

Two new species in the genus *Dideoides* (Diptera: Syrphidae) from China

Jingxian LIU^{1*}, Le ZHAO^{1,2*}, Yicheng HE¹, Xuemei ZHOU¹, Keke HUO¹①

1. *QinLing-Bashan Mountains Bioresources Comprehensive Development C. I. C., School of Bioscience and Engineering, Shaanxi University of Technology, Hanzhong, Shaanxi 723000, China*

2. *College of Life Sciences, Shaanxi Normal University, Xi'an, Shaanxi 710119, China*

Abstract: The Chinese species in the genus *Dideoides* Brunetti, 1908 (Diptera: Syrphidae) are reviewed with descriptions of two new species, *Dideoides angusticinctus* Huo & Zhao **sp. nov.** and *Dideoides latifasciatus* Huo, Zhao & Liu **sp. nov.**, from Sichuan and Shaanxi. So far, eight species of genus *Dideoides* have now been reported from China. A key to the Chinese *Dideoides* species, and the detailed descriptions and illustrations of the new species are offered.

Keywords: Syrphinae; Syrphini; taxonomy; key

中国直脉蚜蝇属二新种（双翅目：蚜蝇科）

刘静娴^{1*}, 赵乐^{1,2*}, 贺屹成¹, 周雪梅¹, 霍科科¹①

1. 陕西理工大学生物科学与工程学院陕南秦巴山区生物资源综合开发协同创新中心, 陕西 汉中 723000; 2. 陕西师范大学生命科学学院, 陕西 西安 710119

摘要: 对中国直脉蚜蝇属进行了系统研究, 并描述该属 2 新种: 狭条直脉蚜蝇 *Dideoides angusticinctus* Huo & Zhao **sp. nov.** 和宽纹直脉蚜蝇 *Dideoides latifasciatus* Huo, Zhao & Liu **sp. nov.**, 标本采自四川和陕西省, 迄今中国已记录直脉蚜蝇属 8 种。文中还提供了中国直脉蚜蝇属的分种检索表、新种描述及特征图。

关键词: 蚜蝇亚科; 蚜蝇族; 分类; 检索表

Introduction

The genus *Dideoides* Brunetti, 1908, with type species *Dideoides ovata* Brunetti, 1908, belonging to the tribe Syrphini, is the largest size group in the subfamily Syrphinae (Brunetti 1908; Vockeroth 1969; Mengual *et al.* 2008). This genus has so far 13 recorded species that are mainly distributed in the Oriental Region and the southeast of the Palaearctic Region. Of these, six species were known to be distributed in China (Brunetti 1908, 1923; Matsumura & Adachi 1917; Curran 1928; Shiraki 1930; Hull 1949; van der Goot 1964; Vockeroth 1969; Knutson *et al.* 1975; Peck 1988; Thompson & Rotherary 1998; Huo *et al.* 2007, 2017, 2020; Huang *et al.* 2012; Lan *et al.* 2018).

Accepted 16 June 2023. Published online 29 August 2023. Published 25 September 2023.

① Corresponding author, E-mail: huokk@163.com

* These authors contributed equally to this work.

Brunetti (1908) regarded the genus *Dideoides* as an intermediate form between the genera *Didea* and *Syrphus* morphologically. Subsequently, the genera *Dideodes* Matsumura, 1917 and *Malayomyia* Curran, 1928 were synonymized under the genus *Dideoides* (Vockeroth 1969; Knutson *et al.* 1975; Peck 1988). Hull (1949) took the genus *Dideoides* Brunetti, 1908 and genus *Asiodidea* Stackelberg, 1930 as subgenera of the genus *Didea* Macquart, 1854, and suggested that the genus *Dideoides* might be a highly specialized group within the genus *Didea*, or developed independently from a group similar to genus *Syrphus*, but not a transition between them. Vockeroth (1969) redefined the genus *Dideoides* with a detailed description of the male terminalia, and considered there were few groups close to it based on the distinctive characteristics of the genus *Dideoides*. Mengual *et al.* (2008) reconstructed the phylogenetic tree of Syrphinae based on the sequence data of mitochondrial COI and nuclear 28S rRNA genes, and divided Syrphini into two parts, within which the genus *Dideoides* was placed in the first part of the tribe Syrphini and forms a clade with *Eriozona*, *Dideopsis*, *Megasyrphus* and *Didea*, i.e. ((*Didea* + *Megasyrphus*) + (*Dideopsis* + (*Eriozona* + *Dideoides*))), which was regarded as the sister group to another clade, i.e. ((*Epistrophe* + *Chrysotoxum*) + (*Epistrophella* + *Xanthogramma*)).

