



## Three new species of the genus *Kuvera* Distant (Hemiptera: Fulgoromorpha: Cixiidae) from Korea

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### ABSTRACT

Three new species of *Kuvera* Distant, 1906 (Hemiptera: Fulgoromorpha: Cixiidae: Cixiini), *K. hagilsanensis* **sp. nov.**, *K. hallasanensis* **sp. nov.** and *K. yecheonensis* **sp. nov.**, from Korea, are described and illustrated. A checklist of all species of *Kuvera* and a key to the species known from Korea are provided.

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## Introduction

The cixiid genus *Kuvera* was established by Distant (1906) based on specimens from Myanmar (type species: *Kuvera semihyalina* Distant 1906). It belongs to the tribe Cixiini within the subfamily Cixiinae (Hemiptera: Fulgoromorpha: Cixiidae) and is easily separated from other members in this tribe by the following characters: vertex short with feeble median carina, lateral carinae moderately elevated, frons with a prominent transverse carina at base, separated from anterior margin of vertex for distance, median carina not reaching this transverse carina, post-clypeus with distinct median carina, post-ocular carinae sharp and arcuate; mesonotum with three distinct carinae all the way, forewing hyaline to semihyaline with small granules on the veins without hairs, aedeagus with two spinose basal processes attached to phallosome and one spinose process attached to flagellum apically, phallosome almost flat and widened at base, anal tube with rounded posterior margin, styli with flat, widened apices. This genus is known to occur in China, Taiwan, Korea, Japan, Russia, India and Myanmar (Distant 1906; Matsumura 1914; Tsaur et al. 1991; Lee and Kwon 1977; Anufriev 2009). To date, 18 species have been described from all over the world (Bourgoin 2014). Previously, only two species were known to occur in Korea: *Kuvera flaviceps* Matsumura,

re-described by Lee (1979) primarily based on external morphology and *Kuvera ligustri* Matsumura (unavailable in current investigation), enlisted from Korea based on its range of distribution (Lee and Kwon 1979). After that, no further taxonomic works were done on the genus *Kuvera*.

While studying the cixiid specimens in the Insect Collection of the Kyungpook National University, Korea, we found the three undescribed species of *Kuvera*. The purpose of this paper is to describe these new species from Korea.

## Materials and methods

The terminology used in this study follows Yang and Wu (1993). The genital segments of examined specimens were observed in glycerine jelly using a stereoscopic microscope (Olympus SZX 12). Photographs of specimens were made using JUJAK 5.5 (DIXI 3000) digital camera and line illustrations were scanned with HP Scanjet 4850 (Hewlett Packard, Houston, TX, USA). Image and plate compositions were produced using the software Helicon Focus 5.1 and Adobe Photoshop CS3, respectively.

The term 'anal segment' used here means the whole tubular structure of the male genitalia and the 'anal style' indicates the process of the anal segment.

Specimens examined in the present study are deposited in the collection of the School of Applied Bio-Sciences, Kyungpook National University, Daegu, Republic of Korea (KNU).

## Systematics

### **Checklist of species of *Kuvera* Distant**

#### ***Kuvera brunettii* Muir**

*Kuvera brunettii* Muir 1922, p. 346

Distribution: India

#### ***Kuvera brunnea* (Dlabola)**

*Latoliarus brunneus* Dlabola 1957, p. 272

Distribution: Afghanistan

#### ***Kuvera communis* Tsaur and Hsu**

*Kuvera communis* Tsaur et al. 1991, p. 59

Distribution: Taiwan

#### ***Kuvera flaviceps* (Matsumura)**

*Oliarus flaviceps* Matsumura 1900, p. 208

Distribution: Japan, Korea

#### ***Kuvera hagilsanensis* sp nov**

Distribution: Korea (Central, South, Jeju-do)

#### ***Kuvera hallasanensis* sp nov**

Distribution: Korea (Central, South, Jeju-do)

***Kuvera hama* Tsaur and Hsu**

*Kuvera hama* Tsaur et al. 1991, p. 61

Distribution: Taiwan

***Kuvera kurilensis* Anufriev**

*Kuvera kurilensis* Anufriev 1987, p. 15

Distribution: Russia (Primorye)

***Kuvera laticeps* (Metcalf)**

*Cixius laticeps* Metcalf 1936, p. 180

Distribution: China

***Kuvera ligustri* Matsumura**

*Kuvera ligustri* Matsumura 1914, p. 409

Distribution: Japan, Korea

***Kuvera longipennis* Matsumura**

*Kuvera longipennis* Matsumura 1914, p. 411

Distribution: Taiwan

***Kuvera pallidula* Matsumura**

*Kuvera pallidula* Matsumura 1914, p. 409

Distribution: Japan

***Kuvera semihyalina* Distant**

*Kuvera semihyalina* Distant 1906, p. 261

Distribution: Myanmar (Type species)

