



Key to species of the genus *Andixius* Emeljanov & Hayashi (Hemiptera: Fulgoromorpha: Cixiidae) with descriptions of two new species

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Abstract

Two new species of the genus *Andixius* Emeljanov & Hayashi, *A. cultratus* Wang, Zhi & Chen, **sp. nov.** and *A. lingulatus* Wang, Zhi & Chen, **sp. nov.** are described and illustrated from China to provide the genus with six species in total. A key to species of *Andixius* is presented.

Key words: male genitalia, Fulgoroidea, morphology, planthopper, taxonomy

Introduction

The cixiid planthopper genus *Andixius* was established by Emeljanov and Hayashi (2007) with *A. nupta* Emeljanov & Hayashi, 2007 (as its type species) and *A. venustus* (Tsaur & Hsu, 1991) (previously placed in the genus *Brixia* Stål, 1856). This genus belongs to the tribe Andini of subfamily Cixiinae (Hemiptera: Cixiidae). Later Zhi *et al.* (2018) described two new species: *A. longispinus* and *A. trifurcus*. To date, four species were recorded in this genus which occurs in the Oriental region (China and Japan) (Bourgoin 2019).

In this paper two new species of the genus *Andixius* are described and illustrated from South China (Guangdong and Guangxi). A key to known species of *Andixius* is provided.

Materials and methods

The morphological terminology and measurements follow Bourgoin (1987) and Bourgoin *et al.* (2015). The morphological terminology of female genitalia follows Bourgoin (1993). Dry specimens were used for the descriptions and illustrations. Body length was measured from apex of vertex to tip of forewing; vertex length was measured the median length of vertex (from apical transverse carina to tip of basal emargination). External morphology and drawings were done with the aid of a Leica MZ 12.5 stereomicroscope. Photographs of the types were taken with the KEYENCE VHX-1000 system. Illustrations were scanned with a CanoScan LiDE 200 and imported into Adobe Photoshop CS7 for labelling and plate composition. The dissected male genitalia are preserved in glycerine in small plastic tubes pinned together with the specimens.

The type specimens examined are deposited in the Institute of Entomology, Guizhou University, Guiyang, Guizhou Province, China (GUGC).

Taxonomy

Order Hemiptera Linnaeus, 1758

Suborder Fulgoromorpha Evans, 1946

Family Cixiidae Spinola, 1839

Andixius Emeljanov & Hayashi, 2007

Andixius Emeljanov & Hayashi, 2007: 127; Tsaour & Hsu, 1991: 66; Zhi *et al.* 2018: 56.

Type species. *Andixius nupta* Emeljanov & Hayashi, 2007; by original designation.

Remarks. For the relationships and diagnosis of *Andixius* see Zhi *et al.* (2018: 56).

Distributions. China, Japan.

Key to species of *Andixius* (males), modified from Zhi *et al.* (2018)

1. Periandrium with an expanded semi-enclosed structure around the left side and ventral margin of periandrium (Zhi *et al.* 2018: Figs 25–28) *A. trifurcus*
- Periandrium without expanded semi-enclosed structure 2
2. Left side of periandrium with a bifurcate process (Emeljanov and Hayashi 2007: Figs 11–13) *A. nupta*
- Left side of periandrium without process or process on left side of periandrium not bifurcated 3
3. Endosoma of aedeagus with a short and small spinose process apically (Figs 31–34) *A. lingulatus* sp. nov.
- Endosoma of aedeagus with a long spinose process basically 4
4. Ventral margin of periandrium with a projection, of which basal 1/3 longitudinally and distal 2/3 horizontally extended, endosoma with two “simple” processes, not bifurcate (Zhi *et al.* 2018: Figs 13–16) *A. longispinus*
- Periandrium without the above spinose process 5
5. Right side of endosoma with a large bifurcate process (Hsu and Stalle 1991: Figs 33D–F) *A. venustus*
- Right side of endosoma without a large bifurcate process, ventral margin of periandrium with a blade-shaped spinose process (Figs 10–13) *A. cultratus* sp. nov.

Andixius cultratus Wang, Zhi & Chen, sp. nov.