Huo *et al.* (2007) recorded six *Dideoides* species from the Qinling-Bashan Mountains in Shaanxi, China. In present paper, two new species from Shaanxi and Sichuan were discovered, namely, *Dideoides angustictus* Huo & Zhao **sp. nov.** and *Dideoides latifasciatus* Huo, Zhao & Liu **sp. nov.** Eight species of the genus *Dideoides* have now been recorded from China. This paper provides detailed descriptions and illustrations of these new species and a key to Chinese species. Type specimens are deposited in Shaanxi University of Technology.

Material and methods

All specimens were collected by hand-net, then generally pinned directly and stored at Shaanxi University of Technology, Hanzhong, China (SNUT). The male genitalia were extracted using an insect pin with a hooked tip. Genitalia were cleared by boiling in tubes of water-diluted KOH pellets for 5 min and with a brief immersion in glacial acetic acid to neutralize the alkaline base, then rinsed twice in ethanol to remove the acid before storage in microvials containing glycerol.

Terminology follows Reemer (2012) and Cumming & Wood (2017). Body length was measured from the frontal prominence, excluding the antenna, to the apex of the abdomen. Wing length is from the base to its apex. All measures are presented in millimeters.

Taxonomy

Genus *Dideoides* Brunetti, 1908

Dideoides Brunetti, 1908: 54. Type-species, *Dideoides ovata* Brunetti, 1908 (monotypy).

Dideodes Matsumura, 1917: 140. Type-species, *Syrphus latus* Coquillett, 1898 (original designation).

Malayomyia Curran, 1928: 225. Type-species, *Malayomyia pretiosa* Curran, 1928 (original designation).

Distribution. Southeastern Palearctic; Oriental.

Diagnosis. Very large and robust flower-flies; compound eye densely pilose; face and gena entirely yellow; facial tubercle broader and lower; basoflagellomere slightly elongate, arista bare; mesonotum grey to greyish-black, with three darker stripes; scutellum yellow to dark brown; katepisternum with dorsal and ventral pile patches broadly joined posteriorly; metasternum with much black pile; hindcoxae with pile tuft on posteromedian apical corner; vein R_{4+5} straight or very slightly and broadly dipped into cell r_{4+5} . Abdomen broadly oval, conspicuously margined, black with broad or narrow, arcuate or angled, yellow to reddish-yellow bands.

1. *Dideoides angusticinctus* Huo & Zhao sp. nov. (Fig. 1)

ZooBank link:urn:lsid:zoobank.org:act:8E2680E8-A2AA-409D-87CF-A62A9D96F9BC

Female. Compound eye densely brownish yellow, pilose. Vertex narrow, frons expanded forwards laterally (Figs 1A, 1B). Vertex and frons black, black pilose, densely with golden yellow pollen concealing the ground colour. Lunule shining black. Occiput yellow pilose, densely with golden yellow pollen concealing the ground colour. Face deep concave below frontal prominence, facial tubercle large, nose-shaped, projecting; face yellow, yellow pilose and densely golden yellow pollinose, bare medially. Gena yellow with yellow hairs. Antenna (Fig. 1D) dark brown, with basoflagellomere elongate oval, sharper apically, basal 2 segments with black hairs; arista dark brown and bare.

