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## DESCRIPTION OF FEMALE GENITALIA OF TWELVE SPECIES OF *LYCOCERUS* GORHAM (COLEOPTERA, CANTHARIDAE)

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The female genitalia for twelve species of *Lycocerus* Gorham from China are described and photographed, including *L. centrochinensis* (Švihla, 2004), *L. confossicollis* (Fairmaire, 1891), *L. bilineatus* (Wittmer, 1995), *L. kiontochanaus* (Pic, 1921), *L. metallicipennis* (Fairmaire, 1887), *L. malaisei* (Wittmer, 1995), *L. pubicollis* (Heyden, 1889), *L. nigeroverticalis* (Fairmaire, 1881), *L. metallescens fukienensis* (Wittmer, 1954), *L. asperipennis* (Fairmaire, 1891), *L. orientalis* (Gorham, 1889), and *L. inopaciceps* (Pic, 1926). Key to the Chinese species of *Lycocerus* based on female genitalia is provided.

KEY WORDS: Beetles, Cantharidae, *Lycocerus*, female genitalia, morphology, key, China.

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Детально описана и проиллюстрирована репродуктивная система самок 12 видов рода *Lycocerus* Gorham: *L. centrochinensis* (Švihla, 2004), *L. confossicollis*

(Fairmaire, 1891), *L. bilineatus* (Wittmer, 1995), *L. kiontochanus* (Pic, 1921), *L. metallicipennis* (Fairmaire, 1887), *L. malaisei* (Wittmer, 1995), *L. pubicollis* (Heyden, 1889), *L. nigerovernalis* (Fairmaire, 1881), *L. metallescens fukienensis* (Wittmer, 1954), *L. asperipennis* (Fairmaire, 1891), *L. orientalis* (Gorham, 1889) и *L. inopaciceps* (Pic, 1926). Приведена определительная таблица китайских видов рода *Lycocerus*, основанная на строении репродуктивной системы самок.

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## INTRODUCTION

*Lycocerus* Gorham, 1889 *sensu lato* (Okushima, 2005) is a one of the largest cantharid genera, which has more than 300 species worldwide at present. According to Okushima (2005) the female genitalia is considered to be a useful morphological structure and applied in description of the *Lycocerus* species. However, except those of the species from Japan (Okushima, 2005), the female genitalia for most other species of *Lycocerus* are hitherto unknown. In the present study, the morphology of female genitalia of twelve *Lycocerus* species from China are studied and compared for the first time, and a key based on the characters of this structure is provided to distinguish these species.

## MATERIAL AND METHOD

The studied materials are deposited in the Museum of Hebei University, Baoding, China (MHBU). The abdomen of the specimen was detached from the body and sunk in 10% NaOH solution for about 10 minutes, then the female genitalia was dissected and dyed with hematoxylin and cleared in the distilled water under the stereomicroscope Nikon SMZ1500. All photos were taken using a Leica M205 A microscope and edited in the Adobe Photoshop 8.0.1. Morphological terminology of female genitalia follows that of Brancucci (1980) and the description format of Okushima (2005).

## RESULTS

### Genus *Lycocerus* Gorham, 1889

DIAGNOSIS (Female genitalia). Vagina stout. Oviduct opening in middle of ventral side of vagina. Diverticulum and spermathecal duct opening at the apex of vagina. Diverticulum thin, spiral tube-shaped. Spermatheca provided with one or two thin, spiral tubes, and attached with a thin accessory gland at the base.

REMARKS. The species of *Lycocerus* differs one from another in the female genitalia as follows: the number of the spiral tubes in the spermatheca; spermatheca evenly or abruptly thinned apically; relative length of spermathecal duct, diverticulum, spiral tubes of spermatheca and accessory gland; relative thickness of spermatheca and diverticulum.

