

<https://doi.org/10.11646/zootaxa.4514.2.9>
<http://zoobank.org/urn:lsid:zoobank.org:pub:FEB19CE2-6275-48F2-9EB4-1C90894DA214>

New species of the leafhopper genera *Kusala* Dworakowska and *Diomma* Motschulsky (Hemiptera: Cicadellidae: Typhlocybinae: Erythroneurini) with description of a new subgenus

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Abstract

Generic characteristics of the leafhopper genus *Kusala* Dworakowska are revised, and a new subgenus *Scodela* is established. A species checklist of the *Kusala* is provided and three new species are added: *Kusala* (*Kusala*) *viraktamathi*, *K.* (*Scodela*) *directa* and *K.* (*S.*) *sinuata* spp. nov.. The related genus *Diomma* Motschulsky is also redescribed and a new species is described: *Diomma* (*Diomma*) *sangzhiensis* sp. nov..

Key words: Homoptera, Auchenorrhyncha, morphology, new subgenus, China

Introduction

The Oriental leafhopper genus *Kusala* was established by Dworakowska (1981a) based on the type species *Kusala sagittata* Dworakowska, 1981 and five other species. Subsequent authors added four additional species (Chiang & Knight 1990, Sohi & Mann 1992, Song *et al.* 2011a) and Song *et al.* (2011a) provided a key to the species. Species in this genus are recognized by the depressed body and distinctive color pattern. They are superficially similar to representatives of another erythroneurine genus *Diomma* Motschulsky, 1863, from which they may be separated by the complete hind wing venation. To date, ten species were reported in *Kusala*, most of them with the aedeagus very similar in shape. Recently, we discovered two new species that are externally similar to most other *Kusala* species, but show many differences in the male genitalia. Here we propose dividing *Kusala* into two subgenera: *Kusala* (*Kusala*) Dworakowska and *Kusala* (*Scodela*) sgen. n. Three new species are described and illustrated: *Kusala* (*K.*) *viraktamathi*, *K.* (*S.*) *directa* and *K.* (*S.*) *sinuata* spp. nov.. We also add a new species to the related genus *Diomma* Motschulsky: *Diomma* (*Diomma*) *sangzhiensis* sp. nov.. All the specimens examined are deposited in Entomological Museum, Northwest A&F University, Yangling, China. Nomenclature of the wing follows Dworakowska (1993).

Kusala Dworakowska, 1981

Kusala Dworakowska, 1981a: 317; Chiang & Knight, 1990: 219; Song *et al.*, 2011a: 49
Type species: *Kusala sagittata* Dworakowska, 1981

Description. Body medium sized, depressed. Ground color yellow, orange to brown with dark patches and smoky areas, forming symmetrical pattern. Head and pronotum with some patches or spots along fore margin, midline and

hind margin of pronotum grey bordered with dark brown. Forewing with irregular orange, brown and smoky areas, brochosome field distinct. Crown fore margin rounded or angulately produced medially, head as wide as or slightly wider than pronotum, face flat in profile, anteclypeus of male broad, lorum large. Forewing venation with third apical cell widest and second apical cell narrowest, fourth apical cell not extended to tip of wing, about half length of third, MP"+CuA' straight or slightly curved basally; AA and AP vein distinct. Hind wing venation usual for Erythroneurini, RA vein absent.

Male 2S abdominal apodemes long and moderately broad, extended to sternite IV–V. Anal tube appendage stick-like, usually straight, weakly sclerotized.

Male genital capsule depressed and well sclerotized, pygofer side with some fine setae on central area or near caudal margin, with or without basolateral macrosetae; dorso-lateral inner ridge well developed; without dorsal and ventral appendages. Subgenital plate short and broad, nearly triangular, with several macrosetae near outer margin, row of marginal microsetae and some microsetae scattered on ventral side. Style stout, apical part lamellate, short to long, usually with distinct subapical extension, preapical lobe cheliform. Connective V-shaped or lamellate, central lobe absent. Aedeagal shaft tubular, with or without dorso-apical lamella; dorsal apodeme usually well developed; preatrium short to long; gonopore terminal.

Diagnosis. This genus is very similar to *Diomma* Motschulsky: both have the body depressed with a distinct dorsal symmetrical color pattern, but *Kusala* has complete hind wing venation, while the hind wing of *Diomma* has a reduced submarginal vein and lacks vein CuA".

Distribution. China; India; Pakistan; Vietnam.

Key to subgenera of *Kusala*

1. Pygofer side with basolateral macrosetae; aedeagus with dorsal lamella distally, preatrium folded *Kusala (Kusala)* Dworakowska
- Pygofer side without basolateral macrosetae; Aedeagus without dorsal lamella, preatrium not folded *Kusala (Scodela) sgen. n.*

Kusala (Kusala) Dworakowska

Kusala Dworakowska, 1981a: 317; Chiang & Knight, 1990: 219; Song *et al.*, 2011a: 49
Type species: *Kusala sagittata* Dworakowska, 1981

Description. Crown fore margin usually angulately produced in both dorsal and lateral view.