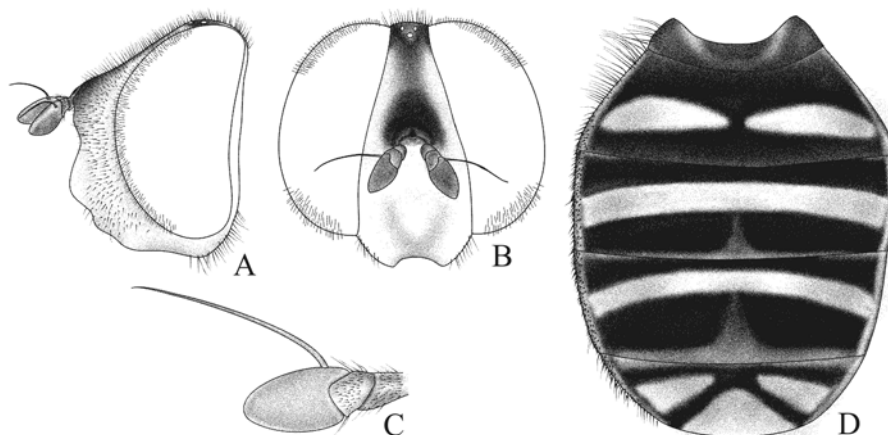
Mesonotum grayish green, yellowish-brown laterally, with three longitudinal dark brown stripes in the middle, and yellow pollinose spots inside postpronotal lobes. The mesonotum yellow pilose, orange pilose laterally. Scutellum orange, black pilose. Subscutellar fringe yellow. Mesopleuron black, grayish yellow pollinose, with pollinose spots on posterior convex part of anepisternum, katepisternum posterodorsally and anterior anepimeron. Yellow pile present on Proepimeron, posterior convex part of anepisternum, anterior anepimeron and katepimeron. Dorsal and ventral hair patches on posterior katepisternum widely separated, narrowly linked posteriorly, dorsal hair patch yellow, ventral one black. Metasternum black, with long and black hairs.

Legs orange, with coxae, trochanters and basal femora black, three middle segments of tarsi dark brown, and metatarsi darker in color. Front and middle leg yellow pilose, coxae and trochanters with black hairs, femora a few black hairs basally. Hind leg mainly black pilose, basal femora with a few long hairs and ventral and posterior of the tibia yellow hairs. Hind coxae with tuft of black long pile at posteromedian apical angle.

Wing slightly yellowish-brown on anterior half, pterostigma yellowish-brown; Wing membrane microtrichose, with a long and narrow bare line in cell cup anteriorly. Vein R_{4+5} straight, crossvein r-m located before the middle of cell dm. Calypter and calyptral fringe orange. Halter orange.

Abdomen (Fig. 1D) broadly ovate and flat, with obvious yellowish-brown lateral margins. Tergite 1 slightly tinged with grayish green, yellowish-brown laterally. Tergite 2 with a pair of separated yellowish-brown spots, of which the inner and outer ends narrower and extending to lateral margin, anterior margin convex, posterior margin nearly straight. Tergites 3 and 4 medially with narrow, arcuate, yellow bands of which the outer ends extend to the lateral margins, and a dark brownish yellow margin posteriorly, with the anterior margin triangularly protruding forward in the middle and nearly attached yellow bands. Tergite 5 brown, with black to dark black band, of which anterior margin straight, posterior

margin deeply concave in inverted V-shaped medially, a pair of yellow, narrow, separated triangular lateral spots on black band. Abdominal tergites mainly orange pilose, yellow long pilose on basal 2 tergites, appressed black pilose on tergites 2–3 posterior to yellow bands, black short bristle on lateral margin. Abdominal sternites shiny black, sternites 2–4 with a pair of large semicircular yellow lateral spots basally, sternite 5 brownish yellow, with a circular black spot medially. Abdominal sternites brownish yellow long pilose, black pilose on posterior margin of sternite 3, thicker black pilose on posterior half of sternite 4 and sternite 5.



Figures 1. Female holotype of *Dideoides angusticinctus* Huo & Zhao **sp. nov.** A. Head, lateral view; B. Head, frontal view; C. Antenna; D. Abdomen, dorsal view.

Body length, ♀17 mm; wing length, ♀15 mm.

Holotype. ♀, **China**, Sichuan, Baliping, Anzihe Nature Reserve, 103°11'E, 30°47'N, 09-VIII-2016, Keke HUO, SNUT. **Paratypes.** **China**, 1♀, Shaanxi, Dabagou, Zibai Mountain, Liuba County, 106°44'16"E, 33°40'38"N, 22-VII-2016, Fei LAN, SNUT; 1♀, Zibai Mountain, Liuba County, 106°43'E, 33°40'N, 25-VII-2016, Keke HUO, SNUT; 4♀, same collection data as preceding, 21-VII-2017, Fei LAN, 1♀, Liangfengya Protection Station, Foping County, 107°51'E, 33°40'N, 02-VIII-2017, Fei LAN, SNUT; 1♀, same collection data as for preceding, 03-VIII-2017.