***Kuvera similis* Tsaur and Hsu**

*Kuvera similis* Tsaur et al. 1991, p. 55

Distribution: Taiwan

***Kuvera taiwana* Tsaur and Hsu**

*Kuvera taiwana* Tsaur et al. 1991, p. 50

Distribution: Taiwan

***Kuvera tappanella* Matsumura**

*Kuvera tappanella* Matsumura 1914, p. 410

Distribution: Taiwan

***Kuvera toroensis* Matsumura**

*Kuvera toroensis* Matsumura 1914, p. 410

Distribution: Taiwan

***Kuvera transversa* Tsaur and Hsu**

*Kuvera transversa* Tsaur et al. 1991, p. 57

Distribution: Taiwan

***Kuvera ussuriensis* (Vilbaste)**

*Unkanodella ussuriensis* Vilbaste 1968, p. 27

Distribution: Russia (Primorye)

***Kuvera vilbastei* Anufriev**

*Kuvera vilbastei* Anufriev 1987, p. 7

Distribution: Russia (Primorye)

***Kuvera yecheonensis* sp. nov.**

Distribution: Korea (Gyeongsangbuk-do)

**Key to species of the genus *Kuvera* from Korea**

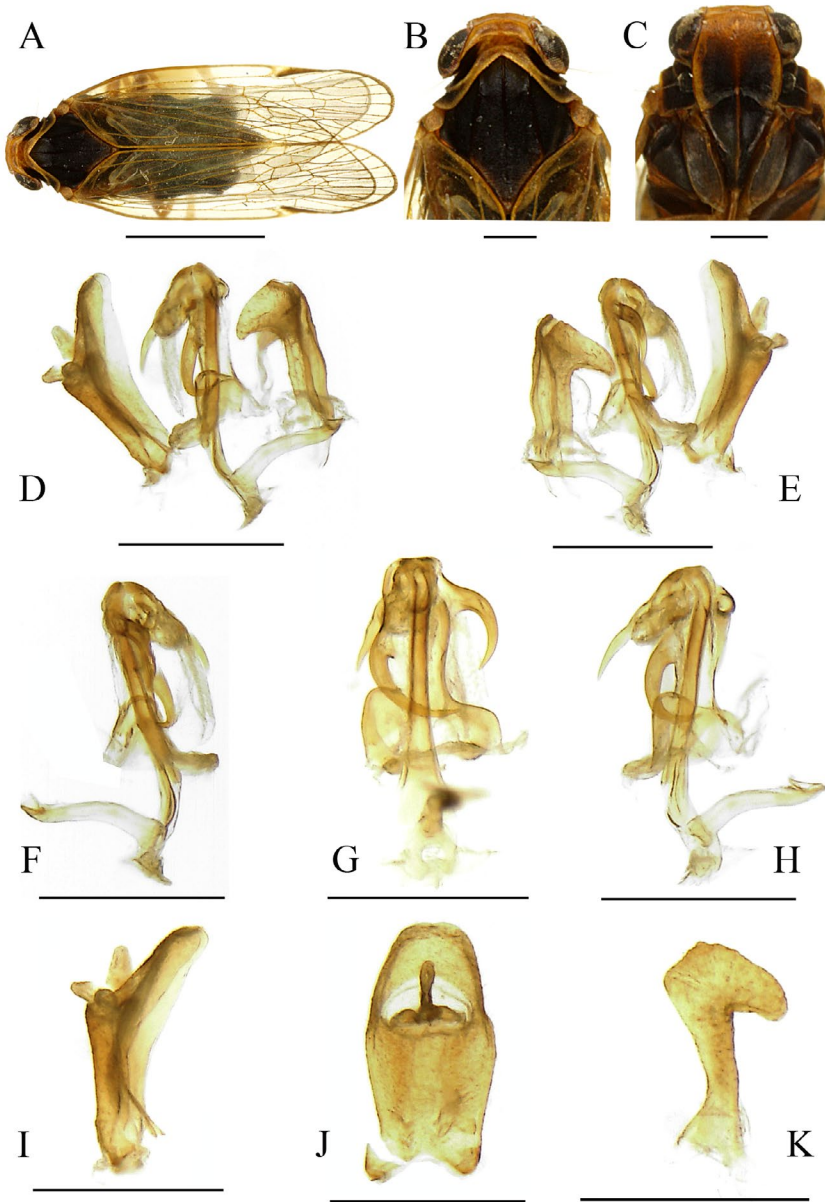
1. Forewings with a single dark brown spot on the margin of anal vein ..... 2  
 – Forewings without a single dark brown spot on the margin of anal vein ..... 3
2. Anal segment asymmetrical due to greater development of right apical lobe as compared to the left one; frons yellowish brown but post-clypeus dark brown; pterostigma light yellow; aedeagus with long spinose process of phallotheca slightly curved and apex directed away from phallotheca .....  
 ..... *K. yecheonensis* **sp. nov.**  
 – Apical lobes of anal segment symmetrical; more than half of frons and post-clypeus dark brown; pterostigma dark brown; aedeagus with long spinose process of phallotheca strongly curved, apex directed towards phallotheca .....  
 ..... *K. hallasanensis* **sp. nov.**
3. Flagellum of aedeagus with short spinose process. Phallotheca with two processes, length of smaller process about one-third of longer one, longer spine curved over the middle of aedeagus shaft and anal segment convex on the ventral side .....  
 ..... *K. flaviceps* (Matsumura)  
 – Flagellum of aedeagus with long spinose process. Phallotheca with two processes, length of smaller process about two-third of longer one, longer spine curved near the base of phallotheca and anal segment concave on the ventral side .....  
 ..... *K. hagilsanensis* **sp. nov.**