Pygofer lobe with group of basolateral macrosetae. Subgenital plate broad, usually with 6 or more macrosetae from subbasal outer margin to apex, apical macrosetae much thinner than basal ones. Style with apical part short. Connective V-shaped, lateral arms narrow. Aedeagal shaft with dorso-apical lamella; preatrium usually long, folded, directed caudad basally then sharply bent anterodorsad.

Species checklist of *Kusala (Kusala) Dworakowska*

K. (K.) datianensis Song & Li, 2011
K. (K.) distincta Dworakowska, 1981
K. (K.) maculata Dworakowska, 1981
K. (K.) marmorata Sohi & Mann, 1992
K. (K.) viraktamathi sp. nov.
K. (K.) pocsi (Dworakowska, 1979)
K. (K.) populi Song & Li, 2011
K. (K.) sagittata Dworakowska, 1981
K. (K.) salicis (Ahmed, 1970)
K. (K.) setosa (Ahmed, 1971)

***Kusala (Kusala) viraktamathi* sp. nov.**

(Figs 1, 5a–d)

Description. Ground color greyish brown, face light brown. Anteclypeus broad. (Figs 5a–d)

Male 2S abdominal apodemes (Fig. 1c) extended to hind margin of sternite IV. Anal tube appendage (Figs 1d, e) long.

Subgenital plate (Figs 1d, g) with about 4 thick and 3 thin macrosetae. Apical part of style (Fig. 1h) broad, with dense furrows. Connective (Fig. 1i) with lateral arms slightly sinuated. Aedeagus (Figs 1j–l) very similar to that of *K. (K.) salicis* (Ahmed, 1970), dorsal lamella long, with serrated margin, shaft with finger-like ventral process subapically; dorsal apodeme relatively long in lateral view; preatrium slim, length subequal to shaft.

Diagnosis. The new species is similar to *K. (K.) salicis*, but the style is broad apically with a larger preapical lobe, the connective has the lateral arms slightly sinuate, and the ventral process of the aedeagal shaft is subapical.

Measurement. Male length 2.50–2.70mm, female length 2.50–2.80mm.

Material examined. Holotype: ♂, CHINA, Yunnan Prov., Jinghong, 600m, *Urtica* sp., 25 xii 1999, coll. I. Dworakowska; paratypes: 16♂♂ 22♀♀, same data as holotype.

Etymology. The new species is named in honor of Dr. Chandra A. Viraktamath (University of Agricultural Sciences, Bangalore, India).

Kusala (Scodela) sgen. n.

Type species: *Kusala (Scodela) directa* sp. nov.

Description. Crown fore margin angulately produced to rounded in dorsal view, rounded in lateral view.

Pygofer lobe with fine setae, macrosetae absent. Subgenital plate relatively narrow, with about 3–4 macrosetae medially near outer margin. Style with apical part very long, pointed apically. Connective V-shaped or lamellate. Aedeagal shaft without dorso-apical lamella; dorsal apodeme rudimentary to large; preatrium not folded, short to long, directed cephalad.

Diagnosis. The new subgenus is similar to subgenus *Kusala* externally, but the head is more broadly rounded in profile, the male pygofer lobe lacks macrosetae, the subgenital plate is narrower and lacks thin macrosetae along the apical outer margin, the style is elongated apically, the aedeagus lacks dorsal lamella and the preatrium is not bent.

Etymology. The new subgeneric name is an arbitrary combination of letters, the gender is feminine.

Checklist to species of *Kusala (Scodela) sgen. nov.*

K. (S.) colibia Chiang & Knight, 1990 **comb. n.**

K. (S.) directa sp. nov.

K. (S.) sinuata sp. nov.

***Kusala (Scodela) directa* sp. nov.**

(Figs 2, 5e–h)

Description. Ground color yellowish-brown, lower 2/3 of face darker. Crown fore margin rounded, anteclypeus rectangular. (Figs 5e–h)

Male 2S abdominal apodemes (Fig. 2a) extended to middle of sternite IV. Anal tube appendage (Figs 2b, c) relatively short.

Subgenital plate (Fig. 2e) very broad basally. Apical part of style (Fig. 2f) straight, subapical extension slightly curved basad. Connective (Fig. 2g) lamellate, manubrium very broad. Aedeagal shaft (Figs 2h, i) relatively broad in lateral view, curved dorso-cephalad, dorso-distal margin slightly expanded and serrated distally; dorsal apodeme large, Y-shaped in caudal view; preatrium short; gonopore on ventral margin.

