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## Six new species of the planthopper genus *Usana* Distant, 1906 (Hemiptera: Fulgoromorpha: Achilidae) from China

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### Abstract

Six new species of the planthopper genus *Usana*, *U. aspergilliformis* sp. nov., *U. concava* sp. nov., *U. congjiangensis* sp. nov., *U. fissura* sp. nov., *U. oblongincisa* sp. nov. and *U. unispina* sp. nov. are described and illustrated from China. A checklist, a key to all species of the genus and illustrations of *U. lineolalis* Distant, 1906 are also given.

**Key words:** Achilid, distribution, Fulgoroidea, taxonomy

### Introduction

The genus *Usana* (Achilidae: Plectoderini), was established by Distant (1906) with *U. lineolalis* Distant, 1906 from Burma as the type species. Three species were subsequently added: *U. yanonis* Matsumura, 1914, *U. abdominalis* Distant, 1916 and *U. demochares* Fennah, 1978.

Among the four known species of *Usana* Distant, only the male genitalia of *U. demochares* was described and illustrated (Fennah, 1978), the descriptions of the remaining three species (*U. lineolalis*, *U. yanonis* and *U. abdominalis*) excluded genitalia. Although male genitalia of *U. lineolalis* was described by Fennah, no illustration was given (Fennah, 1956). In this paper, six new species are described and illustrated from China. A checklist, a key to all species and illustrations of *U. lineolalis* Distant, 1906, including male genitalia, are also provided.

### Material and methods

Specimens were collected by sweeping net. Dry specimens were used for the description and illustration. The morphological terminology and measurements used in this study follow Chen *et al.* (1989) and Yang and Chang (2000). The color photographs of examined specimens were taken with a Keyence VHX-1000C camera. External morphology was observed under an Olympus SZX7 stereoscopic microscope and characters measured with an ocular micrometer. The genital segments of the examined specimens were macerated in 10% KOH and drawn from preparations in glycerin jelly using an Olympus CX41 stereomicroscope. Illustrations were scanned by a Canon CanoScan LiDE100 and imported into Adobe Photoshop CS5 for labeling and plate composition. The spinal formula refers to the numbers of apical spines of the hind tibiae and 1<sup>st</sup> and 2<sup>nd</sup> hind tarsomeres.

Specimens examined are deposited in the Institute of Entomology, Guizhou University, Guiyang, China (GUGC).

## Systematics

### *Usana* Distant, 1906

*Usana* Distant, 1906: 293; Fennah, 1950: 132; Fennah, 1978: 249; Chen *et al.*, 1989: 23.

**Type species:** *Usana lineolalis* Distant, 1906.

**Description.** The distinctive characters used by Fennah (1950) and Chen *et al.* (1989) are modified as follows.

Mid-sized species. Width of head with eyes 0.8–0.9 times wider than pronotum. Vertex not declivous, produced before eyes about 1/3 of its length, median carina distinct, disk not or almost not depressed, anterior margin carinate, obtusely subangulately (about 130 degrees) or slightly convex, triangular areolets at lateroapical angles of head distinct, lateral margins carinate and straight, diverging basad, posterior margin broadly concave. Frons slightly convex in lateral view, upper margin (apex) truncate, median carina percurrent, lateral margin carinate, sinuately diverging to the level of antennae thence gradually incurved to suture. Clypeus with tricarinae distinctly. Rostrum almost or just reaching post-trochanter, with subapical segment shorter than apical segment. Antenna subglobose, not sunk in a depression. Ocelli separated from eyes. Eyes almost not excavate beneath, and slightly overlapping pronotum in dorsal view. Pronotum with length in midline as long as behind eyes, anterior margin of disk broadly convex, posterior margin subangulately excavate about 115 degrees; median carina distinct, lateral carinae straight, parallel or slightly diverging rearward, attaining hind margin, each with length 1.4 times longer than median carina; lateral lobe not inclined antero-ventrally, with a small longitudinal carina between eye and tegula. Mesonotum with length in midline longer than vertex and pronotum combined, tricarinate. Forewing with costal margin slightly convex, apical margin broadly convex, posterior margin with a reentrant angle of 155 degrees at apex of clavus, vein Sc+R forking proximally, distally or same as level of Cu<sub>1</sub> fork, vein M forking basad of the node, vein Cu<sub>1</sub> forking slightly distal union of claval veins, clavus terminating, or slightly distad of middle of forewing. Hindwing with 2 branches of veins M and Cu<sub>1</sub> respectively. Post-tibiae with a lateral spine between basal 1/3 to near basal 1/2, spinal formula 7–7 (6)–7 (6).

**Male genitalia.** Anal segment in dorsal view with length at least as long as width, apical margin distinctly excavate in midline; Pygofer in lateral view with dorsal margin distinctly shorter than ventral margin, medioventral process entire or with apex divided into 2 branches. Genital style with 3 processes rising from its dorsal margin, inner surface near anterior margin with a long process, directed outwards. Phallobase sheath-shaped, generally asymmetrical, with apical 1/2 divided into a dorsal, 2 lateral and a ventral lobes, the former relatively short, the lateral lobes valviform, and the latter with apical margin incised in the midline, subapical surface of ventral lobe in middle gives rise to a long process, directed basad. Each phallic appendage generally not exceeding apical margin of phallobase, with a corner between basal 1/4 to 1/3.

**Distribution.** Oriental and Palaearctic regions.

### Checklist of species of the genus *Usana*

*Usana abdominalis* Distant, 1916; Sikkim

*Usana aspergilliformis* **sp. nov.**; China (Guizhou)

*Usana concava* **sp. nov.**; China (Yunnan)

*Usana congjiangensis* **sp. nov.**; China (Guizhou)

*Usana demochares* Fennah, 1978; Vietnam (Ninh Binh)

*Usana fissura* **sp. nov.**; China (Guizhou)

*Usana lineolalis* Distant, 1906; China (Jiangsu, Zhejiang, Guangdong and Guizhou), Burma (Tenasserim and Myitta)

*Usana oblongincisa* **sp. nov.**; China (Guizhou, Guangxi and Hainan)

*Usana unispina* **sp. nov.**; China (Fujian, Sichuan and Guizhou)