Etymology. This specific epithet indicates the narrow bands on tergites 3 and 4.

Remarks. This new species can be recognized from other *Dideoides* species by the following combination of characters: abdomen broadly oval, tergites 3 and 4 with narrow yellow bands; femora black basally.

2. *Dideoides latifasciatus* Huo, Zhao & Liu **sp. nov.** (Fig. 2)

ZooBank link: urn:lsid:zoobank.org:act:2087D0EE-5FC8-4799-BFCF-548D5FE589CE

Male. Compound eye densely yellowish-brown, pilose. Vertex black, black pilose, yellow pollinose posterior to ocellar triangle locating before the middle. Occiput yellow pilose, densely yellow pollinose, concealing the ground colour. Frons yellow-orange, yellow pollinose and black pilose. Lunule yellowish-brown. Face (Fig. 2A) slightly concave beneath frontal prominence, facial tubercle large, nose-shaped. Face yellow-orange, yellow pilose and pollinose, bare on facial tubercle. Gena yellow, concolorous pilose and pollinose. Antenna (Fig. 2C) dark yellowish-brown; basofagellomere elongate oval, blunt apically; pedicel and flagellum black pilose; arista dark yellow, bare.

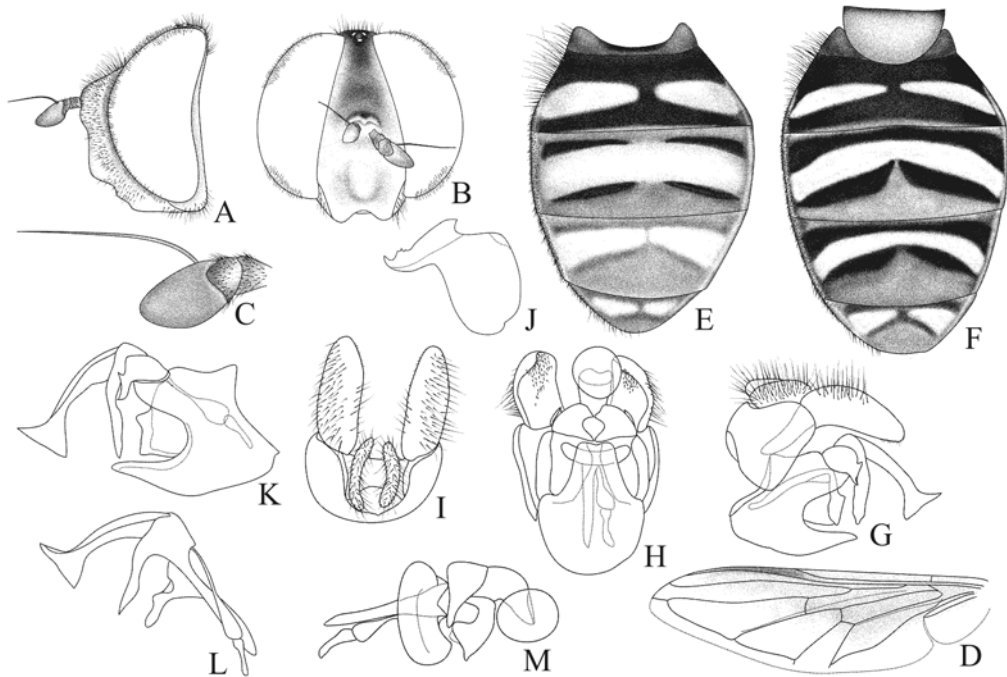


Figure 2. *Dideoides latifasciatus* Huo, Zhao & Liu **sp. nov.** A. Male head, lateral view; B. Female head, frontal view; C. Antenna, inside; D. Wing; E. Male abdomen, dorsal view; F. Female scutellum and abdomen, dorsal view; G. Male terminalia, lateral view; H. Male terminalia, ventral view; I. Epandrium and appendages, dorsal view; J. Superior lobe, lateral view; K. Hypandrium and appendages, lateral view; L. Aedeagus, lateral view; M. Aedeagus, posterolateral view.