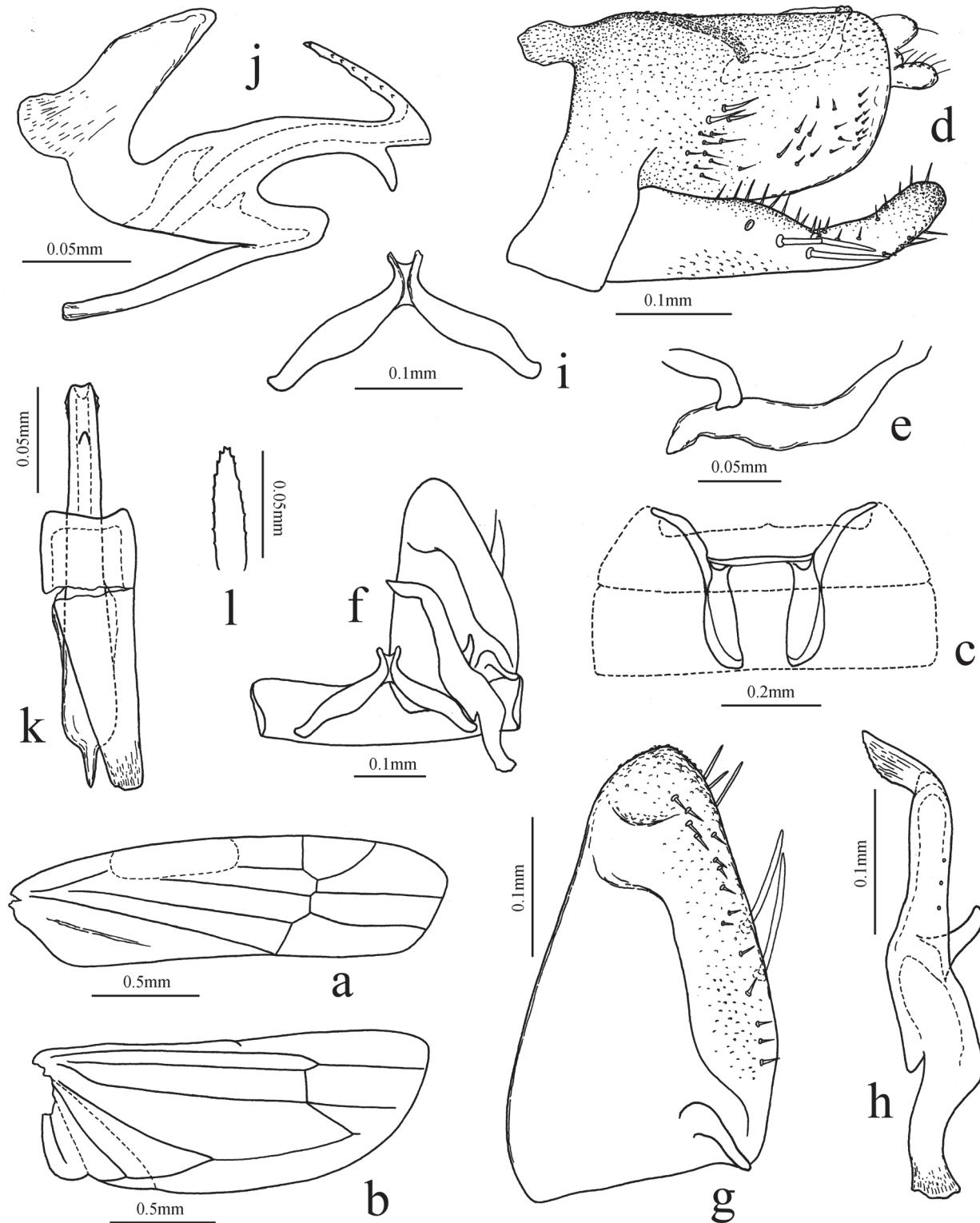


FIGURE 1. *Kusala (Kusala) viraktamathi* sp. nov. a. forewing; b. hind wing; c. 2S abdominal apodemes; d. genital capsule; e. anal tube appendage and pygofer dorso-lateral inner ridge; f. subgenital plate, style, connective and the 9th sternite; g. subgenital plate, dorsal view; h. style, dorsal view; i. connective; j. aedeagus, lateral view; k. aedeagus, ventral view; l. aedeagal dorsal lamella, dorsal view