*Usana yanonis* Matsumura, 1914; China (Taiwan), Japan and Korea

## Key to species of the genus *Usana*

1. Frons with marking(s) ..... 2
- Frons without marking ..... 4
2. Frons with 2 rounded dark brown markings near the apex (Fig. 39); disks of pronotum and mesonotum in dorsal view with 8 and 6 longitudinal dark brown stripes, respectively (Figs 5, 37) ..... *U. concava* sp. nov.
- Frons, pronotum and mesonotum not as above ..... 3
3. Forewing with several small transverse dark brown stripes especially in area of clavus (Figs 1-4, 28); dorsal lobe of phallobase in dorsal view with apical margin aspergilliform (Fig. 35); apex of phallic appendage with 2 small spines at inner side (Figs 35-36) ..... *U. aspergilliformis* sp. nov.
- Forewing without transverse stripes in area of clavus (Figs 9-12, 64); dorsal lobe of phallobase in dorsal view with apical margin roundly convex, and deeply cleft from base to apical 1/4 in midline (Fig. 71); apex of phallic appendage without 2 small spines at inner side (Figs 71-72) ..... *U. fissura* sp. nov.
4. Vertex with 1 or 2 longitudinal brown stripes ..... 5
- Vertex without brown stripes ..... 7
5. Discs of vertex and pronotum with 2 longitudinal stripes between lateral carinae respectively ..... 6
- Discs of vertex and pronotum with only one longitudinal stripe between lateral carinae respectively (Figs 21, 23, 97) ..... *U. unispina* sp. nov.
6. Genae with a brown spot below antenna (Chen, Yang & Wilson, 1989: Fig. 9B); tegulae without a spot (Matsumura, 1914: Fig. 7a; Chen, Yang & Wilson, 1989: Fig. 9A) ..... *U. yanonis*
- Genae without a spot below antenna (Figs 14, 16, 74); tegulae with a spot (Figs 13-16, 73) ..... *U. lineolalis*
7. Genae with a brown spot below antenna ..... 8
- Genae without spot below antenna ..... 9
8. Pronotum and mesonotum with a broad longitudinal brown stripe behind each eye (Figs 7-8, 49); medioventral process of pygofer with apical margin convex, roundly cleft to apical 1/4 in the midline (Fig. 56) ..... *U. congjiangensis* sp. nov.
- Pronotum and mesonotum behind eyes without stripe (Fennah, 1978: Fig. 186); medioventral process of pygofer with apical margin truncate, angularly cleft to apical 1/2 in the midline (Fennah, 1978: Fig. 189) ..... *U. demochares*
9. Ventral lobe of pronotum with a dark brown spot (Figs 18, 20); forewing yellowish brown with a black marking at base, costal margin and clavus with a longitudinal pale yellow stripe respectively (Figs 17-20, 88) ..... *U. oblongincisa* sp. nov.
- Ventral lobe of pronotum with without a spot; forewing pale yellowish brown without a marking at base and without a longitudinal stripe in clavus (Distant, 1916: Fig. 45) ..... *U. abdominalis*

### *Usana aspergilliformis* sp. nov.

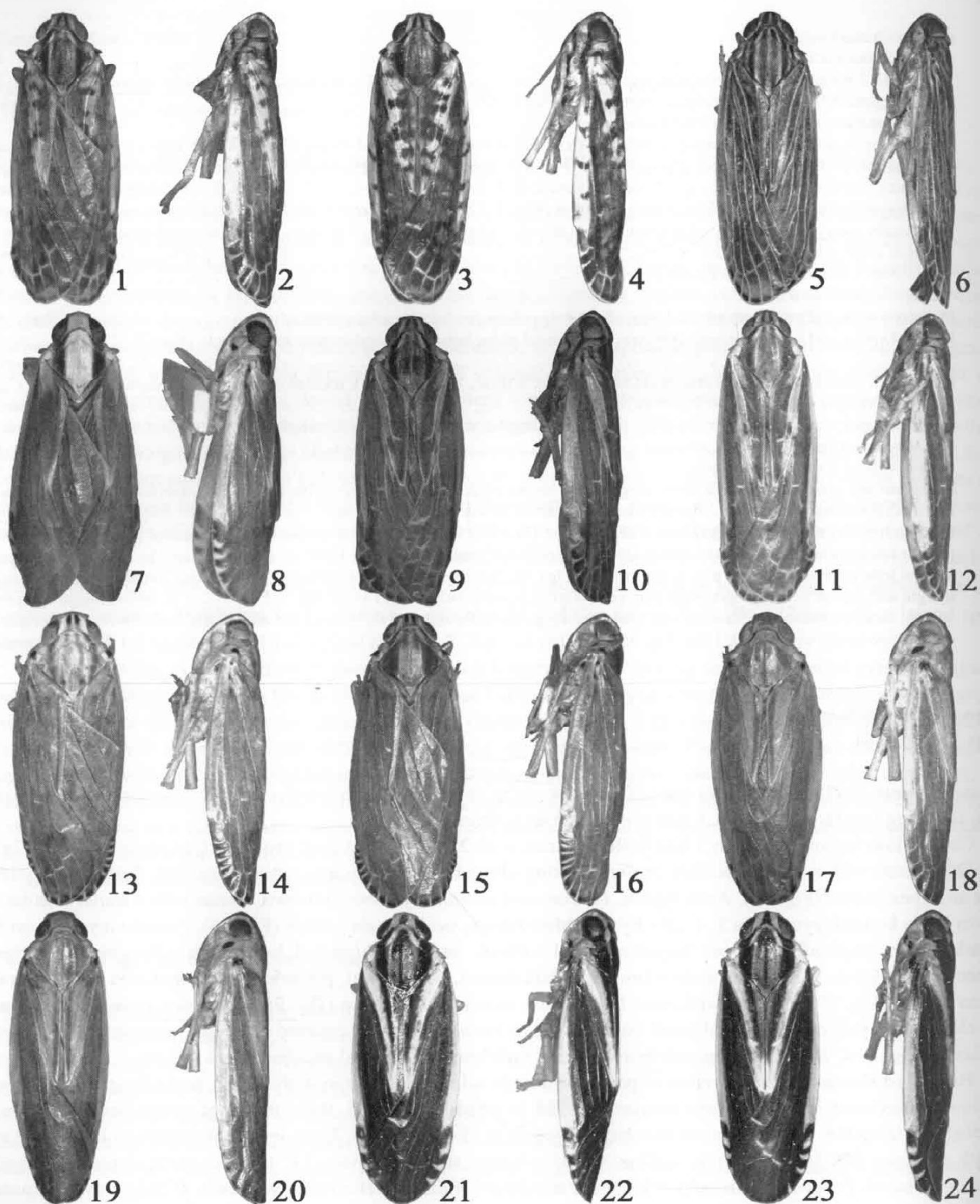
(Figs 1-4, 25-36)

**Measurements.** Body length (from apex of vertex to tip of forewing): male 5.0-5.1 mm (n = 2), female 6.3 mm (n = 1); forewing length: male 4.1-4.1 mm (n = 2, female 5.4 mm (n = 1).