Mesonotum grayish-green, dark yellow laterally, black anteriorly, with three longitudinal medial dark brown stripes and yellow pollinose spots inside the postpronotum. Mesonotum yellowish-brown pilose, except reddish-yellow pilose laterally. Scutellum yellow, black pilose, except yellow pilose basally and laterally, subscutellar fringe yellow. Mesopleuron black, grayish-yellow pollinose, with distinct pollinose spots on the posterior convex part of anepisternum, posterodorsal katapisternum and anterior anepimeron; yellow pile on proepimeron, the posterior convex part of anepisternum, anterior anepimeron and katepimeron. Katapisternum with dorsal and ventral pile patches broadly separated, narrowly connected posteriorly, dorsal patch of yellow pile, ventral one black pile. Metasternum black, long black pilose.

Legs orange, with coxae, trochanters and extreme base of femora black, tarsi dark brown, medial three tarsomeres dark brown and hind-tarsi darker in color. Front and mid-legs yellow pilose, except coxae and trochanters black pilose, femora a few black pilose basally. Hind legs mainly black pilose, except femora a few long yellow pilose basally, tibiae yellow pilose ventrally and posteriorly. Hind coxae with tuft of long black hairs at posteromedian apical angle.

Wing (Fig. 2D) slightly yellowish-brown on anterior half, pterostigma yellowish-brown; wing membrane microtrichose, with a bare portion on anterior cell cup long and narrow. Vein R_{4+5} nearly straight, crossvein r-m joining vein M before middle of cell dm. Calypter and

calyptal fringe orange. Halter orange.

Abdomen (Fig. 2E) broadly oval, flattened, with distinct yellowish-brown lateral margin. Tergite 1 slightly tinged with grayish green, yellowish-brown laterally. Tergite 2 black with a pair of yellowish-brown triangular spots posteromedially. The spots broadly separated medially, with the posterior margin nearly straight and the outer ends nearly extending to the lateral margin of tergite. Tergite 3 dark yellowish-brown, with a median, broad, arcuate yellowish-brown band extending to the lateral margin, a pair of narrow black spots respectively anterior to and posterior to yellowish-brown band. Tergites 4 and 5 similar to tergite 3, but yellowish-brown bands constricted medially, black spots around the yellow band indistinct. Tergites mainly orange pilose, long yellow pilose on basal 2 tergites, nearly appressed black pilose on tergites 2 and 3 posterior to yellow bands, with black short bristles on lateral margins. Sternites brownish-yellow, sternite 1 black, sternite 2 with an inverted T-shaped black spot posteriorly, sternite 3 and 4 with an inverted M-shaped dark brown spot posteriorly. Sternites long brownish-yellow pilose, except black pilose on posterior margin of sternite 3 and posterior half of sternite 4.

Male terminalia (Figs 2G–M). Orange, weakly sclerotized. Epandrium irregularly quadrilateral, longer than broad in lateral view. Cercus slender, long light yellow pilose. Surstylus longer than epandrium, broadly stripe-shaped, blunt and circular apically, with long yellow pile on outer surface and short dark bristles on inner surface. Hypandrium deeply concave on ventral margin laterally, lingula broad apically, slightly shorter than lateral arms. Superior lobe irregular rounded in lateral view, posterior margin slightly extending toward the middle line, posteroventral corner slightly acute, bent downwards and backwards. Distal portion of aedeagus long, expanded apically into a circular form. The apical part of aedeagal base expanded ventrad into a long stripe with an acute inner apical corner extending mesially. Aedeagal apodeme expanded semicircularly at apical end.

Female. (Figs 2B, 2F) Vertex black, black pilose. Frons broadly expanded forwards laterally, black, orange anteriorly, yellow pollinose concealing the ground colour. Yellow spots and bands on tergites narrower than on the male tergites. Sternites shiny black, sternite 2 with yellow triangular spots laterally; sternites 3 and 4 respectively with one pair of yellow semicircular spots basolaterally, yellowish-brown band on posterior margin; sternite 5 yellowish-brown, with a small black median spot anteromedially. The remainder similar to male.

Body length, ♂16 mm; ♀17 mm. Wing length, ♂14 mm; ♀15 mm.