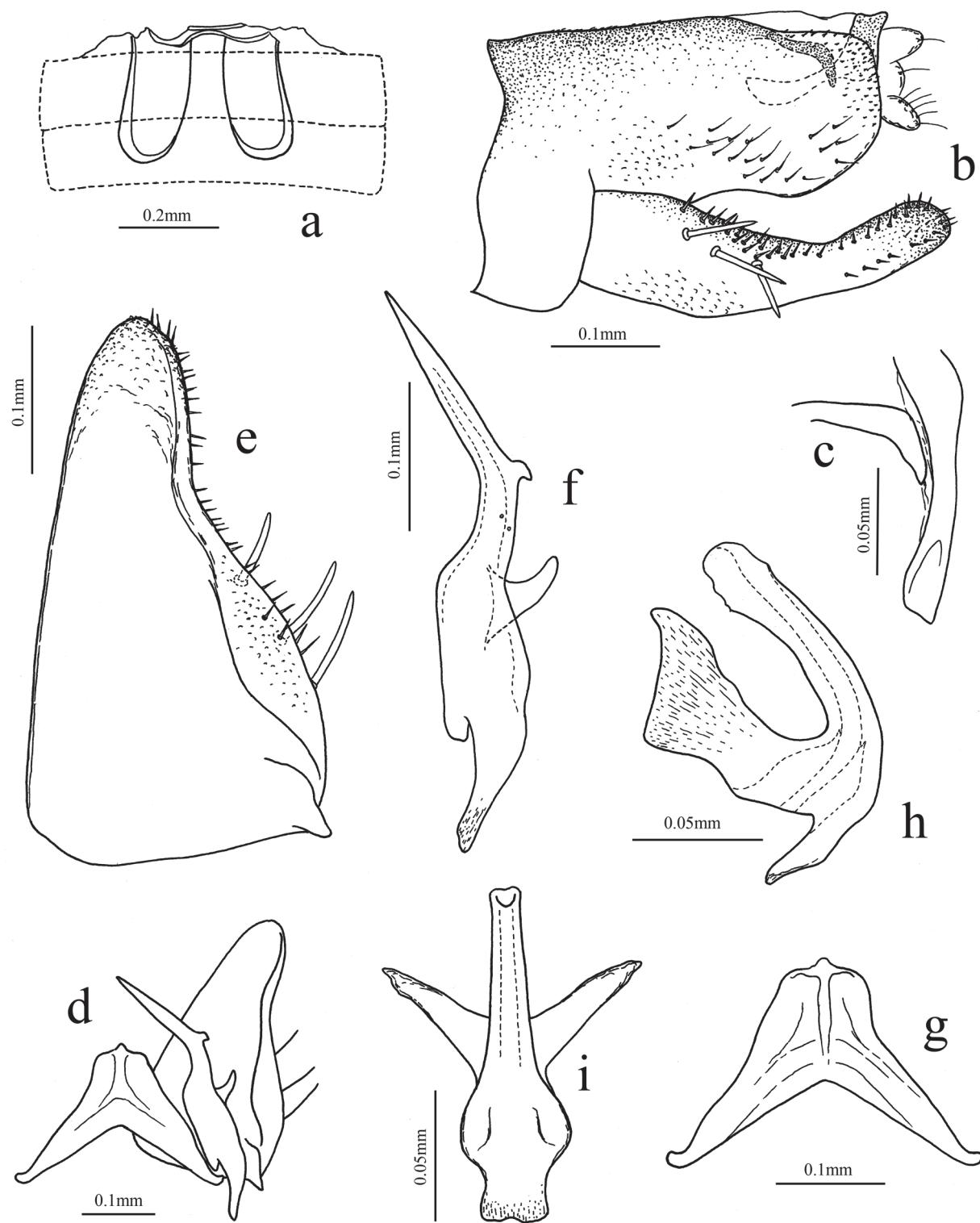


FIGURE 2. *Kusala (Scodela) directa* sp. nov. a. 2S abdominal apodemes; b. genital capsule; c. anal tube appendage and pygofer dorso-lateral inner ridge; d. subgenital plate, style and connective; e. subgenital plate, dorsal view; f. style, dorsal view; g. connective; h. aedeagus, lateral view; i. aedeagus, caudal view

Measurement. Male length 2.90mm.

Material examined. Holotype: ♂, CHINA, Yunnan Prov., Yingjiang, Xima, 24°48'18"N, 97°45'03"E, 1828.9m, 4 v 2012, coll. Yanghui Cao; paratype: 1♂, same data as holotype.