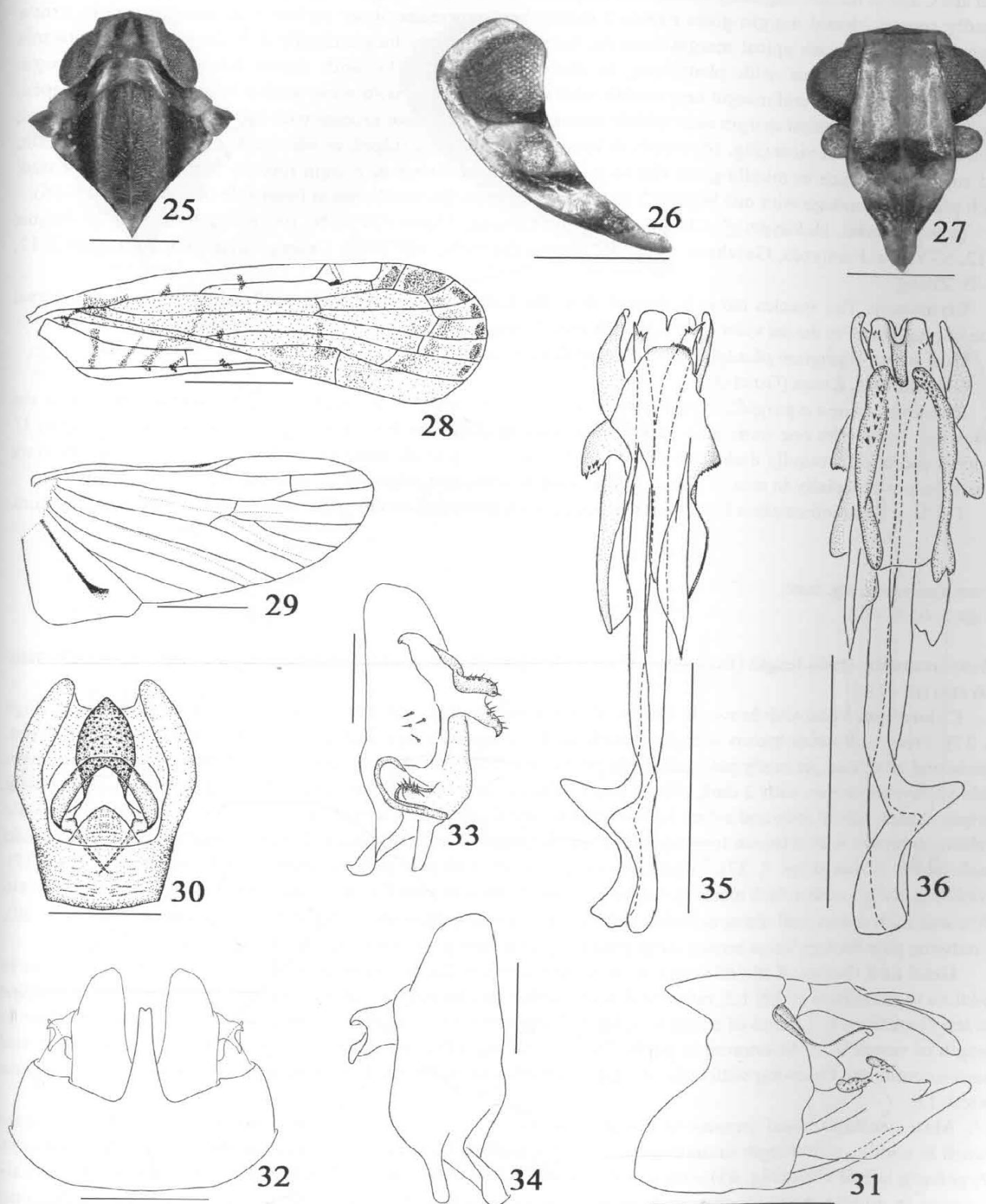
**Coloration.** Yellow to brown. Head yellow. Vertex with 2 longitudinal dark brown stripes along midline (Figs 1, 3, 25). Frons with a transverse dark brown marking along the frontoclypeus suture (Fig. 27). Postclypeus with base and apex brown (Fig. 27). Anteclypeus, rostrum and antennae yellowish brown. Genae with a transverse dark brown stripe beneath eyes (Figs 2, 4, 26). Eyes reddish brown, ocellus pale yellow (Fig. 26). Pronotum yellow with 2 dark brown longitudinal stripes between lateral carinae, lateral and ventral lobes with a longitudinal stripe respectively (Figs 1-4, 25). Mesonotum brown to dark brown, with lateral, posterior angles and area along lateral carina yellow (Fig. 25). Tegulae with inner half yellow, external half brown (Fig. 25). Forewing brown with costal and claval areas yellow and several small transverse dark brown stripes or scattered markings, especially in the area of clavus (Figs 1-4, 28). Hindwing pale brown, veins dark brown. Legs and abdomen light yellow.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 2.2. Ratio length of frons in midline to maximum width 1.2, ratio maximum width to width at apex 1.5. Ratio length of postclypeus in midline to length of frons 0.6. Ratio of apical to subapical segment of rostrum 1.5. Ratio length of pronotum in midline to length of vertex 0.7. Mesonotum in midline 7.0 times longer than pronotum, 3.0 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 3.1. Hindwing with ratio of length to maximum width 1.9.