### Key to the species of *Lycocerus* based on the characters of female genitalia

1. Spermatheca provided with two spiral tubes ..... *L. centrochinensis* (Švihla, 2004)
  - Spermatheca provided with one spiral tube ..... 2
2. Vagina strongly thinned apically into a long tube, at whose apex diverticulum and spermathecal duct opening ..... *L. confossicollis* (Fairmaire, 1891)
  - Vagina unlike above ..... 3
3. Spermatheca abruptly thinned apically ..... 4
  - Spermatheca evenly thinned apically ..... 5
4. Accessory gland distinctly longer than spermatheca .....
  - ..... *L. kiontochanaus* (Pic, 1921)
  - Accessory gland slightly longer than spermatheca ... *L. bilineatus* (Wittmer, 1995)
5. Diverticulum and spermatheca longer than or no shorter than accessory gland; basal portion of spermatheca extended into a very short tube, where accessory gland opening ..... 6
  - Diverticulum and spermatheca shorter than or no longer than accessory gland; accessory gland directly opening at base of spermatheca ..... 9
6. Basal portion of diverticulum as stout as spermathecal duct .....
  - ..... *L. inopaciceps* (Pic, 1926)
  - Basal portion of diverticulum distinctly thinner than spermathecal duct ..... 7
7. Spermatheca much longer than diverticulum .....
  - ..... *L. metallescens fukienensis* (Wittmer, 1954)
  - Spermatheca slightly longer than diverticulum ..... 8
8. Basal portion of spermatheca distinctly thinner than spermathecal duct .....
  - ..... *L. asperipennis* (Fairmaire, 1891)
  - Basal portion of spermatheca slightly thinner than spermathecal duct .....
    - ..... *L. orientalis* (Gorham, 1889)
9. Basal portion of diverticulum nearly as stout as spermathecal duct and distinctly stouter than apical portion ..... *L. pubicollis* (Heyden, 1889)
  - Diverticulum distinctly thinner than spermathecal duct in the whole length ..... 10
10. Spermatheca slightly longer than diverticulum .....
  - ..... *L. metallicipennis* (Fairmaire, 1887)
  - Spermatheca distinctly longer than diverticulum ..... 11
11. Basal portion of spermatheca moderately stouter than apical portion .....
  - ..... *L. malaisei* (Wittmer, 1995)
  - Basal portion of spermatheca much stouter than apical portion .....
    - ..... *L. nigeroververticalis* (Fairmaire, 1881)

#### *Lycocerus centrochinensis* (Švihla, 2004)

Fig. 1A

MATERIAL. 1♀, **China**: Ningxia, Jingyuan, Longtan Forestry, 19–22.VI 2008, leg. G.D. Ren.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long and

much thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca abruptly thinned apically, provided with two spiral tubes, which extended in the same direction, subequal in length and slightly shorter than diverticulum. Basal portion of spermatheca extended into a very short tube, where accessory gland opening. Accessory gland distinctly longer than spermatheca.

REMARKS. The female genitalia of this species is similar to that of *L. okuyugawaranus* (Takahashi, 1992), which belongs to *L. okuyugawaranus* subgroup of *L. lineatipennis* group (Okushima, 2005).