***Kuvera hagilsanensis* sp. nov.** (Figures 1(A–K, 2A–F))*Holotype*

m, adult, Korea: Gyeongsangbuk-do province: Hagilsan, 27 May 1997 (Y.J. Kwon).  
*Paratypes*, Gyeongsangbuk-do province: 1 m, Palgongsan, 20 June 1985; 2 m, Pyongpungsan, 27 May 1997; 1 m, Sambongsan, 28 May 1997; 1 m, Sobaeksan, 30 May 1989; 1 m, Unmunsan, 21 May 1991; 1f, Hagilsan, 27 May 1997. Gyeongsangnam-do province: 1 m, 2f, Hwawangsan, 27 May 1998. Gangwon-do province: 1 m, Odaesan, 18 September 1982; 1 m, same locality, 4 August 1983. Jeollabuk-do province: 1 m, Togyusan, 28 May 1991; 3 m, 1f, Unjangsan, 31 May 1998; 1f, same locality, 9 May 1998; 3 m, Jeju-do province: 2f, Hallasan, 19 June 1994; Jeollanam-do province: 1f, Paegunsan, 13 August 1999; all same collector (KNU).

*Diagnosis*

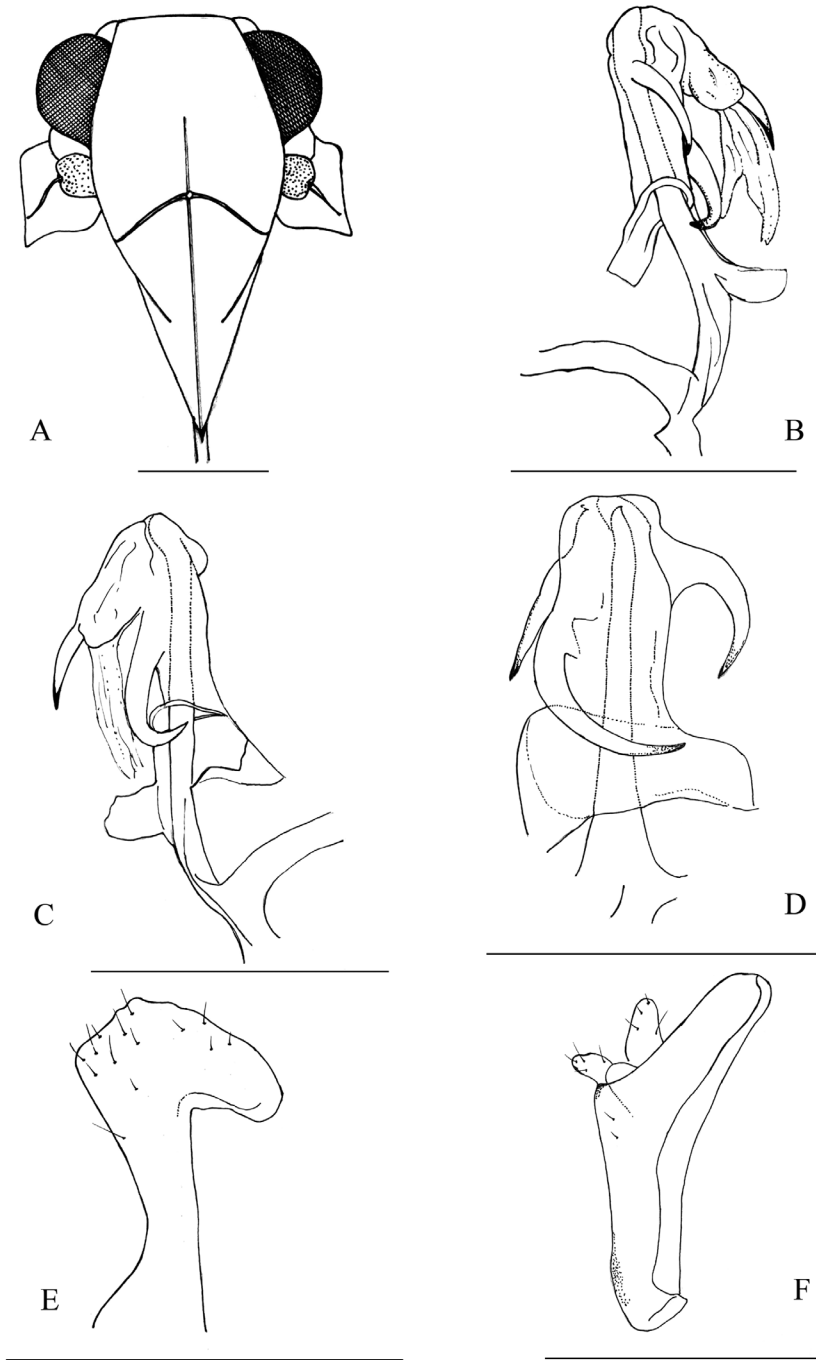
This species is similar to *Kuvera flaviceps* (Matsumura) but differs from the latter in: Flagellum of aedeagus with long spinose process. Phallotheca with two processes, length of smaller process about two-third of longer one, longer spine curved subapically near the base of theca and anal segment concave on the ventral side. In the latter, flagellum of aedeagus with short spinose process. Phallotheca with two processes, length of smaller process about one-third of longer one, longer spine curved over the middle of aedeagus shaft and anal segment convex on ventral side.