**Male genitalia.** Anal segment in dorsal view (Fig. 30) with ratio length to maximum width 1.4, apical margin distinctly concave; apex of anal stylet not exceeding apex of anal segment. Pygofer in lateral view (Fig. 31) with dorsal margin distinctly shorter than ventral margin, narrowest part at dorsal fourth, posterior margin with a finger-like process, of which beneath with a round, broad process with its apex ventrally bent at dorsal third; medioventral process of pygofer in ventral view (Fig. 32) entire, long, narrowing apically, with width of anterior 4.2 times wider



FIGURES 1–24. Habitus (dorsal and lateral views): 1–2. *Usana aspergilliformis* sp. nov. (♂); 3–4. *Usana aspergilliformis* sp. nov. (♀); 5–6. *Usana concava* sp. nov. (♂); 7–8. *Usana congjiangensis* sp. nov. (♂); 9–10. *Usana fissura* sp. nov. (♂); 11–12. *Usana fissura* sp. nov. (♀); 13–14. *Usana lineolalis* Distant, 1906 (♂); 15–16. *Usana lineolalis* Distant, 1906 (♀); 17–18. *Usana oblongincisa* sp. nov. (♂); 19–20. *Usana oblongincisa* sp. nov. (♀); 21–22. *Usana unispina* sp. nov. (♂); 23–24. *Usana unispina* sp. nov. (♀).



**FIGURES 25–36.** *Usana aspergilliformis* sp. nov. 25. Head and thorax, dorsal view; 26. Head, lateral view; 27. Face; 28. Forewing; 29. Hindwing; 30. Anal segment, dorsal view; 31. Male genitalia, lateral view; 32. Pygofer and genital style, ventral view; 33. Left genital style, dorsal view; 34. Left genital style, ventral view; 35. Aedeagus, dorsal view; 36. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 28–29); 0.5 mm (Figs 25–27, 31–32, 35–36); 0.2 mm (Figs 30, 33–34).

than apex, apical margin angularly concave in midline. Genital style straight, slightly narrowing apically, with apex broadly convex, dorsal margin gives rise to 3 stubby bent processes; inner surface near anterior margin with a finger-like process with apical margin truncate, basal 2/3 distinctly longitudinally dehiscent, directed outwards (Figs 33–34). Aedeagus with phallobase, in dorsal view (Fig. 35), with dorsal lobe with apical margin aspergilliform, right lateral margin near middle with a stubby process with some teeth at basal lateral side of apex, directed basad, left lateral margin near middle with an obtuse angle-like process with basal lateral margin serrated; ventral lobe in ventral view (Fig. 36) with both lateral sides distinctly ridged, of which apical 1/3 with several teeth, and subapical surface in middle gives rise to a long process with apical margin roundly convex, directed basad. Each phallic appendage with one big and 2 small apical spines, the small ones at inner side of apex (Figs 35–36).

**Type material.** Holotype: ♂, CHINA, **Guizhou**: Ceheng, Zhelou (24°92'N, 105°83'E), scrubland, 26 August 2012, S.-Y. Xu. Paratypes, **Guizhou**: 1 ♂, 1 ♀, Zhelou (24°92'N, 105°83'E), Ceheng, scrubland, 26 August 2012, W.-B. Zheng.

**Etymology.** The species name is derived from the Latin word “*aspergilliformis*”, which refers to the dorsal lobe of phallobase in dorsal view (Fig. 35) with apical margin aspergilliform.

**Host plant.** *Alangium platanifolium* (Sieb. et Zucc.) Harms.

**Distribution.** China (Guizhou).

**Remarks.** *Usana aspergilliformis* is similar to *U. yanonis* and *U. concava* but differs from the latter two in the following: frons with one transverse dark brown marking along the frontoclypeus suture (without marking in *U. yanonis* and with 2 roundly dark brown near the apex in *U. concava*); forewing with several small transverse dark brown stripes especially in area of clavus (without such transverse stripes in *U. yanonis* and *U. concava*).

The host plant information for *Usana aspergilliformis* presented in this paper was retrieved from the collectors.

#### *Usana concava* sp. nov.

(Figs 5–6, 37–48)

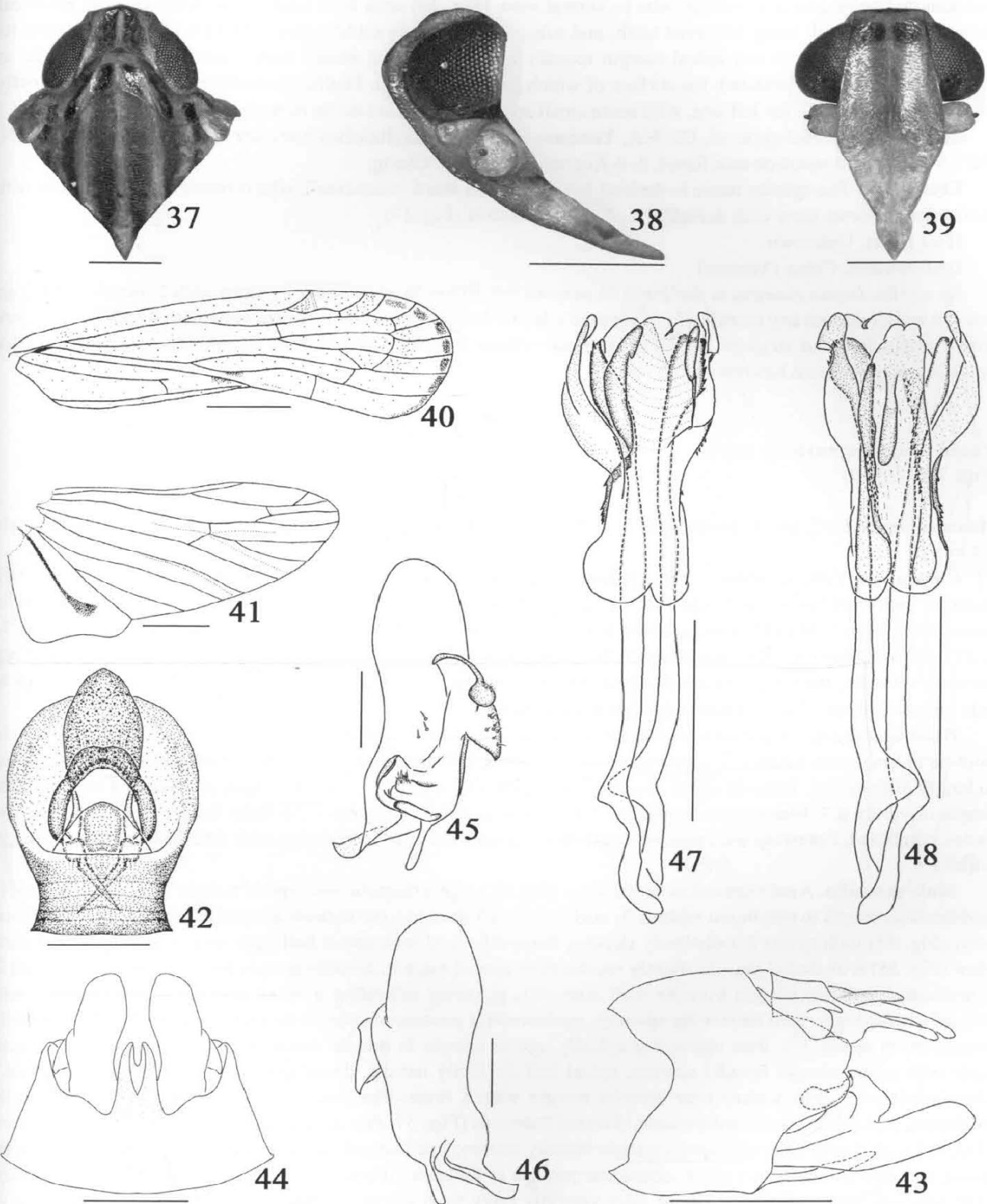
**Measurements.** Body length (from apex of vertex to tip of forewing): male 6.6 mm (n = 1); forewing length: male 5.6 mm (n = 1).