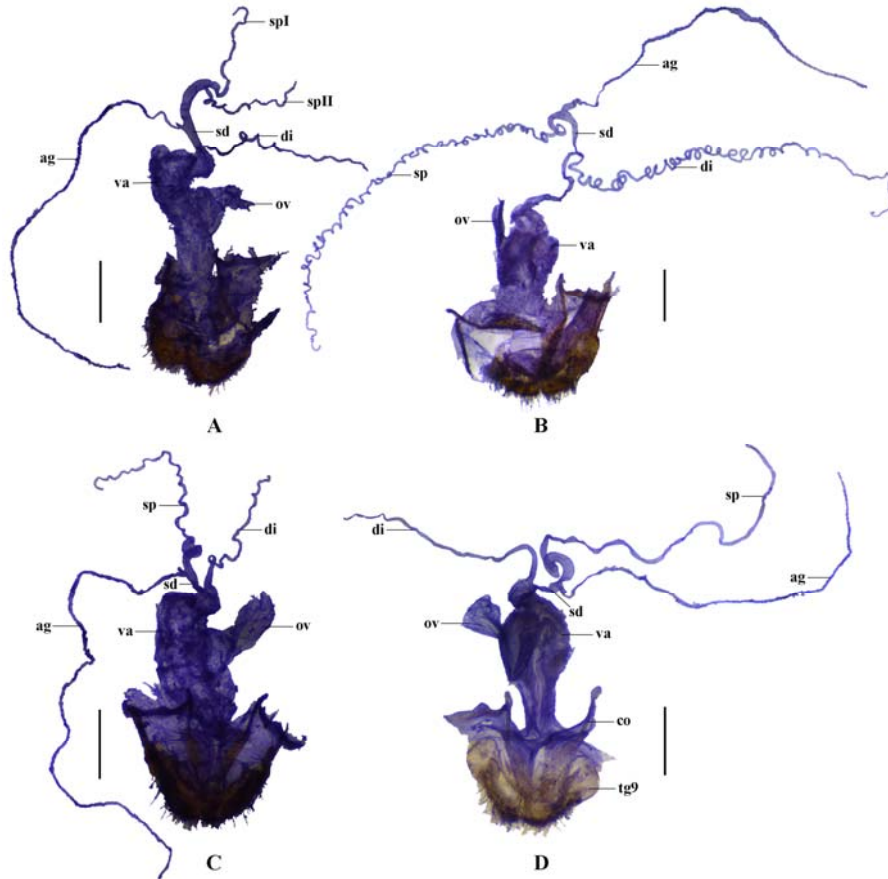


Fig. 1. Female genitalia, lateral view (ag: accessory gland; co: coxite; di: diverticulum; tg9: abdominal tergite IX; sd: spermathecal duct; sp: spermatheca; ov: median oviduct; va: vagina): A – *Lycocerus centrochinensis* (Švihla, 2004); B – *L. confossicollis* (Fairmaire, 1891); C – *L. bilineatus* (Wittmer, 1995); D – *L. kiontochanaus* (Pic, 1921). Scale bars: 0.5 mm.

***Lycocerus confossicollis* (Fairmaire, 1891)**

Fig. 1B

MATERIAL. 1♀, **China**: Hubei, Dalaoling Nat. Res., 1200–1300 m, 1.V 2011, leg. G.L. Xie.

DESCRIPTION. Vagina strongly thinned apically into a long tube, at whose apex diverticulum and spermathecal duct opening. Diverticulum very long and much thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is very long and nearly as long as diverticulum. Basal portion of spermatheca extended into a short tube, where accessory gland opening. Accessory gland distinctly shorter than spermatheca.

REMARKS. The female genitalia of this species is similar to that of *L. aegrotus* (Kiesenwetter, 1874), which belongs to the *L. aegrotus* subgroup of *L. aegrotus* group (Okushima, 2005).

***Lycocerus bilineatus* (Wittmer, 1995)**

Fig. 1C

MATERIAL. 1♀, **China**: Hubei, Wufeng, Houhe, 900–1100 m, 2.V 2004, leg. G.L. Xie.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long, basal portion slightly thinner than spermathecal duct and distinctly stouter than apical portion. Spermathecal duct stout and short. Spermatheca abruptly thinned apically into a spiral tube, which is slightly longer than diverticulum. Basal portion of spermatheca extended into a short tube, where accessory gland opening. Accessory gland distinctly longer than spermatheca.

REMARKS. Its female genitalia is similar to *L. akemiae* (M. Satô et Okushima, 1992), which belongs to *L. teruhisai* subgroup of *L. adusticollis* group (Okushima, 2005).

***Lycocerus kiontochanaus* (Pic, 1921)**

Fig. 1D

MATERIAL. 1♀, **China**: Shaanxi, Danfeng, Qinchuan, 1.VII 2014, leg. C.X. Yuan & Y. Tian.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long, basal portion slightly thinner than spermathecal duct and distinctly stouter than apical portion. Spermathecal duct stout and short. Spermatheca abruptly thinned apically into a spiral tube, which is nearly as long as diverticulum. Basal portion of spermatheca extended into a short tube, where accessory gland opening. Accessory gland slightly longer than spermatheca.

REMARKS. The female genitalia of this species is similar to that of *L. bilneatus*, also resembles those of *L. hubeiensis* Y. Yang et X. Yang, 2014, *L. sichuanus* Y. Yang et X. Yang, 2014 and *L. quadrilineatus* Y. Yang et X. Yang, 2014 (Yang *et al.*, 2014).