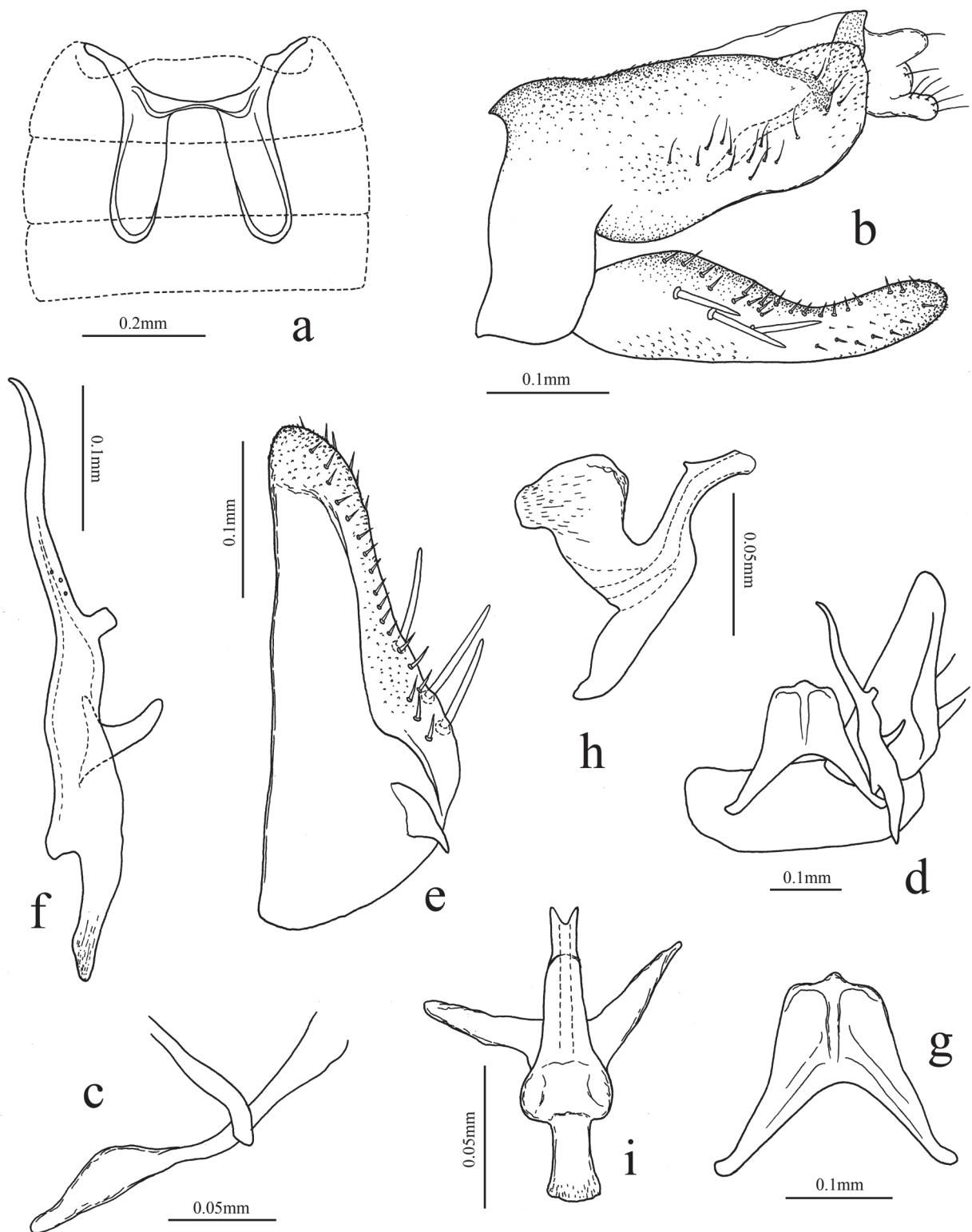


FIGURE 3. *Kusala (Scodela) sinuata* sp. nov. a. 2S abdominal apodemes; b. genital capsule; c. anal tube appendage and pygofer dorso-lateral inner ridge; d. subgenital plate, style, connective and the 9th sternite; e. subgenital plate, dorsal view; f. style, dorsal view; g. connective; h. aedeagus, lateral view; i. aedeagus, caudal view

Etymology. The new specific epithet is derived from Latin adjective “*directus*”, which means “straight”, referring to the straight apical part of the style.

***Kusala (Scodela) sinuata* sp. nov.**

(Figs 3, 5i–l)

Description. Ground color orange-brown, face brown. Crown fore margin rounded, anteclypeus ovoid. (Figs 5i–l)

Male 2S abdominal apodemes (Fig. 3a) surpassing hind margin of sternite IV. Anal tube appendage (Figs 3b, c) long.

Subgenital plate (Fig. 3e) narrow. Apical part of style (Fig. 3f) sinuate, subapical extension rectangular. Connective (Fig. 3g) lamellate, manubrium very broad. Aedeagal shaft (Figs 3h, i) directed dorso-caudad, with a small protrusion on dorsal margin subapically, apex concave in caudal view; dorsal apodeme large, Y-shaped in caudal view; preatrium relatively long.

Diagnosis. The new species is similar to *K. (S.) directa* sp. nov., but the subgenital plate is narrower, the apical part of the style is sinuate, the aedeagal shaft is narrower, directed dorso-caudad and has a small protrusion on the dorsal margin subapically, and the preatrium is longer.