**Coloration.** Yellowish brown to brown. Vertex along midline and lateral margins pale yellowish brown (Figs 5, 37). Frons yellowish brown with 2 rounded dark brown markings near the apex (Fig. 39). Clypeus, rostrum, genae and antennae generally pale yellowish brown. Eyes reddish brown, ocellus pale yellow (Fig. 38). Pronotum pale yellowish brown with 2 dark brown longitudinal stripes between lateral carinae, 3 dark brown longitudinal stripes at each lateral lobe and a dark brown longitudinal strips at each ventral lobe (Figs 5–6, 37). Mesonotum pale yellowish brown with 2 brown longitudinal stripes between lateral carinae and 2 brown longitudinal stripes outside each lateral carina (Figs 5, 37). Tegula yellowish brown with pale yellow along inner lateral margin (Fig. 37). Forewing brown with a dark marking respectively at the base of vein  $Cu_1$ , near base of vein  $Cu_{1b}$ , near apex of vein PCu and each apical cell along apical margin, all veins pale yellowish brown to yellowish brown (Figs 5–6, 40). Hindwing pale brown, veins brown. Legs pale yellowish brown and abdomen yellowish brown.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 2.0. Ratio length of frons in midline to maximum width 1.2, ratio maximum width to width at apex 1.6. Ratio length of postclypeus in midline to length of frons 0.7. Ratio of apical to subapical segment of rostrum 1.6. Ratio length of pronotum in midline to length of vertex 0.7. Mesonotum in midline 6.8 times longer than pronotum, 2.7 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 3.2. Hindwing with ratio of length to maximum width 1.9.

**Male genitalia.** Anal segment in dorsal view (Fig. 42) bulb-like, with apical margin with a small V-shaped notch in middle, ratio length to maximum width 1.4; anal stylet large, with apex exceeding apex of anal segment. Pygofer in lateral view (Fig. 43) with dorsal margin slightly shorter than ventral margin, anterior margin distinctly concave in middle, posterior margin in middle distinctly wavelike and convex, above with a finger-like process with a round, broad process beneath; medioventral process of pygofer in ventral view (Fig. 44) with apical 1/3 divided into 2 branches. Genital style with apex roundly convex, dorsal margin gives rise to 2 large sharp processes and a small blunt process; inner surface near anterior margin with a bent finger-like process, directed outwards (Figs 45–46). Aedeagus with phallobase slightly constricted in middle (Figs 47–48), dorsal lobe in dorsal view





**FIGURES 37–48.** *Usana concava* sp. nov. 37. Head and thorax, dorsal view; 38. Head, lateral view; 39. Face; 40. Forewing; 41. Hindwing; 42. Anal segment, dorsal view; 43. Male genitalia, lateral view; 44. Pygofer and genital style, ventral view; 45. Left genital style, dorsal view; 46. Left genital style, ventral view; 47. Aedeagus, dorsal view; 48. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 40–41); 0.5 mm (Figs 37–39, 43–44, 47–48); 0.2 mm (Figs 42, 45–46).

(Fig. 47) with apical margin incised in middle, lateral margins with apical 1/2 distinctly rolled-up, making middle area longitudinally concave; ventral lobe in ventral view (Fig. 48) with both lateral sides from base to subapical distinctly ridged, with many scattered teeth, and subapical surface in middle gives rise to a long process with its basal 1/3 slightly narrow and apical margin roundly convex, directed basad; right lateral lobe from middle to subbasal much more sclerotized, the surface of which has several teeth. Phallic appendages with apices distinctly intumescent, especially the left one, with some small spines interspersed on its outer apical surface (Fig. 48).

**Type material.** Holotype: ♂, CHINA, Yunnan: Lüchun, Huanglianshan National Natural Reserve (22°88'N, 102°25'E), tropical montane rain forest, 3–4 August 2012, Z.-M. Chang.

**Etymology.** The species name is derived from the Latin word “*concauus*”, which refers to the aedeagus with phallobase in dorsal view with dorsal lobe distinctly concave (Fig. 47).

**Host plant.** Unknown.

**Distribution.** China (Yunnan).

**Remarks.** *Usana concava* is similar to *U. yanonis* but differs from the latter in: frons with 2 rounded markings near the apex (without any marking in *U. yanonis*); lateral lobe of pronotum in dorsal view with 3 longitudinal dark brown stripes (without stripe in *U. yanonis*); genae without a dark brown marking beneath antennae (with a dark brown marking beneath antennae in *U. yanonis*).