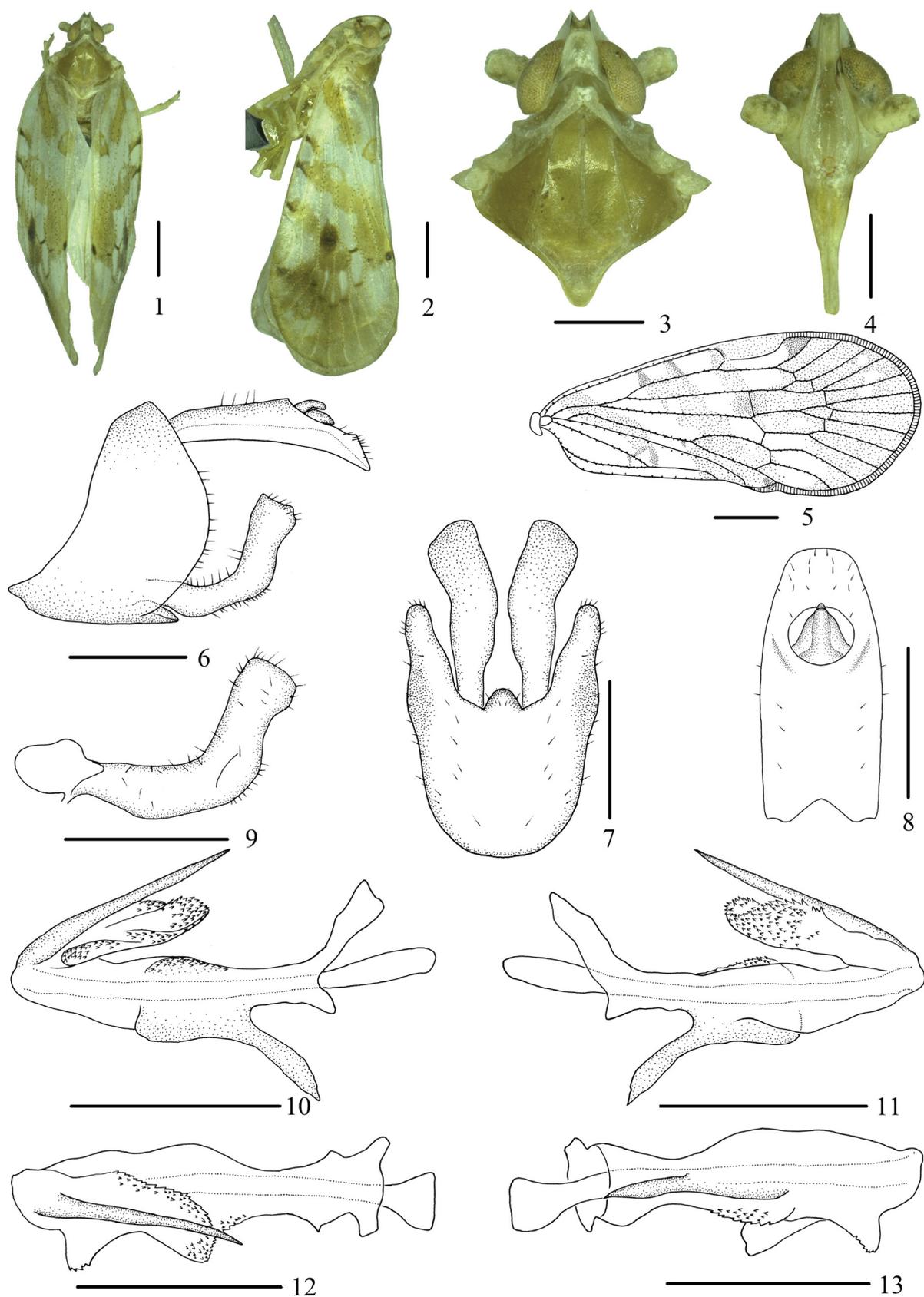
Figs 1–21

Diagnosis. The salient features of the new species include: aedeagus (Figs 10–13) with two spinose processes; ventral margin of periandrium with a blade-shaped spinose process at basal 1/3 (Fig. 13); dorsal margin of endosoma with a large spinose process, not furcate (Fig. 12); middle of right part of endosoma with a laminal process (Fig. 10); apical 1/2 of left side and apical part of periandrium with multiple small teeth (Fig. 11).

Measurements. Body length: male 5.9–6.7 mm (N = 24), female 6.6–8.3 mm (N = 16).

Coloration. General color yellowish white (Figs 1–2). Eyes yellow, ocelli faint yellow, semi-translucent. Antenna, vertex, face and rostrum generally yellowish white. Pronotum generally yellowish white. Mesonotum light brown. Forewing semi-translucent, costal vein with three small spaced dark brown spots; slightly behind stigma, middle part of forewings and behind clavus with an irregular puce spot respectively, near claval fork with a triangular yellow spot, basal and middle part of forewings with two inner oblique yellow stripes; apical half of wing with brown patches. Hind tibiae yellow. Ventral abdomen yellowish brown.