Measurement. Male length 2.60mm.

Material examined. Holotype: ♂, CHINA, Yunnan Prov., Yingjiang, Xima, 24°48'18"N, 97°45'03"E, 1828.9m, 4 v 2012, coll. Yanghui Cao.

Etymology. The new specific epithet is derived from Latin verb “*sinuatus*”, which means “bend”, referring to the sinuate apical part of the style.

***Diomma* Motschulsky, 1863**

Diomma Motschulsky, 1863: 102; Dworakowska, 1981b: 364; Chiang & Knight, 1990: 199; Song & Li, 2011b: 58

Platyttex Matsumura, 1932: 104

Zyginoides Matsumura, 1932: 106; Dworakowska, 1972: 857

Platytteticis Strand, 1942: 393

Pakeasta Ahmed, 1971: 188

Type species: *Diomma ochracea* Motschulsky, 1863

Description. Body medium sized, depressed. Ground color pale to yellowish-brown with dark patches and smoky areas forming symmetrical pattern as in *Kusala* Dworakowska. Crown fore margin rounded or angulately produced, head as wide as or slightly wider than pronotum, face flat in profile, anteclypeus of male broad, lorum small. Forewing venation with second apical cell narrowest, third apical cell sometimes petiolate, fourth apical cell not extended to tip of wing, about half length of third, MP" + CuA' straight or slightly curved basally; AA and AP visible or not. Hind wing with submarginal vein (av) reduced to various extent, usually both basally and apically, CuP" absent or present, but not connected with av, RA vein usually present.

Male 2S abdominal apodemes long and moderately broad, extended to sternite IV–V. Anal tube short, without or with poorly developed appendages.

Male genital capsule depressed and well sclerotized, pygofer lobe with well developed setosity on distal half, usually with some macrosetae in central area or near dorsal margin, numerous fine setae and microsetae on lower and caudal area; dorsal appendage lamellate, short, fused to lobe basally; ventral appendage absent. Subgenital plate short and broad, nearly triangular, with row of macrosetae near outer margin and row of microsetae along outer margin. Style stout, apical part short to long, slim to broad, preapical lobe distinct. Connective V-shaped or Y-shaped, central lobe absent. Aedeagal shaft tubular, with or without process; dorsal apodeme well developed; preatrium rudimentary to long, without process or with single process far from shaft; gonopore usually terminal.

Diagnosis. This genus is closely related to *Kusala* Dworakowska, but can be easily distinguished by the reduced submarginal vein of the hind wing. It contains three subgenera: *Diomma* Motschulsky, 1863, *Bunyipia* Dworakowska, 1972 and *Dilobonota* Dworakowska, 1972, which show remarkable differences in wing venation. The nominate subgenus, distributed in Oriental region, has CuP" absent on the hind wing. *Diomma* (*Bunyipia*), consisting of two Australian species, has CuP" long and av shorter in the hind wing. The Afrotropical subgenus *Diomma* (*Dilobonota*) has the third apical cell of the forewing petiolate, CuP" short and av shortest in the hind wing.

Distribution. Bangladesh; China; India; Indonesia; Japan; Malaysia; Nigeria; Papua New Guinea; Sri Lanka; Sudan; Thailand.