***Lycocerus metallicipennis* (Fairmaire, 1887)**

Fig. 2A

MATERIAL. 1♀, **China**: Yunnan, Zhongdian, Xiaozhongdian, 3170 m, 12.VI 2007, leg. C. Wei.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long, basal portion distinctly thinner than spermathecal duct and slightly stouter than apical portion. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is slightly longer than diverticulum. Basal portion of spermatheca much stouter than apical portion. Accessory gland directly opening at base of spermatheca, slightly longer than spermatheca.

REMARKS. This species belongs to *L. maculicollis* group, according to the definition of *Lycocerus* species-group by Okushima (2005).

***Lycocerus malaisei* (Wittmer, 1995)**

Fig. 2B

MATERIAL. 1♀, **China**: Yunnan, Gaoligongshan, 2000 m, 26–27.VII 2012, leg. J. S. Xu & L.X. Chang.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long and distinctly thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is distinctly longer than diverticulum. Basal portion of spermatheca slightly stouter than apical portion. Accessory gland directly opening at base of spermatheca, slightly longer than spermatheca.

REMARKS. This species belongs to *L. maculicollis* group, according to the definition of *Lycocerus* species-group by Okushima (2005).

***Lycocerus pubicollis* (Heyden, 1889)**

Fig. 2C

MATERIAL. 1♀, **China**: Hebei, Chengde, Mulanweichang Nat. Res., 1.VI 2015, leg. H.Y. Liu.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long, basal portion nearly as stout as spermathecal duct and distinctly stouter than apical portion. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is nearly as long as diverticulum. Basal portion of spermatheca much stouter than apical portion. Accessory gland directly opening at base of spermatheca, slightly longer than spermatheca.

REMARKS. This species belongs to *L. maculicollis* group, according to the definition of *Lycocerus* species-group by Okushima (2005).