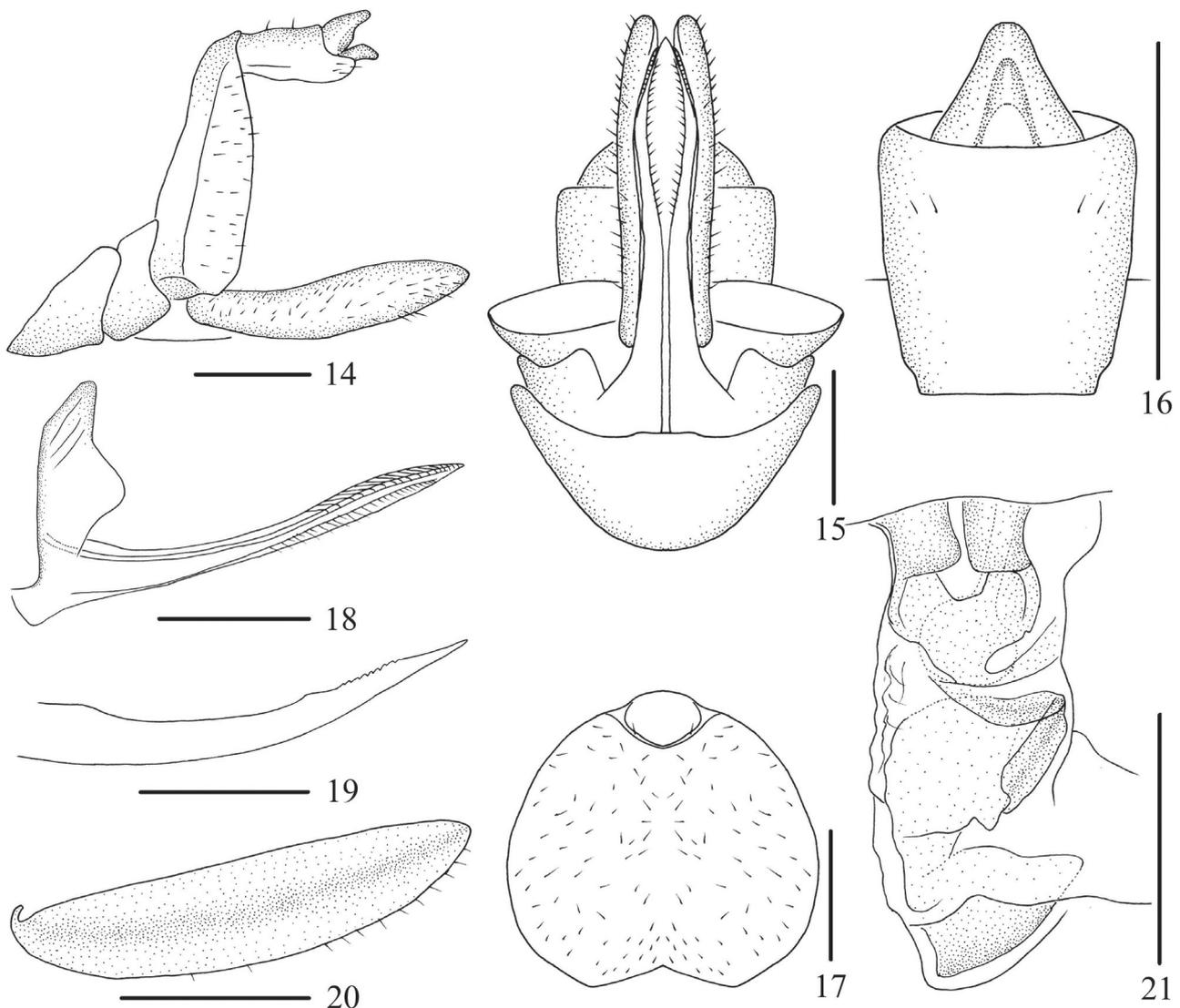
Head and thorax. Vertex (Figs 1, 3) 0.9 times wider than long; anterior margin nearly straightly, posterior margin U-shaped recessed, median carina absent. Frons (Fig. 4) 2.9 times as long as wide. Pronotum (Figs 1, 3) 2.4 times longer than vertex; posterior margin recessed in a right angle. Mesonotum 1.4 times longer than pronotum and vertex combined. Forewing (Figs 2, 5) 2.4 times longer than wide, with twelve apical cells and six subapical cells; RP 3 branches, MP with 5 terminals: MP₁₁, MP₁₂, MP₂, MP₃, and MP₄, fork MP₁+MP₂ basad of fork MP₃+MP₄. Hind tibia with six lateral spines, usually small; chaetotaxy of hind tarsi: 8/8, 2nd hind tarsus with three platellae.