### *Usana congjiangensis* sp. nov.

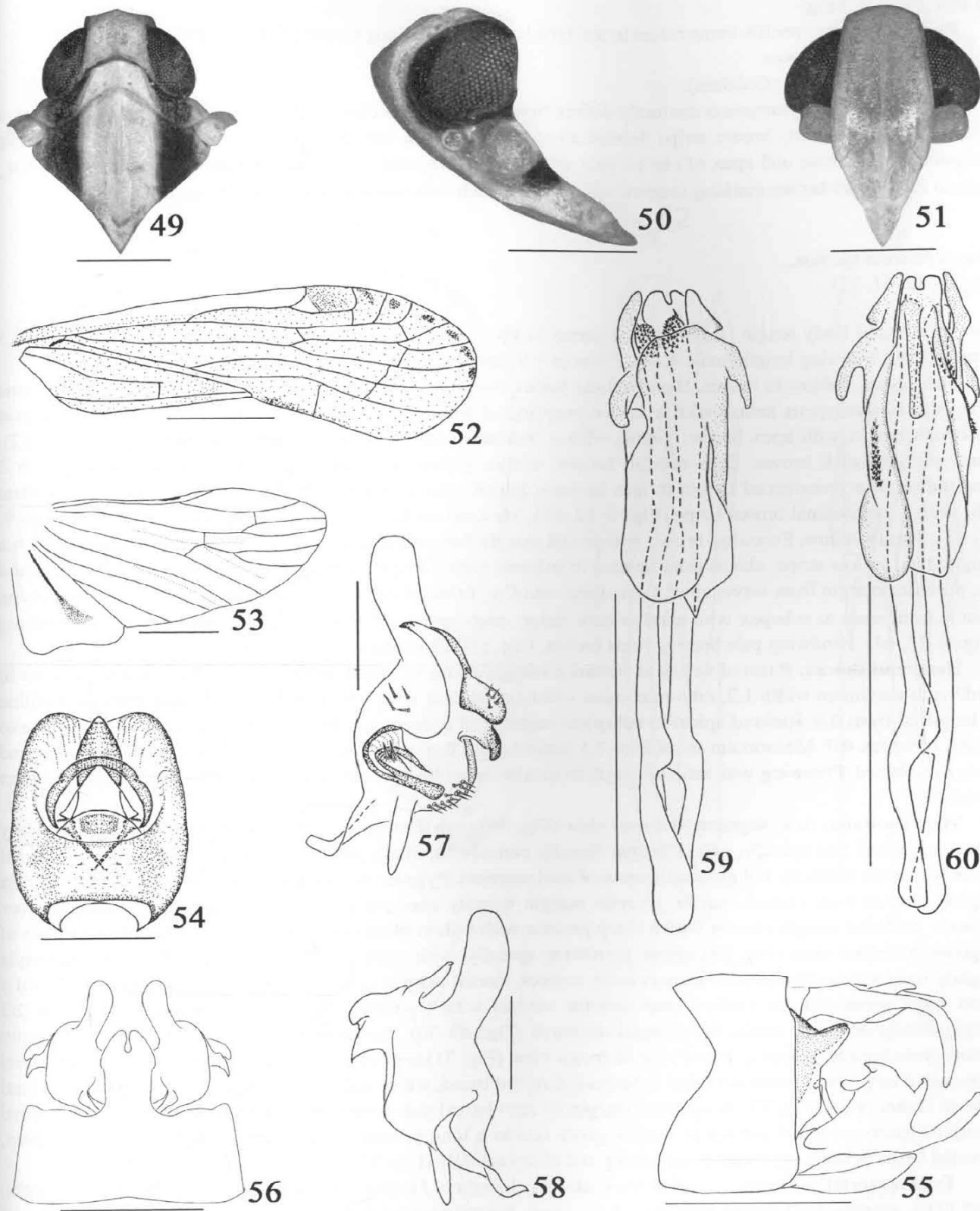
(Figs 7–8, 49–60)

**Measurements.** Body length (from apex of vertex to tip of forewing): male 5.3 mm (n = 1); forewing length: male 4.3 mm (n = 1).

**Coloration.** Yellow to brown. Head yellow. Genae with a dark brown marking beneath antennae (Figs 8, 50). Rostrum yellowish brown, with apex brown. Eyes reddish brown, ocellus pale yellow (Fig. 50). Thorax yellow in dorsal view (Figs 7, 49) with a broad longitudinal dark brown stripe behind eyes. Tegula yellow. Forewing (Figs 7–8, 52) yellowish brown with areas along costal margin, claval base and apex pale yellowish brown, each apical cell between veins Sc<sub>2</sub> and Cu<sub>1a</sub> with an apical dark brown marking. Hindwing pale brown, veins brown. Legs yellow to pale yellowish brown, and abdomen pale yellowish brown.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 1.5. Ratio length of frons in midline to maximum width 1.5, ratio maximum width to width at apex 1.6. Ratio length of postclypeus in midline to length of frons 0.5. Ratio of apical to subapical segment of rostrum 1.7. Ratio length of pronotum in midline to length of vertex 0.7. Mesonotum in midline 6.5 times longer than pronotum, 2.6 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 2.7. Hindwing with ratio of length to maximum width 1.8.

**Male genitalia.** Anal segment in dorsal view (Fig. 54) subrectangular with apical margin shallowly concave in middle, ratio length to maximum width 1.3; anal stylet with apex just not exceeding apex of anal segment; in lateral view (Fig. 55) with apical 2/3 distinctly slender, finger-like, and with apical half bent ventrally. Pygofer in lateral view (Fig. 55) with dorsal margin slightly shorter than ventral margin, anterior margin broadly concave at dorsal 2/5 distinctly, posterior margin truncate with inner side posteriad extending a broad process, of which apical half abruptly constricted, then narrowing apically; medioventral process of pygofer in ventral view (Fig. 56) distinctly broadened at apical 1/3, then narrowing apically, apical margin in middle concave, reaching apical 1/4. Genital style with apical margin broadly convex, apical half distinctly narrow, dorsal margin gives rise to a blunt and 2 sharp processes; inner surface near anterior margin with a finger-like process with its basal 2/3 longitudinally dehiscent, and apical margin subtruncate, directed outwards (Figs 57–58). Aedeagus with phallobase in dorsal view (Fig. 59) with dorsal lobe with apical margin broadly convex, each lateral side with a process subapically, directed basad, left lateral lobe with a short subangular process at subapex, directed outwards; ventral lobe in ventral view (Fig. 60) with inner margins of lateral sides ventrally ridgy from apical 1/3 to base, which a longitudinal group of teeth distributed near the middle, subapical surface in middle gives rise to a long process with its apical margin broadly convex, directed basad. Phallic appendage with an apical spine, and surface of apex with dense small teeth (Fig. 59).