Holotype. ♂, **China**, Sichuan, Longdenggou, Anzihe Nature Reserve, 103°13'E, 30°46'N, 10-VIII-2016, Fei LAN, SNUT. **Paratypes.** **China**, 1♂, same collection data as for holotype; 1♂1♀, same collection data as for holotype, 11-VIII-2016; 1♂, Shaanxi, Zibai Mountain, Liuba County, 106°43'E, 33°40'N, 19-VII-2017, Fei LAN, SNUT; 1♀, Shaanxi, Liangfengya Protection Station, Foping County, 107°51'E, 33°40'N, 02-VIII-2017, Fei LAN, SNUT; 1♂, same collection data as preceding, 03-VIII-2017; 1♀, Chongqing, Huangcaoping, Lanying Town, Yintiaoling National Nature Reserve, Wuxi County, 109°74'E, 31°25'N, 17-VIII-2022, Jingxian LIU, SNUT.

Etymology. This specific epithet indicates the broad bands on tergites 3 and 4.

Remarks. This new species can be recognized from other *Dideoides* species by the following combination of characters: tergite 2 black, with one pair of narrow yellow spots;

tergites 3 and 4 with broad yellow bands; femora black extremely basally.

Key to the Chinese species of *Dideoides* Brunetti, 1908

1. Abdominal tergites 4 and 5 entirely black..... *D. kempi*
- Abdominal tergites 4 and 5 yellow and black..... 2
2. Posterior half of tergite 4 and tergite 5 rufous, yellow pilose..... *D. coquilletti*
- Abdominal tergites 4 and 5 in ground color black with yellow bands or yellow with black bands..... 3
3. Three pairs of femora black extremely basally..... 4
- At least basal third of anterior and mid femora black..... 6
4. Abdominal tergite 2 black with a pair of narrow brown-yellow spots in the middle; tergites 3–5 dark brown-yellow, tergites 3 and 4 with arcuate brown-yellow bands in the middle, a pair of narrow black spots respectively anterior to and posterior to yellowish-brown band; tergite 5 with brown-yellow spots, around which is dark brown..... *D. latifasciatus* **sp. nov.**
- Abdominal tergites 2–5 brown-yellow, respectively with two black bands which are weak or disappear on anterior tergite 2 and tergite 5, interrupted on posterior tergites 3 and 4..... 5
5. Abdominal tergite 1 black, yellow laterally; tergite 2 with posterior margin of anterior black band protruding backwards medially and anterior margin of posterior black band protruding forwards; abdominal sternite 2 with inverted T-shaped black spot centrally..... *D. qinlingensis*
- Abdominal tergite 1 yellow, at most with dark greyish green spots anteriorly, anterior band on tergite 2 indistinct or disappears. Abdominal sternite 2 with triangular spot, sternites 3 and 4 with anchor-shaped spots..... *D. latus*
6. Abdomen black, tergite 2 with narrow yellow band basally and a pair of long yellow spots in the middle; tergites 3 and 4 with narrow yellow anterior margins and arcuate yellow bands in the middle; tergite 4 with narrow yellow posterior margin..... *D. zhengi*
- Abdomen black, tergite 2 absent of narrow yellow band basally, only with a pair of elongate yellow spots medially..... 7
7. Abdominal tergites 3 and 4 with broad orange bands in the middle, narrow yellow anterior margin and posterior margin, tergite 4 with broader yellow posterior margin protruding triangularly in the middle; tergite 5 orange with narrow black band anteriorly..... *D. ovatus*
- Abdominal tergites 3 and 4 with narrow brown-yellow bands in the middle, only narrow brown-yellow posterior margins protruding triangularly forward medially; tergite 5 brown-yellow with blackish brown band which has deeply triangularly concave posterior margin and a pair of triangular yellow spots laterally..... *D. angusticinctus* **sp. nov.**

Acknowledgements

We are sincerely grateful to Fei LAN (SNUT) for collecting the specimen. This research was funded by the China Postdoctoral Science Foundation (2022M722020), the Scientific Research Foundation of Shaanxi University of Technology (SLGKYXM2302), the Opening Foundation of Shaanxi University of Technology (SLGPT2019KF02-02), the Key Project of Shaanxi Natural Science Basic Research Plan (2022JZ-12), Shaanxi Provincial Special Support Program for High-Level Personnel (2017), and the Fund for Survey of Spiders and Insects from the Yintiaoling Nature Reserve.