FIGURES 1–13. *Andixius cultratus* sp. nov., male 1. Dorsal view; 2. Lateral view; 3. Head and thorax, dorsal view; 4. Face, ventral view; 5. Forewing; 6. Genitalia, lateral view; 7. Pygofer and gonostyli, ventral view; 8. Anal segment, dorsal view; 9. Gonostyli, lateral view; 10. Aedeagus, right side; 11. Aedeagus, left side; 12. Aedeagus, dorsal view; 13. Aedeagus, ventral view. Scale bars: 0.5 mm (1–4, 6–13); 1.0 mm (5).

Male genitalia. Pygofer (Figs 6–7) symmetrical, dorsal margin shallowly convex and U-shaped ventrally, widened towards apex, slightly concaved medially; in lateral view, lateral lobes semicircular and extended caudally. Medioventral process in ventral view rounded protruding. Anal segment (Figs 6, 8) flat tubular, dorsal margin almost straight, ventral margin curved slightly in lateral view; 2.2 times longer than wide in dorsal view; anal style strap-shaped, not beyond anal segment. Gonostyli (Figs 7, 9) symmetrical ventrally; in inner lateral view, dorsal margin bending inwards medially, apical margin enlarged slightly. Aedeagus (Figs 10–13) with two processes. Ventral margin of perianthrium with a wide spinose process, blade-shaped, slightly curved, of which basal 1/3 longitudinally, directed ventrocephalad; left and right sides of the dorsum with a laminal process, right margin with many small teeth. Dorsal margin of endosoma with a large spinose process, directed dorsocephalad, middle of right part with a laminal process, margin with small teeth, multiple small teeth from and apical 1/2 of left side and apical part of perianthrium.

Female genitalia. Tergite IX (Figs 14, 15, 17) moderately sclerotized, with a large nearly elliptical wax plate. Anal segment (Fig. 16) rectangular, widening to apex, 1.1 times wider than long in dorsal view, anal style strap-shaped. Gonapophysis VIII (Fig. 18) elongate, and slightly curved upwards. Gonapophysis IX (Fig. 19) with one middle tooth, distance ratio between middle tooth to apex and length of denticulate portion is 2.6. Gonoplac (Fig. 20) rod-like, 4.3 times longer than wide in lateral view. Posterior vagina pattern as shown in Fig. 21.



FIGURES 14–21. *Andixius cultratus* sp. nov., female 14. genitalia, lateral view; 15. genitalia, ventral view; 16. anal segment, dorsal view; 17. tergite IX, caudal view; 18. Gonapophysis VIII and gonocoxa VIII, dorsal view; 19. gonapophysis IX, lateral view; 20. gonoplac, inner lateral view; 21. posterior vagina, ventral view. Scale bars: 0.5 mm

Type material. Holotype: ♂, China: Guangdong, Shixing County, Chebaling National Natural Reserve (24°43'N, 114°15'E), 10–13 May 2018, by Meng Jiao and Bin Li; paratypes: 23♂♂16♀♀, same data as holotype.

Etymology. The specific name is derived from the Latin adjective “*cultratus*”, referring to the one blade-shaped spinose process arising from the ventral margin of periandrium.

Remarks. This species is similar to *Andixius venustus* (Tsaur & Hsu, 1991) in appearance, but differs in: (1) ventral margin of periandrium with a blade-shaped spinose process at basal 1/3 (left side of periandrium with a spinose process in *A. venustus*); (2) dorsal margin of endosoma with a large spinose process, not furcate (*A. venustus* without process in the same position); (3) middle of right part of endosoma with a laminal process (basal of right side of endosoma with a dichotomous spinose process in *A. venustus*); (4) apical 1/2 of left side and apical part of periandrium with multiple small teeth (without process in *A. venustus*).

Distribution. China (Guangdong) (Fig. 43).

Andixius lingulatus Wang, Zhi & Chen, sp. nov.

Figs 22–42

Diagnosis. The salient features of the new species include: endosoma of aedeagus with a short and small spinose process apically (Figs 31–34); ventral margin of periandrium of laminal process with three spinose process around the ventral margin (Fig. 34); apical right side of periandrium with a large linguiform laminal process (Fig. 31).

