and tarsomere II with 14–19 apical teeth.

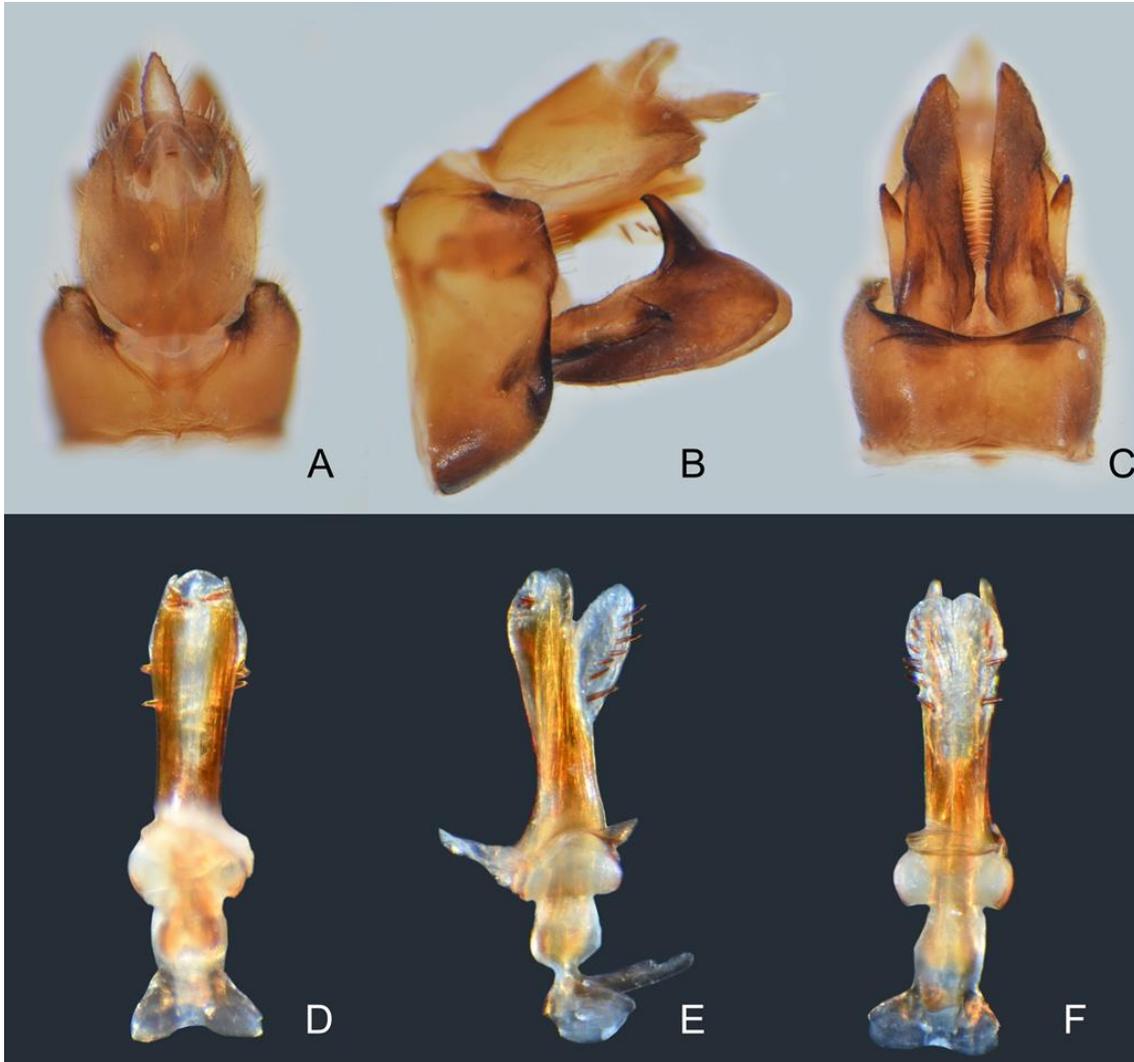


Figure 7. *Doryphorina stali* Melichar, 1912. **A**, pygofer and anal tube, dorsal view; **B**, pygofer, gonostyles and anal tube, lateral view; **C**, pygofer and gonostyles, ventral view; **D**, aedeagus, dorsal view; **E**, aedeagus, lateral view; **F**, aedeagus, ventral view.

Male genitalia. Pygofer large and broad, ventrally distinctly wider than dorsally (about 1.6:1); posterior margin protruded near upper middle in lateral view (Fig. 8B). Gonostyles with upper process relatively short and broad, somewhat incurved and acute apically. Aedeagus large and robust, bases of dorsal and lateral parts and most portion of ventral part of phallobase sclerotized and pigmented, the remaining part membranous; dorsal part with two pairs of dorsolateral apical lobes directed laterally, with 2–3 long apical spines in dorsal view (Fig. 8D), respectively; ventral part with a pair of V-shaped elongate apical lobes directed ventrally, each with 3–4 long spines in ventral view (Fig. 8F).

Anal tube long oval, with ratio of the longest length to width near middle about 1.6:1 in dorsal view (Fig. 8A).

Type material examined: Holotype ♀, VIETNAM: Thanh-ha Province, Hoa Binh, 12.VI.1966, R. Bielawski & B. Pisarski; Holotype; *Doryphorina stali subdeflexa* R. G. Fennah (Inst. Zool. P.A.N., Warszawa, 52/66; MIZPAS).