**Figure 1.** (A–K) *Kuvera hagilsanensis* sp. nov.: (A) male habitus (dorsal view); (B) head, pronotum, mesonotum (dorsal view); (C) frons and clypeus; (D) anal segment, aedeagus and genital styles (left lateral view); (E) ditto (right lateral view); (F) aedeagus (right lateral view); (G) ditto (ventral view); (H) ditto (left lateral view); (I) anal segment (lateral view); (J) ditto (dorsal view); (K) genital style (dorsal view). Scale bar – 2.0 mm (A); 0.5 mm (B–K).

### *Description*

Body length: male, 5.5–5.7 mm; female, 6.4–6.6 mm. Generally yellow brown body with hyaline wings. Vertex widened, yellow brown, median carina reaching the transverse carinae. Frons at base smooth, median carina disappearing in basal



**Figure 2.** (A–F) *Kuvera hagilsanensis* **sp. nov.** [line illustration]; (A) frons and clypeus; (B) aedeagus (right lateral view); (C) ditto (left lateral view); (D) ditto (ventral view); (E) genital style (dorsal view); (F) anal segment (lateral view). Scale bar – 0.5 mm.

half, distinct in apical half, lateral margins of frons and area adjacent to vertex yellow brown, area adjacent to epistomal suture black. Clypeus black. Rostrum yellow brown. Epistomal suture distinct.

Pronotum yellow with darker areas. Tegulae brown. Mesonotum black. Forewing hyaline, veins yellow brown with brown granules; pterostigma dark brown. Legs dark brown to mid brown and abdomen dark brown.

*Male genitalia.* Anal segment in lateral profile (Figure 1(I)) straight at basal half, curved and slightly ventrad apically, basal part longer than apical part (1.33:1), in dorsal view (Figure 1(J)) longer in middle line than wide at widest part (2.57:1), lateral margin convex, apical margin rounded, anal style sits near middle, concave ventrally. Aedeagus shaft almost straight, in right lateral view (Figure 1(F)) with two sclerotised processes of phallosome, one comparatively short, rigid, curved over shaft, directed ventrocephalad, another one comparatively elongate, rigid, curved from left lateral side to right lateral side, apex near the base of theca, directed ventrad. Flagellum with a long and stout process extending from base, directed cephalad, flagellum reaching base of shaft. Genital styles, in dorsal view (Figure 1(K)) longer in mid-line than wide at widest part subapically (1.66:1), hook-shaped apex, inner margin deeply concave but outer margin straight and right and left styles symmetrical.

#### *Etymology*

This species is named after the type locality Mt. Hagilsan.

#### *Distribution*

Korea (Central, South, Jeju-do)

#### *Host*

Unknown

### ***Kuvera hallasanensis* sp. nov.** (Figures 3(A–N), 4A–F))

#### *Holotype*

m, adult, Korea: Jeju-do province: Hallasan, 19 June 1994 (Y.J. Kwon). *Paratypes*, Gyeongsangbuk-do province: 1f, Palgongsan, 19 June 1985. Gangwon-do province: 1 m, Odaesan, 19 September 1982; 1 m, Mt. Seolaksan, 30 July 1982. Jeju-do province: 17 m, 17f, Hallasan, 19 June 1994; 1f, same locality, 20 June 1977; 1 m, 2f, San'gumburi, 28 May 1992; all same collector (KNU).