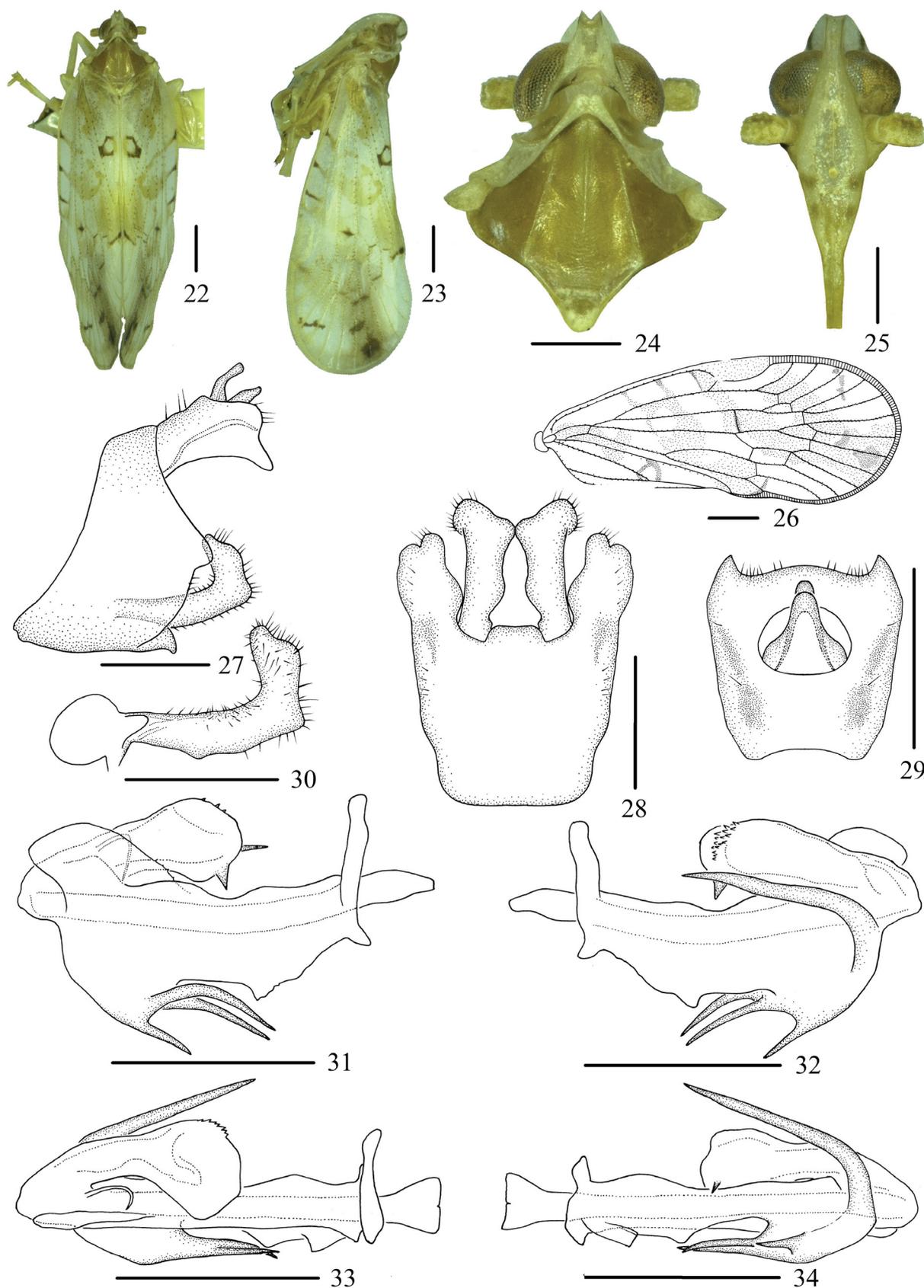
Measurements. Body length: male 7.1–7.8 mm (N = 4), female 8.0–8.8 mm (N = 4).

Coloration. General color yellowish white (Figs 22–23). Eyes brown, ocelli faint yellowish brown, semi-translucent. Antenna yellowish brown. Vertex, face and rostrum generally yellowish white. Mesonotum brown. Forewing semi-translucent, costal vein with 3 small spaced dark brown spots; near claval fork and behind clavus with an irregular tan spot respectively, basal and middle part of forewings with two inner oblique yellow stripes; apical half of wing with brown patches. Hind tibiae yellow. Ventral abdomen yellowish brown.