**FIGURES 49–60.** *Usana congjiangensis* sp. nov. 49. Head and thorax, dorsal view; 50. Head, lateral view; 51. Face; 52. Forewing; 53. Hindwing; 54. Anal segment, dorsal view; 55. Male genitalia, lateral view; 56. Pygofer and genital style, ventral view; 57. Left genital style, dorsal view; 58. Left genital style, ventral view; 59. Aedeagus, dorsal view; 60. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 52–53); 0.5 mm (Figs 49–51, 55–56, 59–60); 0.2 mm (Figs 54, 57–58).

**Type material.** Holotype: ♂, CHINA, **Guizhou:** Congjiang, Yueliangwan (25°71'N, 108°73'E), scrubland, 9–20 July 2006, Y. Tang.

**Etymology.** The specific name refers to the type locality, Congjiang County, Guizhou Province, China.

**Host plant.** Unknown.

**Distribution.** China (Guizhou).

**Remarks.** *U. congjiangensis* distinctly differs from other nine species in: thorax in dorsal view yellow with a broad longitudinal dark brown stripe behind eyes (without such coloration in other nine species); forewing yellowish brown, base and apex of clavus pale yellowish brown, and each apical cell between vein Sc<sub>2</sub> and Cu<sub>1a</sub> with an apical dark brown marking respectively (without such coloration in other nine species).

### *Usana fissura* sp. nov.

(Figs 9–12, 61–72)

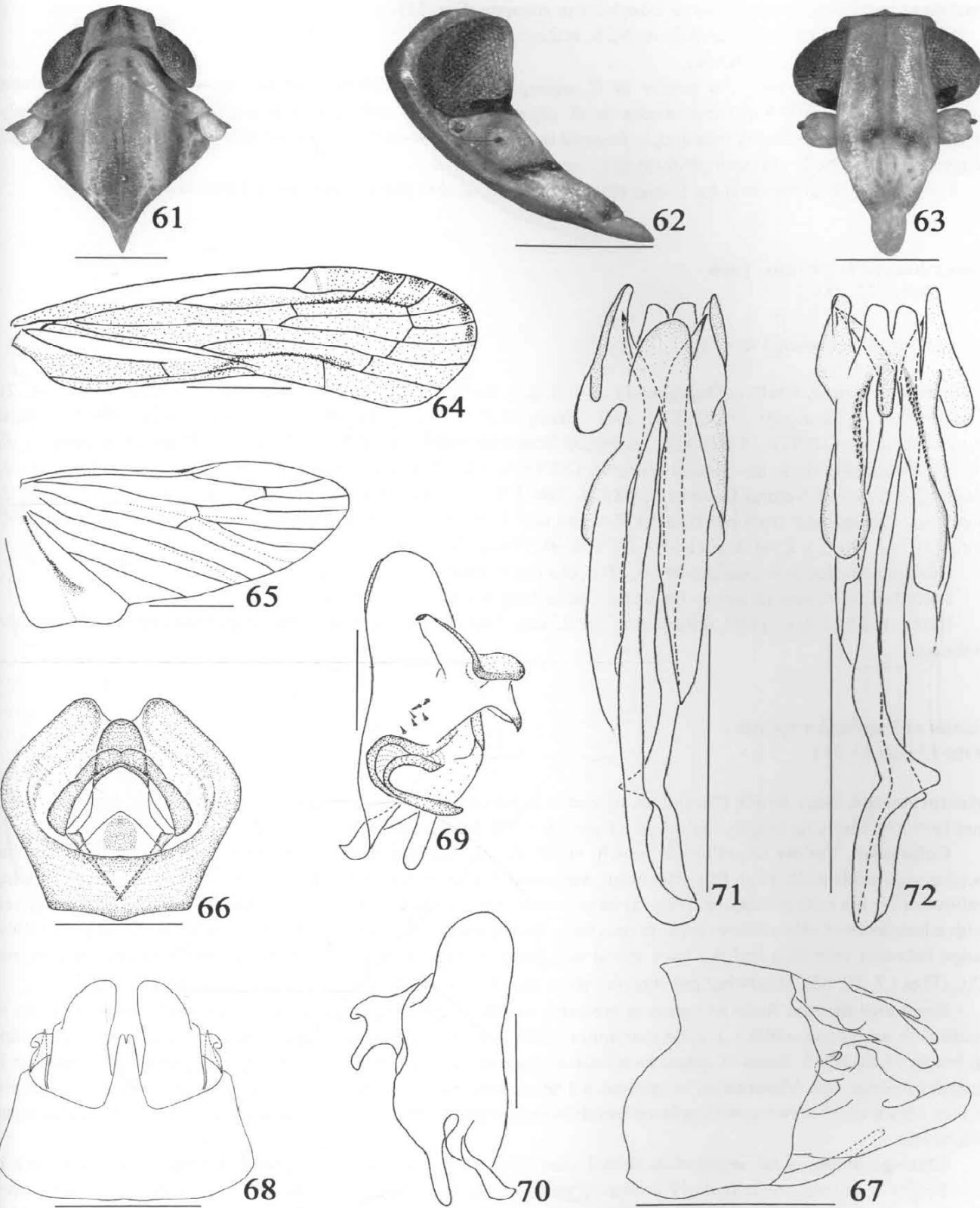
**Measurements.** Body length (from apex of vertex to tip of forewing): male 5.2–5.6 mm (n = 9), female 5.9–6.5 mm (n = 18); forewing length: male 4.1–4.7 mm (n = 9, female 4.9–5.5 mm (n = 18).