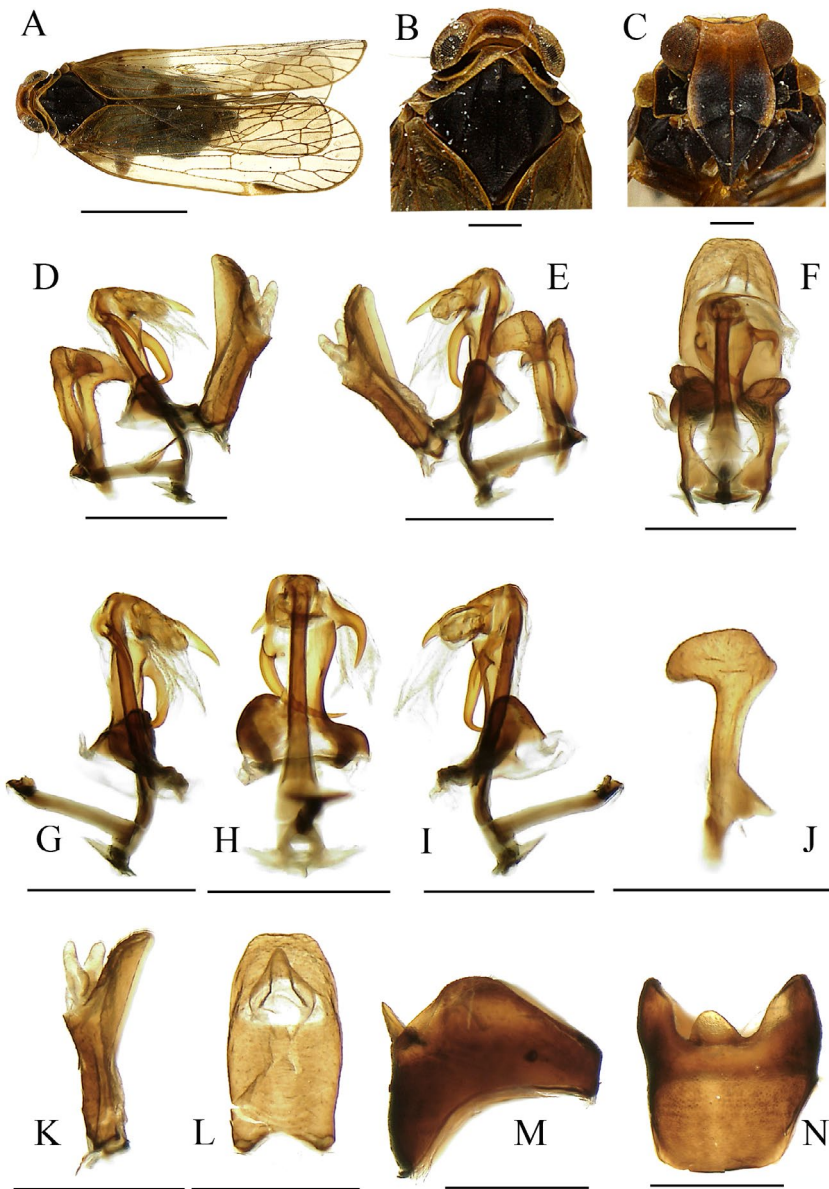
#### *Diagnosis*

This species is similar to *K. yecheonensis* **sp. nov.** but differs from the latter in: the body size 5.9–6.3 mm (male) and 6.5–6.7 mm (female), apical lobe of anal segment symmetrical, aedeagus with two strongly curved processes of phallosome, apex of processes directed towards phallosome, flagellum with a short and stout process. In the latter, the body size 4.6–5.0 mm (male); 5.2–5.6 mm (female), apical lobe of anal segment asymmetrical, aedeagus with two weakly curved processes of phallosome, apex of processes directed away from phallosome, flagellum with a long and stout process.

#### *Description*

Body length: male, 5.9–6.3 mm; female, 6.5–6.7 mm. Generally brown body with hyaline wings. Vertex dark brown, median carina narrow, reaching transverse