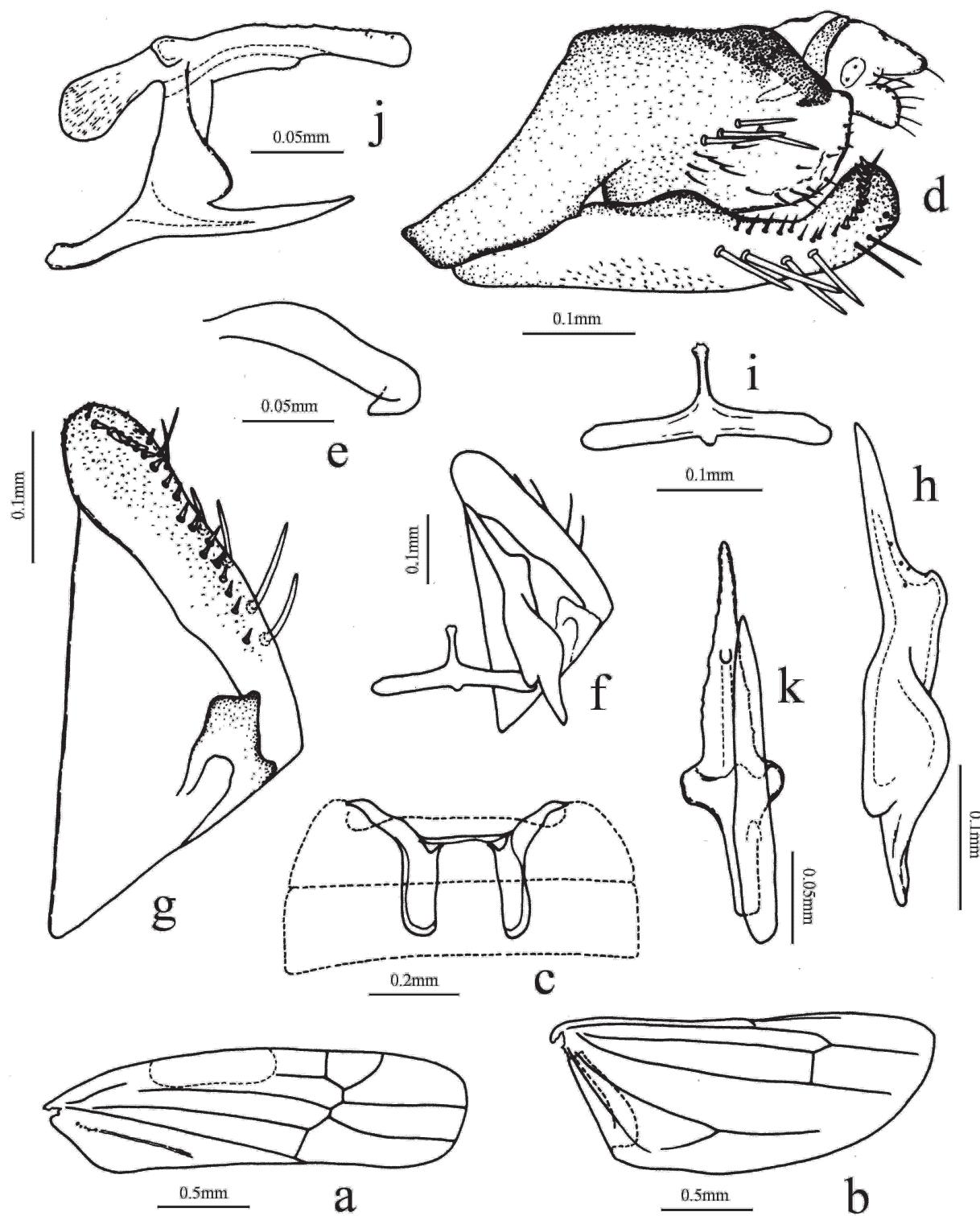


FIGURE 4. *Diomma (Diomma) sangzhiensis* sp. nov. a. forewing; b. hind wing; c. 2S abdominal apodemes; d. genital capsule; e. pygofer dorsal appendage; f. subgenital plate; style and connective; g. subgenital plate, dorsal view; h. style, dorsal view; i. connective; j. aedeagus, lateral view; k. aedeagus, ventral view