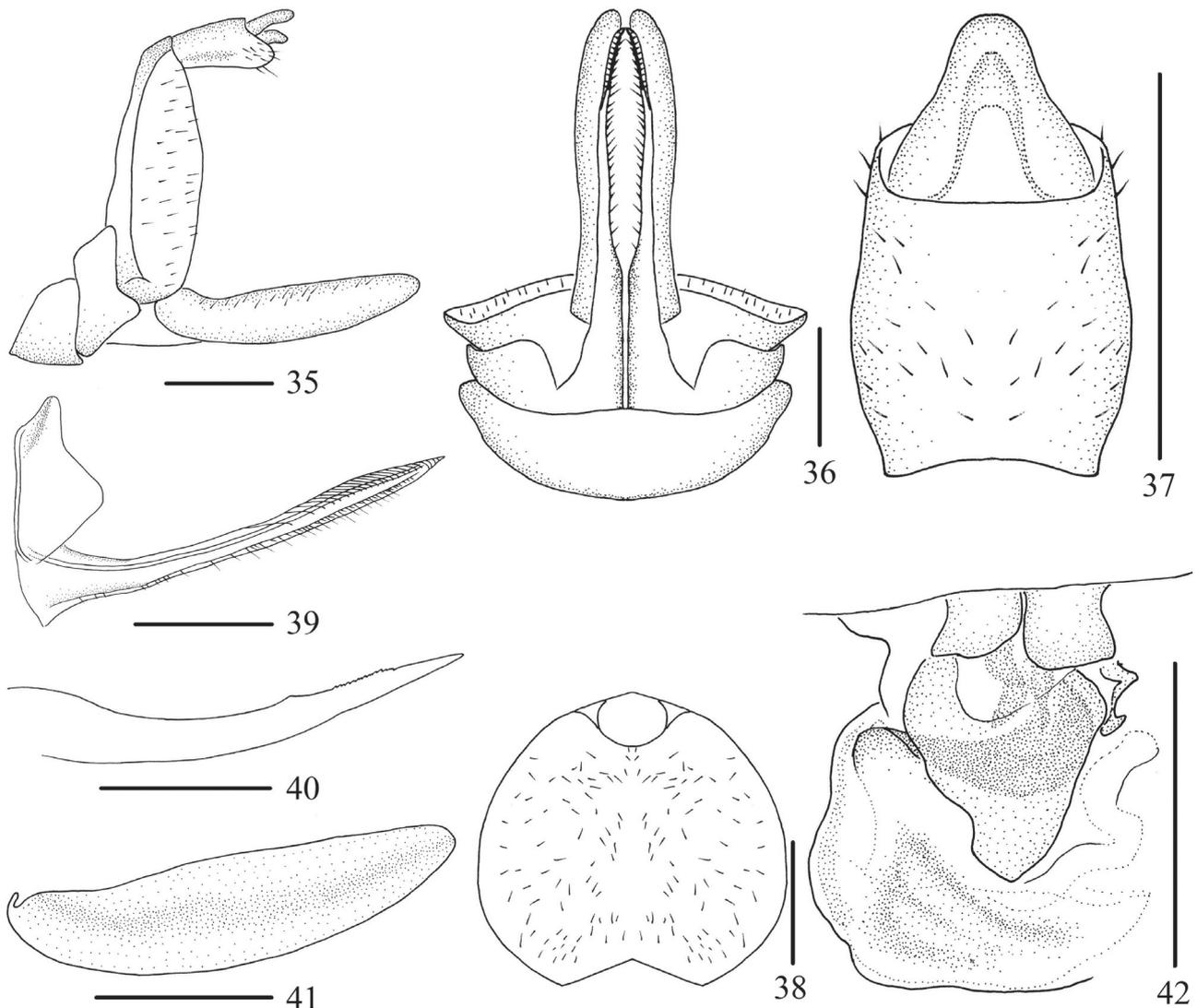
Head and thorax. Vertex (Figs 22, 24) 0.8 times wider than long; anterior margin slightly curved recessed, posterior margin U-shaped recessed, median carina absent. Frons (Fig. 25) 2.4 times as long as wide. Pronotum (Figs 22, 24) 2.3 times longer than vertex; posterior margin curved recessed in a right angle. Mesonotum 1.3 times longer than pronotum and vertex combined. Forewing (Figs 23, 26) 2.4 times longer than wide, with twelve apical cells and seven subapical cells; RP 3 branches, MP with 5 terminals: MP₁₁, MP₁₂, MP₂, MP₃, and MP₄, fork MP₁+MP₂ basad of fork MP₃+MP₄. Hind tibia with four lateral spines, two big and the others small; chaetotaxy of hind tarsi: 7–8/7–8, 2nd hind tarsus with 1–3 platellae.