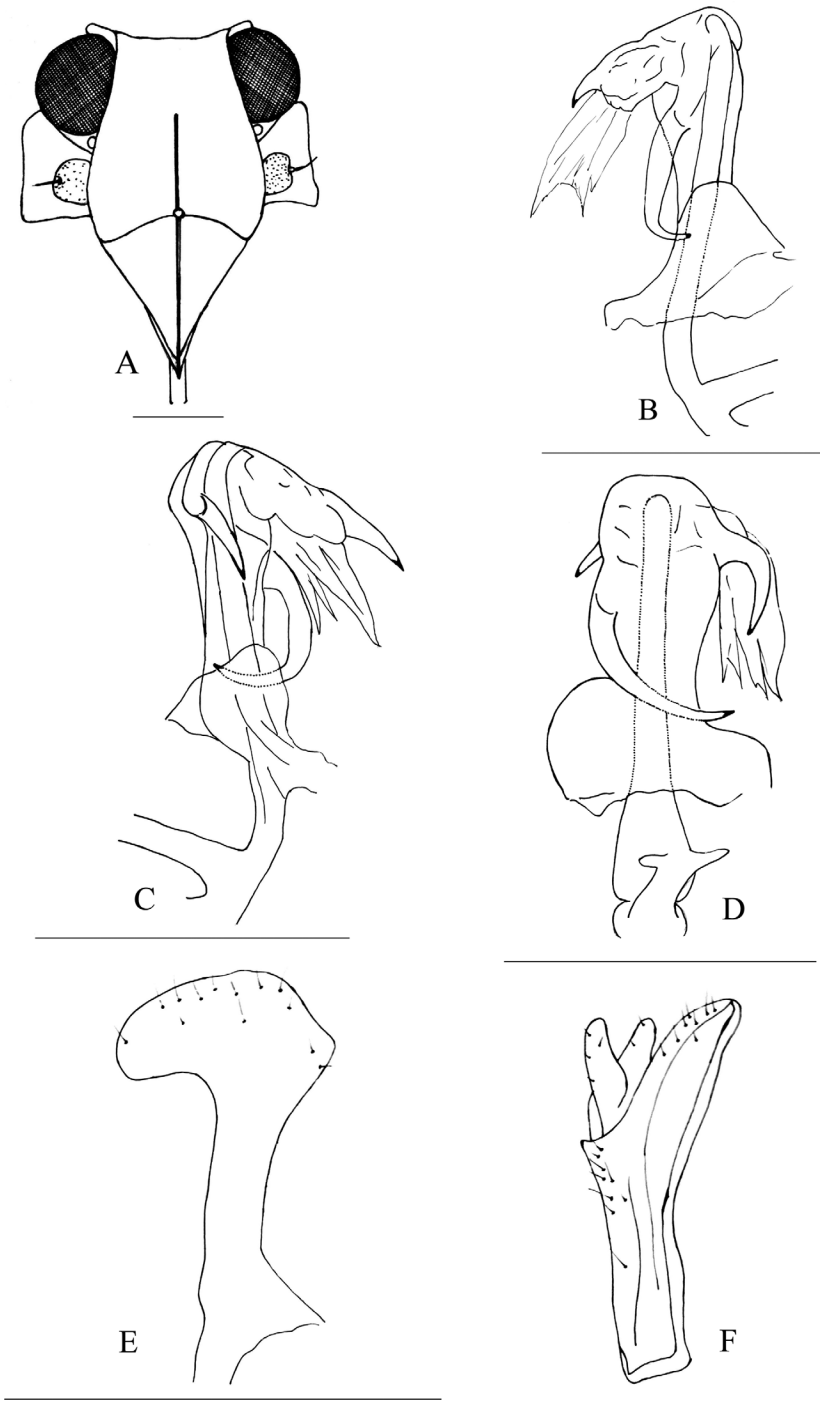




**Figure 3.** (A–N) *Kuvera hallasanensis* **sp. nov.** (A) Habitus (dorsal view); (B) head, pronotum, mesonotum (dorsal view); (C) frons and clypeus; (D) genital styles, aedeagus and anal segment (right lateral view); (E) ditto (left lateral view); (F) ditto (ventral view); (G) aedeagus (right lateral view); (H) ditto (ventral view); (I) ditto (left lateral view); (J) genital style (dorsal view); (K) anal segment (lateral view); (L) ditto (dorsal); (M) pygofer (lateral view); (N) ditto (ventral view). Scale bar – 2.0 mm (A); 0.5 mm (B–N).

carina; lateral and transverse carinae slightly elevated. Frons smooth at base, golden brown; median carina extended from near middle to apex; ground colour black. Epistomal suture distinct. Rostrum yellow brown.





**Figure 4.** (A–F). *Kuvera hallasanensis* **sp. nov.** [line illustration]; A, frons and clypeus; B, aedeagus (left lateral view); C, ditto (right lateral view); D, ditto (ventral view); E, genital style (dorsal view); F, anal segment (lateral view). Scale bar – 0.5 mm.

Pronotum brown with darker areas. Tegulae brown, roof-shaped. Mesonotum including carinae black. Forewing with a single brown spot on margin of anal vein, all veins brown with concolours granules; pterostigma dark brown. Legs brown and abdomen dark brown.

*Male genitalia.* Anal segment in lateral profile (Figure 3(K)) straight at basal part, curved and slightly caudad apically, basal part longer than apical part (1.26:1), apical lobe of anal segment symmetrical, in dorsal view (Figure 3(L)) longer in mid-line than wide at widest part (1.70:1), lateral margin subparallel, apical margin flat, anal style sits subapically, concave ventrally. Aedeagus shaft almost straight in right lateral view (Figure 3(G)), with two sclerotised processes of phallosome, one comparatively short, stout, curved over shaft, directed cephalad, another one comparatively long, rigid, curved and apex directed towards phallosome. Flagellum with a short and stout process extending from base, directed dorsad, flagellum reaching the half of shaft. Left and right genital styles in dorsal view (Figure 3(J)), symmetrical, longer in mid-line than wide at widest part subapically (1.68:1), inner margin deeply concave but outer margin straight. Pygofer with symmetrical dorsolateral process, ventromedian process small, wider than long in ventral view (1.40:1) (Figure 3(N)).

#### *Etymology*

This species is named after the type locality Mt. Hallasan.

#### *Distribution*

Korea (Central, South, Jeju).