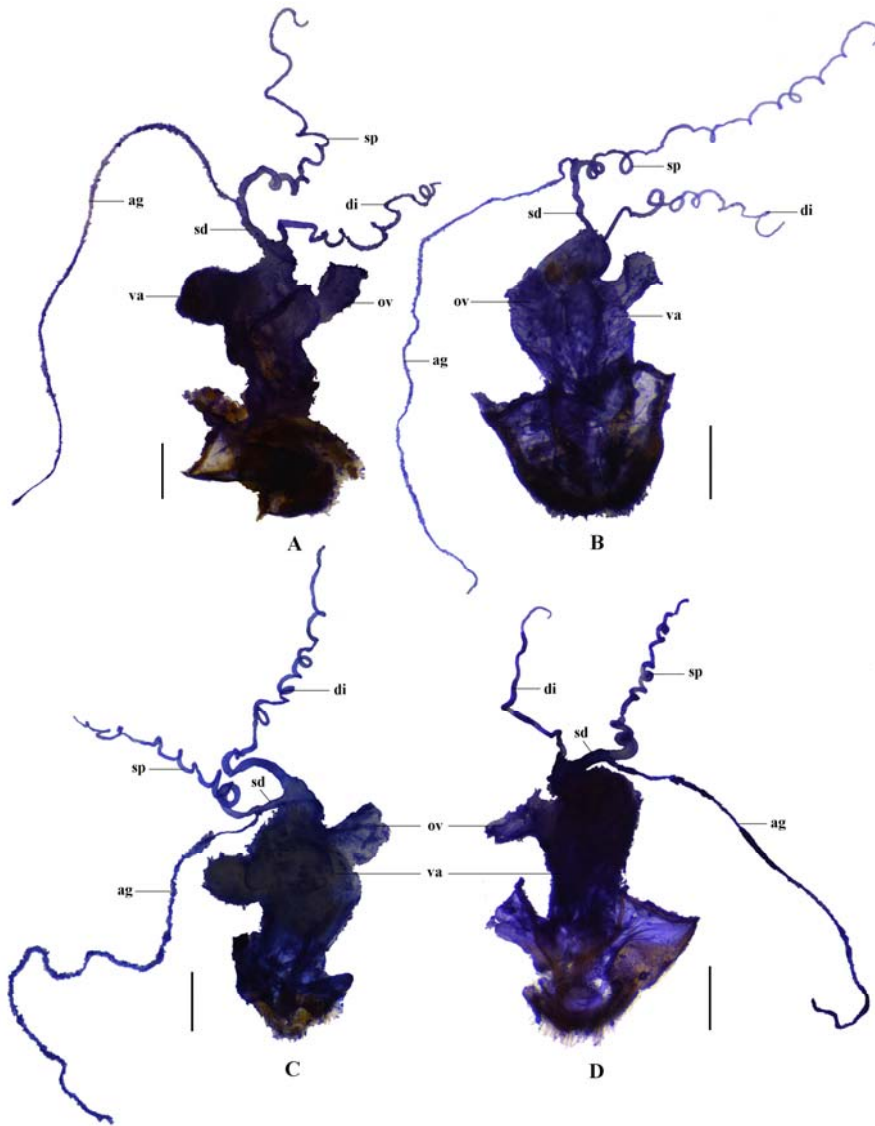


Fig. 2. Female genitalia, lateral view (ag: accessory gland; di: diverticulum; sd: spermathecal duct; sp: spermatheca; ov: median oviduct; va: vagina): A – *Lycocerus metallicipennis* (Fairmaire, 1887); B – *L. malaisei* (Wittmer, 1995); C – *L. pubicollis* (Heyden, 1889); D – *L. inopaciceps* (Pic, 1926). Scale bars: 0.5 mm.

***Lycocerus nigerovernalis* (Fairmaire, 1881)**

Fig. 2D

MATERIAL. 1♀, **China**: Yunnan, Binchuan, Qiaodian, 14.VI 2008, leg. J.S. Xu.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum moderately long and distinctly thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, distinctly longer than diverticulum. Basal portion of spermatheca much stouter than apical portion. Accessory gland directly opening at base of spermatheca, slightly longer than spermatheca.

REMARKS. This species belongs to *L. maculicollis* group, according to the definition of *Lycocerus* species-group by Okushima (2005).

***Lycocerus metallescens fukienensis* (Wittmer, 1954)**

Fig. 3A

MATERIAL. 1♀, **China**: Zhejiang, Qingliangfeng, Tianchi, 21–23.V 2012, leg. J.S. Xu & L.X. Chang.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum long and distinctly thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is very long and much longer than diverticulum. Basal portion of spermatheca extended into a very short tube, where accessory gland opening. Accessory gland distinctly shorter than spermatheca.

REMARKS. The female genitalia of this species is similar to those of the *Lycocerus suturellus* group (Okushima, 2005).

***Lycocerus asperipennis* (Fairmaire, 1891)**

Fig. 3B

MATERIAL. 1♀, **China**: Shaanxi, Zhen'an, Yungaisi, 21.VI 2014, leg. C.X. Yuan & Y. Tian.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum long, evenly thin in the whole length and distinctly thinner than spermathecal duct. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is very long and moderately longer than diverticulum. Basal portion of spermatheca extended into a very short tube, where accessory gland opening. Accessory gland shorter than spermatheca.

REMARKS. This species belongs to *Lycocerus suturellus* group, noted by Okushima (2005).