Male genitalia. Pygofer (Figs 27–28) symmetrical, dorsal margin shallowly concaved and U-shaped ventrally, widened towards apex, slightly concaved medially; in lateral view, lateral lobes trapezoidal and extended caudally. Medioventral process in ventral view rounded protruding. Anal segment (Figs 27, 29) tubular, stubby, dorsal margin almost straight, ventral margin curved, apical margin expanded downward in lateral view; 1.1 times longer than wide in dorsal view; anal style strap-shaped, not beyond anal segment. Gonostyli (Figs 27, 30) symmetrical ventrally, inner margin with a small curved process near base; in lateral view, dorsal margin bending inwards medially, apical margin expanded slightly. Aedeagus (Figs 31–34) with six processes, left and right sides of the periandrium flat, ventral margin laminal protruding, the laminal process with four spinose process, three of them around the ventral margin, directed ventrocephalad, apical one short, the top two are slightly longer; another curved upward along the left side of the outer margin of the laminal process and directed left-dorsocephalad. Apical right side of periandrium with a large linguiform laminal process, directed right-dorsocephalad; apex of dorsal margin with an extremely slender spinose process, medium length, curved, directed ventrocephalad. Endosoma slightly sclerotized, apex of ventral margin with a short and small spinose process, directed ventrocephalad.

Female genitalia. Tergite IX (Figs 35, 36, 38) moderately sclerotized, with a large nearly elliptical wax plate. Anal segment (Fig. 37) rectangular, widening to apex, 1.3 times wider than long in dorsal view, anal style strap-shaped. Gonapophysis VIII (Fig. 39) elongate, and slightly curved upwards. Gonapophysis IX (Fig. 40) with one middle tooth, distance ratio between middle tooth to apex and length of denticulate portion is 2.8. Gonoplac (Fig. 41) rod-like, 3.9 times longer than wide in lateral view. Posterior vagina pattern as shown in Fig. 42.



FIGURES 22–34. *Andixius lingulatus* sp. nov., male 22. Dorsal view; 23. Lateral view; 24. Head and thorax, dorsal view; 25. Face, ventral view; 26. Forewing; 27. Genitalia, lateral view; 28. Pygofer and gonostyli, ventral view; 29. Anal segment, dorsal view; 30. Gonostyli, lateral view; 31. Aedeagus, right side; 32. Aedeagus, left side; 33. Aedeagus, dorsal view; 34. Aedeagus, ventral view. Scale bars: 0.5 mm (22–25, 27–34); 1.0 mm (26).



FIGURES 35–42. *Andixius lingulatus* sp. nov., female 35. genitalia, lateral view; 36. genitalia, ventral view; 37. anal segment, dorsal view; 38. tergite IX, caudal view; 39. Gonapophysis VIII and gonocoxa VIII, dorsal view; 40. gonapophysis IX, lateral view; 41. gonoplac, inner lateral view; 42. posterior vagina, ventral view. Scale bars: 0.5 mm.

Type material. Holotype: ♂, China: Guangxi, Jinxiu County, Dayaoshan National Natural Reserve (24°08'N, 110°11'E), 10 May 2019, by Ling Qu, Yun-fei Wu and Fan Yang; paratypes: 3♂♂4♀♀, same data as holotype.

Etymology. The specific name is derived from the Latin adjective “*lingulatus*”, referring to the one large linguiform laminal process arising from the apical right side of periandrium.

Remarks. This species is similar to *Andixius cultratus* sp. nov. in appearance, but differs in: (1) ventral margin of periandrium of laminal process with three spinose processes around the ventral margin (*A. cultratus* without process in the same position); (2) apical right side of periandrium with a large linguiform laminal process (ventral margin of periandrium with a blade-shaped spinose process at basal 1/3 in *A. cultratus*); (3) apex of ventral margin of endosoma with a short and small spinose process (apical 1/2 of left side and apical part of periandrium with multiple small teeth in *A. cultratus*).

Distribution. China (Guangxi) (Fig. 43).

Discussion

This genus can be easily distinguished from other genera of Andini by the following characters: forewings without

trifid branching of ScP+R and MP near basal cell, ScP+R (ScP+RA and RP) forming a short common stalk, while ScP, RP and MP emerge independently or very close to the basal cell in the other Andini genera.