#### *Host*

Unknown

#### ***Kuvera yecheonensis* sp. nov.** (Figures 5(A–N), 6(A–F))

#### *Holotype*

m, adult, Korea: Gyeongsangbuk-do province: Yecheon, 7 August 2008 (Y.J. Kwon).

*Paratypes*, 9 m, 13f, same data as holotype; all same collector (KNU).

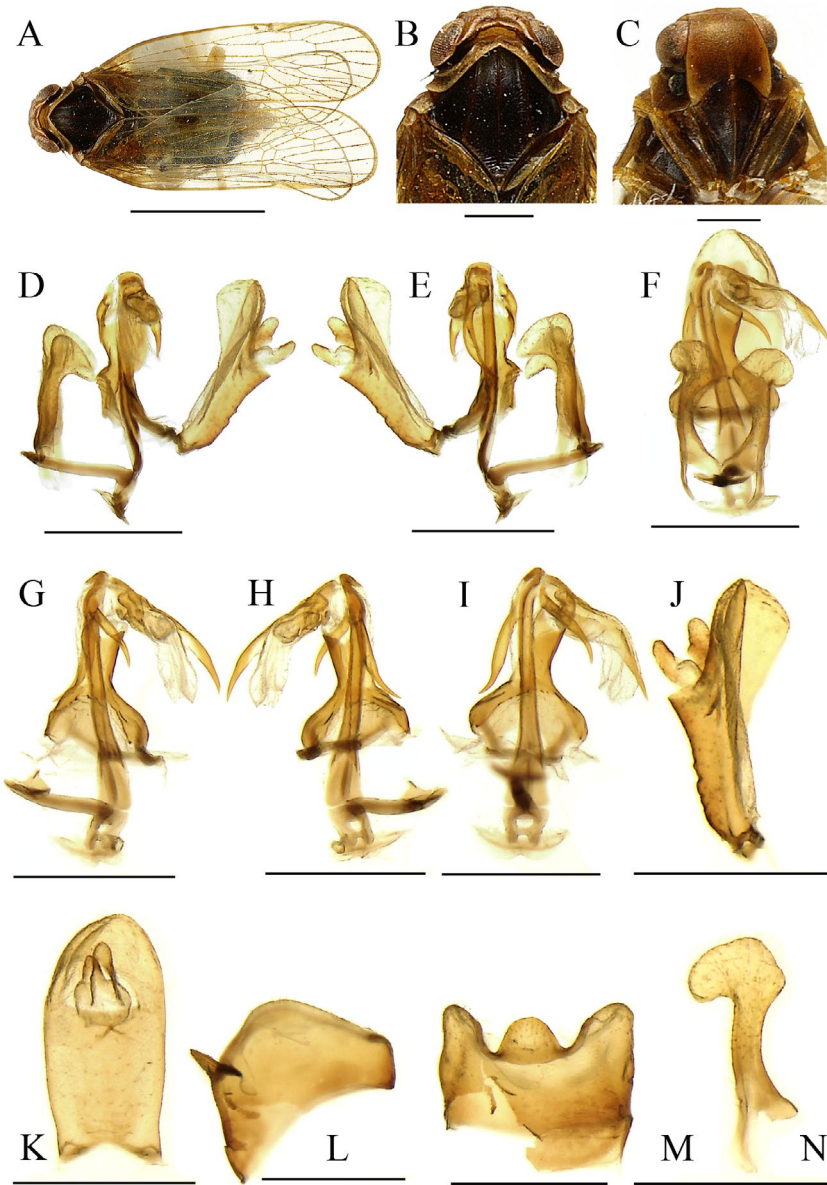
#### *Diagnosis*

This species is similar to *K. hallasanensis* sp. nov. but differs from the latter in the body size and male genital structures which are described in the remarks of *K. hallasanensis* sp. nov.