Other material examined: CHINA: 1♂, Yunnan, Jingdong, 1200 m, 29.IV.1955, B. Popov; 1♀, Yunnan, Jingdong, Dongjiafen, 1250 m, 23.VI.1956, Zagulyaev; 1♀, Yunnan, Mojiang, 27.III.1955, Krizhanovsky; 1♀, Yunnan, Masupo, 23.VII.1958; 1♀, Yunnan, Mangshi, 26.VIII.1979, S. L. Liu; 1♀, Yunnan, Ruili, Mengxiu, 3.IX.1979, H. G. Zhou (IZCAS).

Distribution: China, Vietnam.

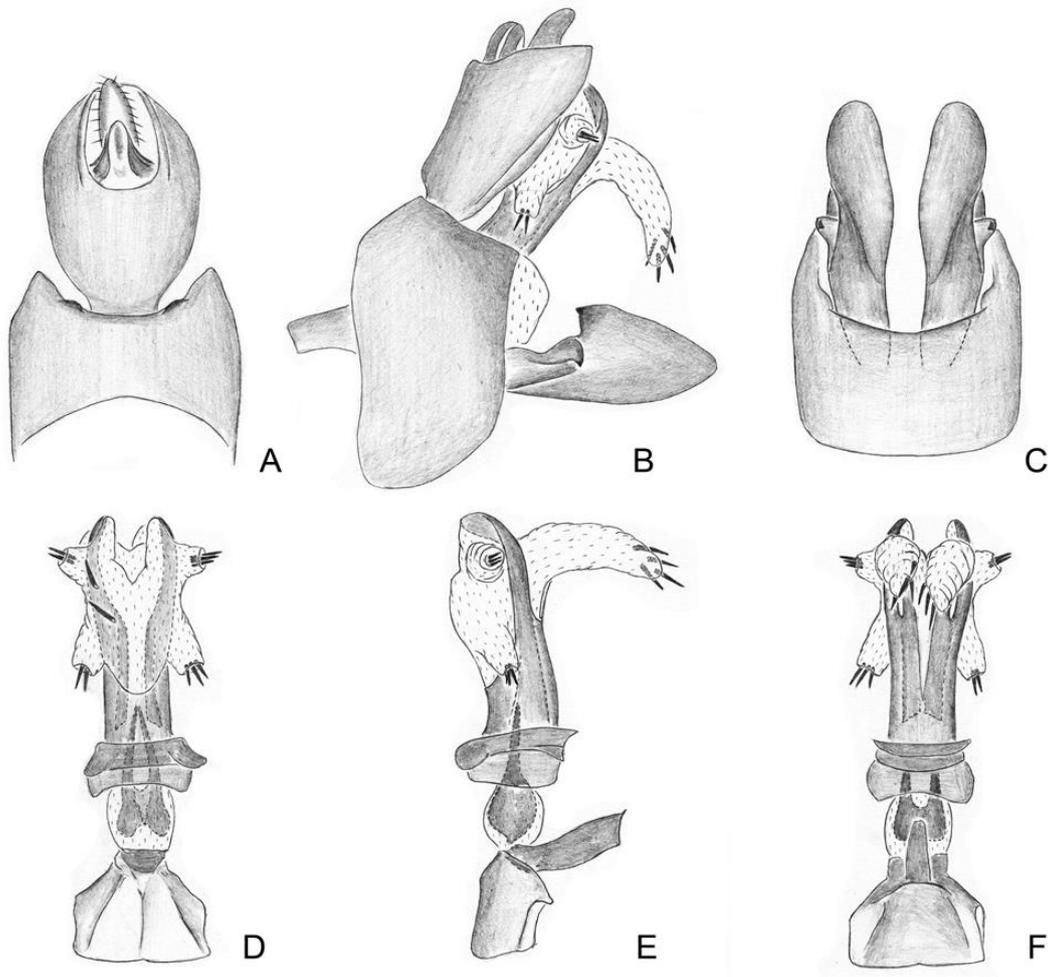


Figure 8. *Doryphorina subdeflexa* Fennah, 1978. **A**, pygofer and anal tube, dorsal view; **B**, pygofer, gonostyles and anal tube, lateral view; **C**, pygofer and gonostyles, ventral view; **D**, aedeagus, dorsal view; **E**, aedeagus, lateral view; **F**, aedeagus, ventral view.

Remarks: The species can be distinguished from *D. minor* Fennah and *D. stali* Melichar by the relatively robust cephalic process; the forewings without dull ochraceous spot near stigma; and the aedeagus with two pairs of dorsal apical lobes, so it should also be elevated to specific status from subspecies of *D. stali*.

Acknowledgments

We are grateful to Mr. Tomasz Huflejt, Museum and Institute of Zoology, Polish Academy of Sciences, Warszawa, Poland, for loan of the specimens. The work on which this paper is based was supported by the following sources: National Natural Science Foundation of China (No. 31101657, 31172128), Scientific Survey on the Middle- and Lower-reaches of Lancang (Mekong) River and Grand Shangri-La Area (No. 2008FY110300), National Science Fund for Fostering Talents in Basic Research (Special subjects in animal taxonomy, NSFC-J1210002) and a grant (No. O529YX5105) from the Key Laboratory of Zoological Systematics and Evolution of Chinese Academy of Sciences.

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Received: 25.06.2013 Accepted: 22.08.2013 Published: 03.09.2013

Cite paper: Song Z. S. & Liang A. P. 2013. Review of the genus *Doryphorina* Melichar, 1912 (Hemiptera: Fulgoromorpha: Dictyopharidae). *Journal of Insect Biodiversity* 1(7): 1–12.

<http://dx.doi.org/10.12976/jib/2013.1.7>

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