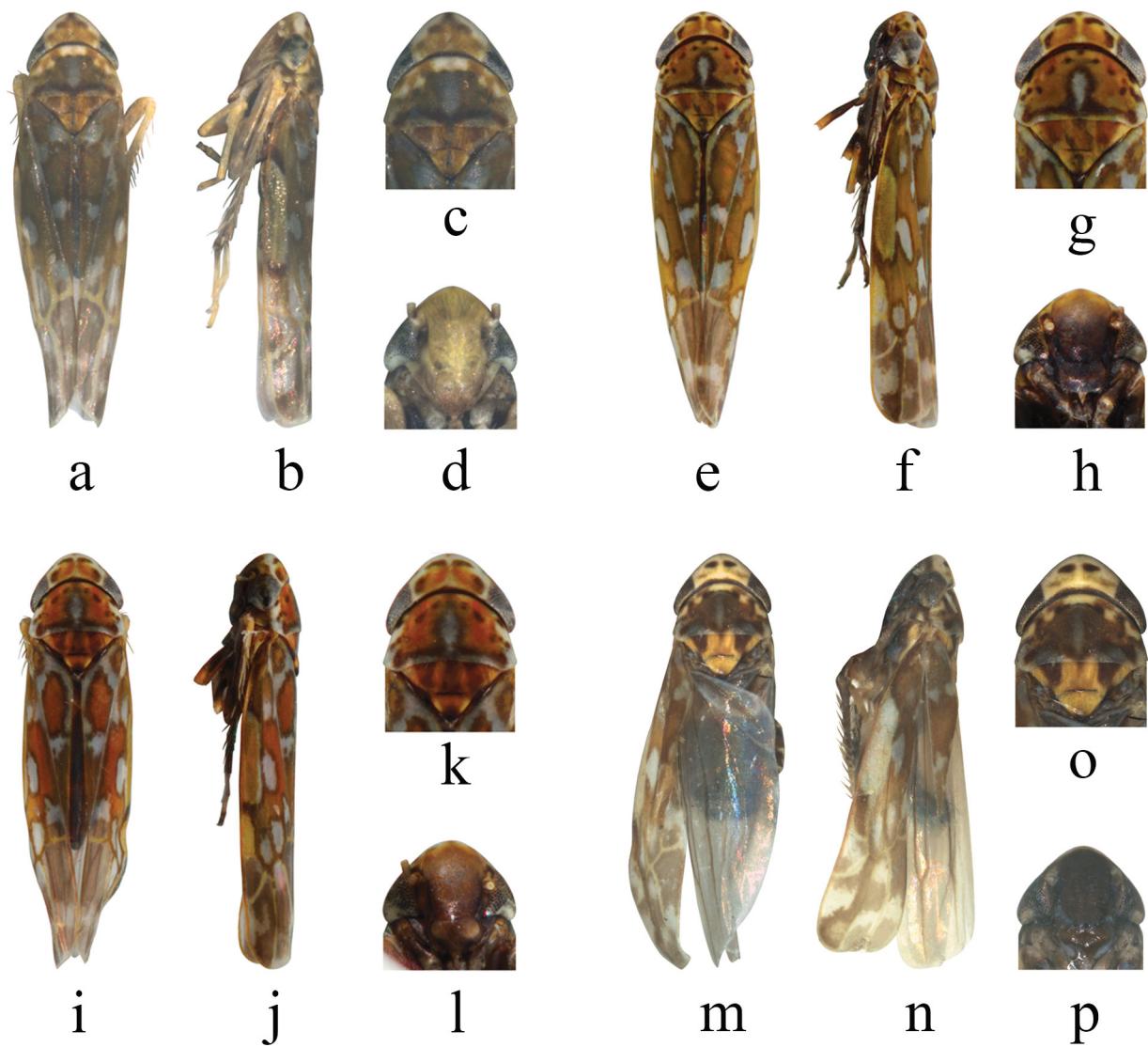


FIGURE 5. a–d. *Kusala (Kusala) viraktamathi* sp. nov.; e–h. *Kusala (Scodela) directa* sp. nov.; i–k. *Kusala (Scodela) sinuata* sp. nov.; m–p. *Diomma (Diomma) sangzhiensis* sp. nov.

***Diomma (Diomma) sangzhiensis* sp. nov.**

(Figs 4, 5m–p)

Description. Ground color (Figs 5m–p) yellowish-brown, face dark, eyes black. Vertex with pair of dark patches. Pronotum with fore margin yellowish-brown, midline and hind margin of pronotum grey bordered with dark brown. Brochosome field of forewing grey. Crown fore margin rounded in dorsal view, anteclypeus ovoid. Hind wing (Fig. 4b) with av almost complete between AP'+AA and CuP.

Male 2S abdominal apodemes (Fig. 4c) not extended to hind margin of sternite IV. Anal tube appendage (Fig. 4d) very short and weakly sclerotized.

Pygofer lobe (Fig. 4d) with group of macrosetae in middle area and some fine setae near ventral and caudal margins; dorsal appendage (Fig. 4e) thick, apex pointed and sharply bent cephalad. Subgenital plate (Fig. 4g) with about 6 macrosetae, apical ones much thinner than basal ones, with row of microsetae along outer margin. Style (Fig. 4h) stout, apical part thick and straight. Connective (Fig. 4i) with manubrium very narrow, lateral arms

horizontal, in a line. Aedeagal shaft (Figs 4j, k) almost straight, dorsal and lateral margins serrated, apex blunt in lateral view, widened basally and tapering towards apex in ventral view; dorsal apodeme well developed, narrow and long in lateral view; preatrium as long as shaft, widened near preatrial process, process narrow and long; gonopore middle on ventral margin.

Diagnosis. The new species has a vein of hind wing developed basally (between AP'+AA and CuP), which is similar to *Diomma (Diomma) knighti* Dworakowska, 1981, but different with most other species in *Diomma*. The male genitalia of the new species is very close to *Diomma (Diomma) pincersa* Song, Li & Xiong, 2011, but the pygofer dorsal appendage is bent cephalad, the subgenital plate is much wider and has a straight outer margin, the style has shorter, thicker apical part and the lateral arms of the connective are shorter.

Measurement. Male length 2.70mm.

Material examined. Holotype: ♂, CHINA, Hunan Prov., Sangzhi, 06 ix 1981, coll. Xinwang Tong.

Etymology. The new species name is an adjective referring to the type locality, Sangzhi.

Acknowledgement

We are grateful to Dr. C. H. Dietrich (Illinois Natural History Survey, University of Illinois at Urbana-Champaign, USA) and an anonymous referee for reviewing this manuscript. This study is supported by the National Natural Science Foundation of China (31420103911, 31372233), the Ministry of Science and Technology of the People's Republic of China?2015FY210300, 2005DKA21402) and the U.S. NSF grant DEB 16-39601.

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