#### *Description*

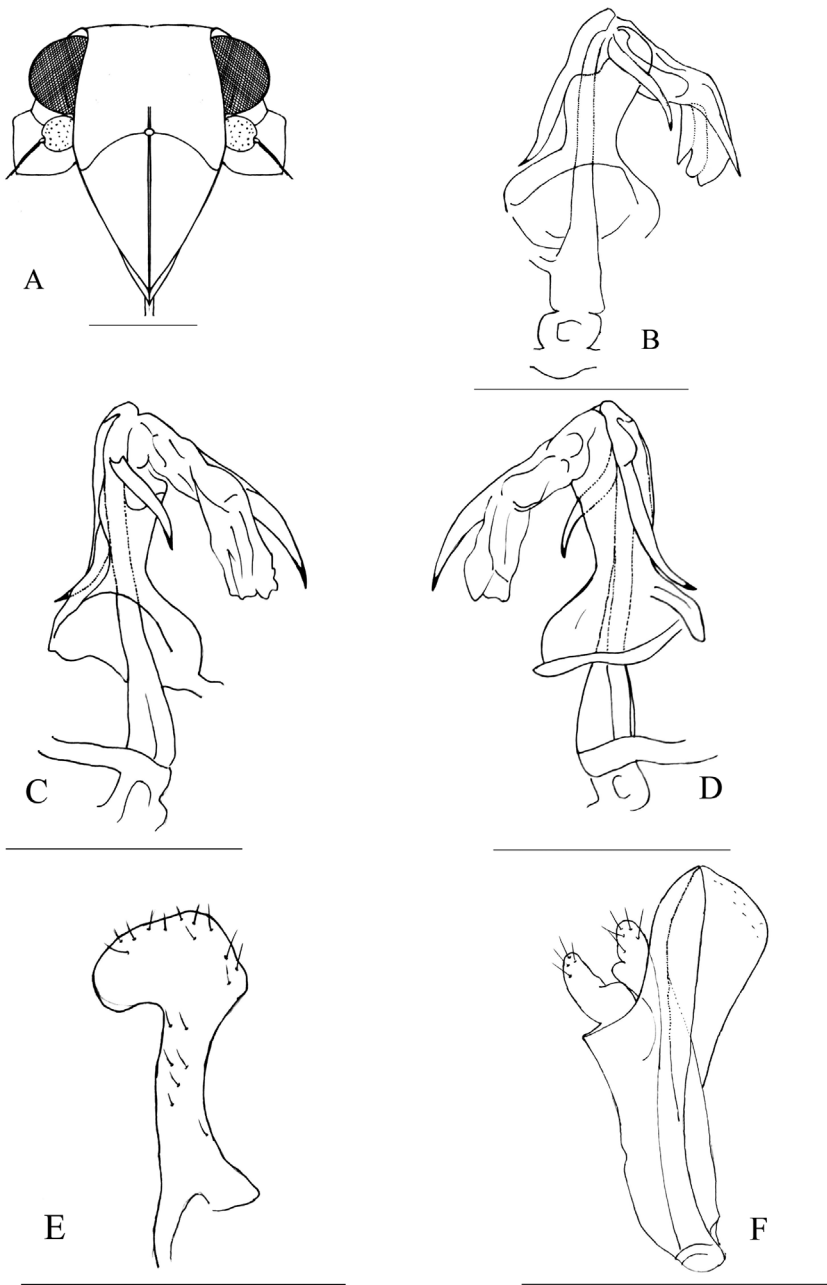
Body length: male, 4.6–5.0 mm; female 5.2–5.6 mm. Generally body brown with black scutellum and hyaline wings; Vertex brown, median carina reaching the transverse carina, little depressed in middle, not elevated. Frons smooth up to epistomal suture, yellow brown, convex. Clypeus including median carina dark brown. Rostrum yellow brown.

Pronotum, post-ocular parts and lateral parts of paradiscal area brown; tegulae pale brown. Mesonotum black with ochraceous brown carinae. Forewing with a single dark brown spot on the margin of anal vein, all veins yellow with concolours granules; pterostigma pale yellow; legs pale brown and abdomen dark brown.



**Figure 5.** (A–N). *Kuvera yecheonensis* **sp. nov.** A, male habitus (dorsal view); B, head, pronotum, mesonotum (dorsal view); C, frons and clypeus; D, genital styles, aedeagus and anal segment (right lateral view); E, ditto (left lateral view); F, ditto (ventral view); G, aedeagus (right lateral view); H, ditto (left lateral view); I, ditto (dorsal view); J, anal segment (lateral view); K, ditto (dorsal view); L, pygofer (lateral view); M, ditto (ventral view); N, genital style (dorsal view). Scale bar – 2.0 mm (A); 0.5 mm (B–N).

*Male genitalia.* Anal segment in lateral profile (Figure 5(J)) straight, directed caudad, apical lobes asymmetrical, basal part longer than apical part (1.23:1), in dorsal view (Figure 5(K)) longer in mid-line than wide at widest part (1.88:1), lateral margin subparallel, apical margin rounded, anal style sits subapically. Aedeagus



**Figure 6.** (A–F) *Kuvera yecheonensis* **sp. nov.** [line illustration]; A, frons and clypeus; B, aedeagus (dorsal view); C, ditto (right lateral view); D, ditto (left lateral view); E, genital style (dorsal view); F, anal segment (lateral view). Scale bar – 0.5 mm.

shaft almost straight in right lateral view (Figure 5(G)) with two sclerotised processes of phallosome, short process about two-third of long process in length, long process reaching the base of theca, apex of processes away from phallosome. Flagellum with a long and stout process, almost as long as flagellum, pointed apex

and directed laterad. Left and right genital styles in dorsal view (Figure 5(N)) symmetrical, longer in mid-line than wide at widest part subapically (1.85:1), inner margin deeply concave but outer margin straight, widened apically. Pygofer with symmetrical dorsolateral process, ventromedian process small, wider than long in ventral view (1.28:1) (Figure 5(M)).

#### *Etymology*

This species is named after the type locality Yecheon.

#### *Distribution*

Korea (South)

#### *Host*

Unknown

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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