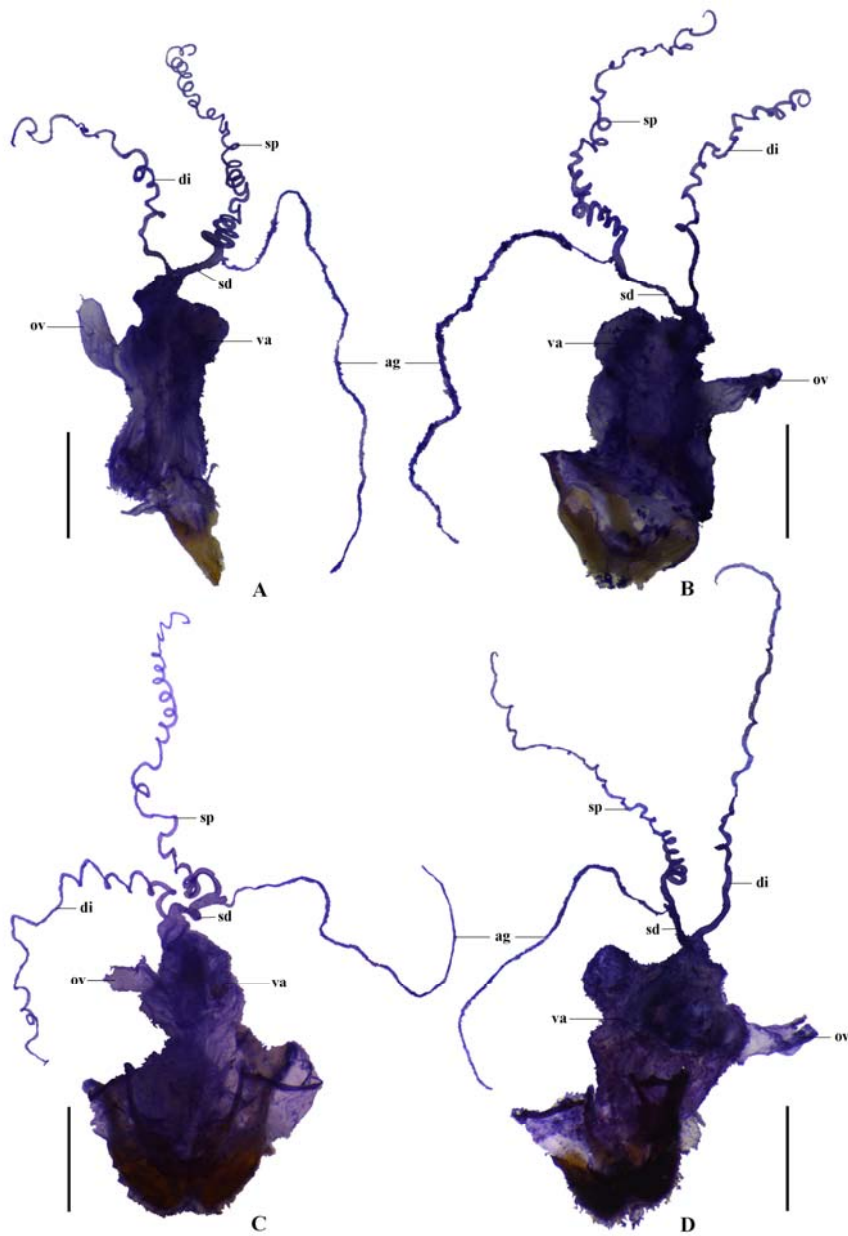


Fig. 3. Female genitalia, lateral view (ag: accessory gland; di: diverticulum; sd: spermathecal duct; sp: spermatheca; ov: median oviduct; va: vagina): A – *Lycocerus metallescens fukienensis* (Wittmer, 1954); B – *L. asperipennis* (Fairmaire, 1891); C – *L. orientalis* (Gorham, 1889); D – *L. inopaciceps* (Pic, 1926). Scale bars: 1.0 mm.

***Lycocerus orientalis* (Gorham, 1889)**

Fig. 3C

MATERIAL. 1♀, **China**: Zhejiang, Qingliangfeng, Longtangshan, 18–21.V 2012, leg. J.S. Xu & L.X. Chang.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum long and distinctly thinner than spermathecal duct in the whole length. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is very long than moderately longer than diverticulum. Basal portion of spermatheca distinctly thinner than spermathecal duct and extended into a very short tube, where accessory gland opening. Accessory gland distinctly shorter than spermatheca.

REMARKS. This species belongs to *Lycocerus suturellus* group, noted by Okushima (2005).

***Lycocerus inopaciceps* (Pic, 1926)**

Fig. 3D

MATERIAL. 1♀, **China**: Shaanxi, Fengxian, Heigou, 13.VI 2005, leg. Y.B. Ba.

DESCRIPTION. Vagina slightly thinned apically. Diverticulum and spermathecal duct opening at ventroapical portion of vagina. Diverticulum long, basal portion as stout as spermathecal duct and distinctly stouter than apical portion. Spermathecal duct stout and short. Spermatheca evenly thinned apically into a spiral tube, which is long and slightly longer than diverticulum. Basal portion of spermatheca extended into a very short tube, where accessory gland opening. Accessory gland shorter than spermatheca.

REMARKS. The female genitalia of this species is similar to those of the *Lycocerus suturellus* group (Okushima, 2005).

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