As these two new species, all of the four previously species belonging to the genus *Andixius* are distributed in the Asian region, especially China: *A. venustus* (Tsaour & Hsu, 1991), *A. longispinus* Zhi & Chen, 2018 and *A. trifurcus* Zhi & Chen, 2018, *A. cultratus* Wang, Zhi & Chen, **sp. nov.** and *A. lingulatus* Wang, Zhi & Chen, **sp. nov.** It is obvious from the geographic distribution that these species are distributed in the Oriental realm. China straddles the Oriental and Palearctic zoogeographical regions, with complex and changeable geomorphological environment and a variety of vegetation resources. Thus, there should be a large number of new species to be discovered and recorded. Further collects are necessary to get a better knowledge of their distribution range.

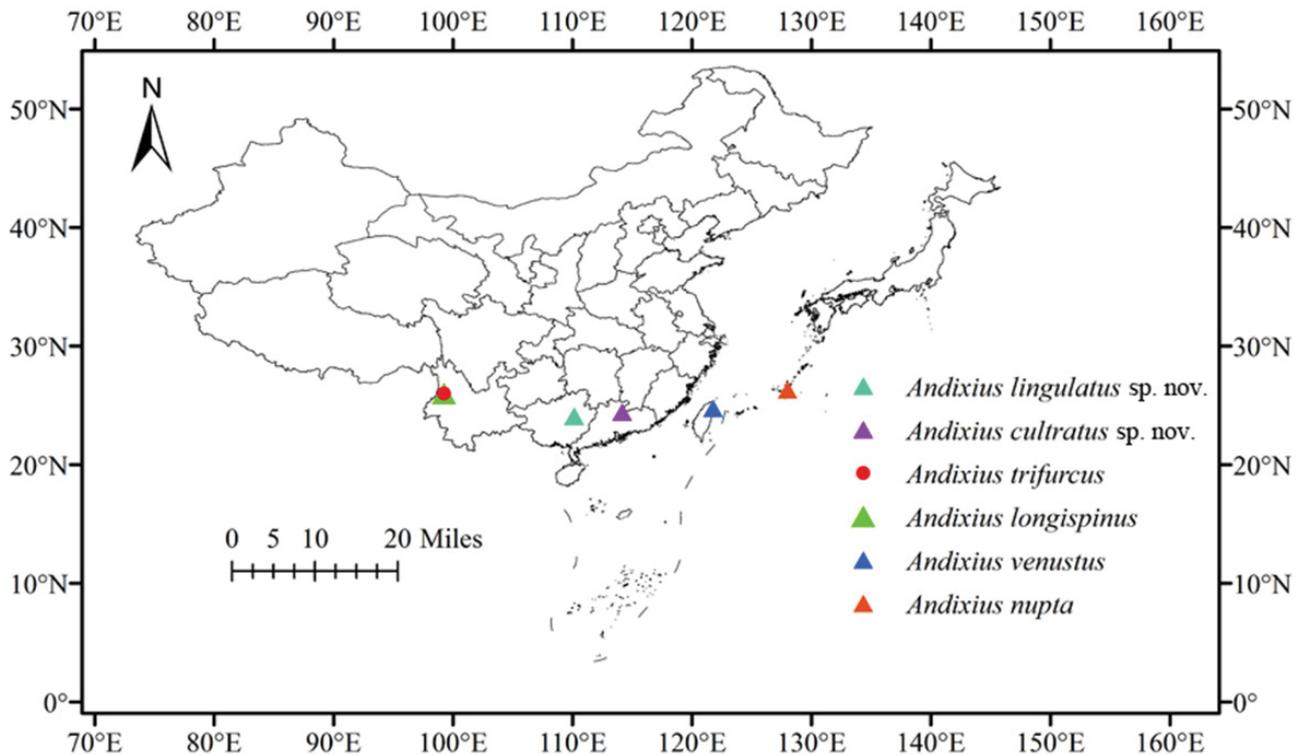


FIGURE 43. Geographic distributions of *Andixius* species.

Acknowledgements

The authors are grateful to the specimen collectors for their hard work in the field collections. This work was supported by the National Natural Science Foundation of China (No. 31472033), the Science and Technology Program in Guizhou Province (Grant No. Qiankehe and Platform for talents [2018]5781), the Academic New Cultivation and Innovation Exploration Special Project of Guizhou University (Grant No. Qiankehe and Platform for talents [2018]5781–29), the Program of Excellent Innovation Talents, Guizhou Province (No. 20154021) and the Program of Science and Technology Innovation Talents Team, Guizhou Province (No. 20144001).

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