References

- Brunetti E. 1908. Notes on Oriental Syrphidae with descriptions of new species. Part I. *Records of the Indian Museum*, 2: 49–96.
- Brunetti E. 1923. Pipunculidae, Syrphidae, Conopidae, Oestridae. Diptera. Vol. III. In: Shipley AE (Ed.), *Fauna of British India including Ceylon and Burma*. Taylor & Francis, London, pp. xi + 424.
- Cumming JM & Wood DM. 2017. Adult morphology and terminology. In: Kirk-Spriggs AH & Sinclair BJ (Eds.), *Manual of Afrotropical Diptera. Volume 1. Introductory Chapters and Keys to Diptera Families. Suricata 4*. South African National Biodiversity Institute, Pretoria, pp. 89–133.
- Curran CH. 1928. The Syrphidae of the Malay Peninsula. *Journal of the Federated Malay States Museum*, 14: 141–324.
- Goot van der VS. 1964. Fluke's catalogue of Neotropical Syrphidae (Insects, Diptera), a critical study with an appendix on new names in Syrphidae. *Beaufortia*, 10: 212–221.
- Huang CM & Cheng XY. 2012. *Fauna Sinica, Insecta Vol. 50. Diptera Syrphidae*. Science Press, Beijing, 852 pp.
- Hull FM. 1949. The morphology and inter-relationship of the genera of syrphid flies, recent and fossil. *Transactions of the Zoological Society of London*, 26: 257–408.
- Huo KK. 2020. Syrphidae. In: Yang D, Wang MQ & Li WL (Eds.), *Species Catalogue of China. Volume 2. Animals. Insecta. Diptera (3). Cyclorrhaphous Brachycera (i)*. Science Press, Beijing, pp. 30–181.
- Huo KK & Zhang KY. 2017. Syrphidae. In: Yang XK (Ed.), *Insect Fauna of the Qinling Mountains*. World Publishing Corporation, Beijing, pp. 1262.
- Huo KK, Ren GD & Zheng ZM. 2007. *Fauna of Syrphidae from Mt. Qinling-Bashan in China (Insect: Diptera)*. Chinese Agriculture Science and Technology Press, Beijing, 512 pp.
- Knutson LV, Thompson FC & Vockeroth JR. 1975. Family Syrphidae. In: Delfinado MD & Hardy DE (Eds.), *A Catalog of the Diptera of the Oriental Region. Vol. II. Suborder Brachycera through Division Aschiza, Suborder Cyclorrhapha*. University of Hawaii Press, Honolulu, pp. 307–374.
- Lan F, Li H & Huo KK. 2018. Investigation on Syrphidae in Anzihe Nature Reserve of Sichuan. *Journal of Shaanxi University of Technology (Natural Science Edition)*, 34: 72–78.
- Matsumura S & Adachi J. 1917. Synopsis of the economic Syrphidae of Japan. (Pt. II). *The Entomological Magazine*, 2(4): 133–156.
- Mengual X, Ståhls G & Rojo S. 2008. First phylogeny of predatory flower flies (Diptera, Syrphidae, Syrphinae) using mitochondrial COI and nuclear 28S rRNA genes: conflict and congruence with the current tribal classification. *Cladistics*, 24: 543–562.
- Peck LV. 1988. Family Syrphidae-Conopidae. In: Soós Á & L Papp (Eds.), *Catalogue of Palaearctic Diptera. Vol. 8*. Elsevier Science Publishers and Akadémiai Kiadó, Amsterdam and Budapest, pp. 11–230.
- Reemer M. 2012. *Unravelling a hotchpotch: phylogeny and classification of the Microdontinae (Diptera, Syrphidae)*. PhD thesis, Leiden University, 384 pp.
- Shiraki T. 1930. Die Syrphiden des japanischen Kaiserreichs, mit Berücksichtigung benachbarter Gebiete. *Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University*, 1: xx+446.
- Thompson FC & Rotheray GE. 1998. Family Syrphidae. In: Papp L & Darva B (Eds.), *Contributions to a Manual of Palaearctic Diptera (With Special Reference to Flies of Economic Importance). Vol. 3, Higher Brachycera*. Science Herald, Budapest, pp. 81–139.
- Vockeroth JV. 1969. A revision of the genera of the Syrphini (Diptera: Syrphidae). *Memoirs of the Entomological Society of Canada*, 101: 5–176.