**Coloration.** Yellow to brown. Head yellow. Vertex with 2 brown stripes along midline (Figs 9, 11, 61). Frons along the frontoclypeus suture with a brown marking at each side of median carina (Fig. 63). Rostrum pale yellowish brown with apex brown. Genae with a transverse brown stripe beneath antennae (Figs 10, 12, 62). Antennae yellowish brown. Eyes reddish brown, ocellus yellowish white (Fig. 62). Pronotum yellow with 2 longitudinal less pronounced brown stripes between lateral carinae, lateral lobe behind eyes brown, and ventral lobe with a longitudinal brown stripe (Figs 9–12, 61). Mesonotum brown with tricarinae yellowish brown (Figs 9, 11, 61). Tegula yellow. Forewing brown with costal margin from subbase to basal half of second costal cell with a longitudinal yellow stripe; clavus from its base to subapex with a longitudinal yellow stripe between veins PCu and A<sub>1</sub>; posterior margin from claval apex, then along vein Cu<sub>1b</sub> to basal apical cross vein with a dark stripe, and along vein R from node to subapex with another dark stripe; each apical cell along apical margin with a dark marking (Figs 9–12, 64). Hindwing pale brown, veins brown. Legs and abdomen yellowish brown.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 2.3. Ratio length of frons in midline to maximum width 1.2, ratio maximum width to width at apex 1.6. Ratio length of postclypeus in midline to length of frons 0.6. Ratio of apical to subapical segment of rostrum 1.3. Ratio length of pronotum in midline to length of vertex 0.7. Mesonotum in midline 7.5 times longer than pronotum, 3.2 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 3.0. Hindwing with ratio of length to maximum width 1.9.

**Male genitalia.** Anal segment in dorsal view (Fig. 66) with maximum width near middle, hence respectively narrowing basad and apically, apical margin roundly concave in middle, ratio length to maximum width 1.0; anal stylet with apex distinctly not exceeding apex of anal segment. Pygofer in lateral view (Fig. 67) with dorsal margin slightly shorter than ventral margin, anterior margin broadly concave above the middle, then broadly convex beneath, posterior margin sinuate with a sharp process with a short blunt process beneath; medioventral process of pygofer in ventral view (Fig. 68) entire, narrowing apically, with apical margin angularly incised. Genital style slightly narrowing apically, with apex roundly convex, dorsal margin gives rise to 2 large sharp processes and a short blunt process; inner surface near anterior margin with a slender finger-like process with its basal 2/3 longitudinally dehiscent distinctly, directed outwards (Figs 69–70). Aedeagus with phallobase in midline deeply fissure from base to subapex, dorsal lobe in dorsal view (Fig. 71) with apical margin roundly convex, right lateral lobe with a large and a small subapical processes, directed basad, either with apical margin roundly convex; ventral lobe in ventral view (Fig. 72) along inner margin of each lateral side from subapical to middle with a longitudinal group of teeth, subapical surface in middle gives rise to a long process with its apical margin roundly convex, directed basad. Phallic appendages narrowing and sharp apically (Figs 71–72).

**Type material.** Holotype: ♂, CHINA, **Guizhou:** Jiangkou, Fanjingshan National Natural Reserve (27°92'N, 108°70'E), scrubland, 21 September 2011, J.-K. Long. Paratypes, **Guizhou:** 1 ♂, 3 ♀♀, same data as holotype; 6 ♂♂, 11 ♀♀, Fanjingshan National Natural Reserve (27°32'N, 108°70'E), scrubland, 21–22 September 2011, Z.-H. Fan (2 ♂♂, 2 ♀♀), X.-F. Yu (1 ♂, 3 ♀♀), Z.-M. Chang (1 ♂, 3 ♀♀), W.-B. Zheng (2 ♂♂, 3 ♀♀); 1 ♀, Libo, Maolan National Natural Reserve (25°30'N, 107°98'E), Karst forest, 21–24 August 2011, Z.-H. Meng; 1 ♂, 3 ♀♀, Anlong, Xianheping Provincial Natural Reserve (24°98'N, 105°61'E), Karst forest, 28 August 2012, J.-K. Long.



**FIGURES 61–72.** *Usana fissura* sp. nov. 61. Head and thorax, dorsal view; 62. Head, lateral view; 63. Face; 64. Forewing; 65. Hindwing; 66. Anal segment, dorsal view; 67. Male genitalia, lateral view; 68. Pygofer and genital style, ventral view; 69. Left genital style, dorsal view; 70. Left genital style, ventral view; 71. Aedeagus, dorsal view; 72. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 64–65); 0.5 mm (Figs 61–63, 67–68, 71–72); 0.2 mm (Figs 66, 69–70).

**Etymology.** The species name is derived from the Latin word “*fissura*”, which refers to the aedeagus with phallobase in midline deeply fissured from base to subapex (Fig. 71).

**Host plant.** *Alangium platanifolium* (Sieb. et Zucc.) Harms.

**Distribution.** China (Guizhou).

**Remarks.** *Usana fissura* is similar to *U. aspergilliformis* but differs from the latter in: forewing without transverse stripes (with transverse stripes in *U. aspergilliformis*); aedeagus with phallobase in midline deeply fissured from base to subapex (not deeply fissured in *U. aspergilliformis*); and dorsal lobe of phallobase with apical margin not aspergilliform (aspergilliform in *U. aspergilliformis*).

The host plant information for *Usana fissura* presented in this paper was retrieved from the collectors.

### ***Usana lineolalis* Distant, 1906**

(Figs 13–16, 73–84)

Distant, 1906: 294; Fennah, 1956: 486.

**Material Examined.** CHINA, **Jiangsu:** 11 ♂♂, 5 ♀♀, Baohuashan (32°14'N, 119°08'E), Nanjing, scrubland, 21 August 2009, P. Zhang (9 ♂♂, 2 ♀♀), J.-Q. Zhang (2 ♂♂, 3 ♀♀). **Fujian:** 1 ♂, Jianou, Wanmulin Provincial Natural Reserve (27°03'N, 118°09'E), evergreen broad-leaved forest, 8 July 2009, Y.-L. Zheng. **Guizhou:** 1 ♂, Yanhe, Mayanghe National Natural Reserve (28°36'N, 108°17'E), scrubland, 6 June 2007, X.-S. Chen; 1 ♀, Mayanghe National Natural Reserve (28°36'N, 108°17'E), scrubland, 6 October 2007, Y.-J. Li; 15 ♂♂, 16 ♀♀, Jiangkou, Fanjingshan National Natural Reserve (27°92'N, 108°70'E), scrubland, 20–25 September 2011, J.-K. Long (10 ♂♂, 7 ♀♀), Z.-H. Fan (1 ♂, 3 ♀♀), W.-B. Zheng (4 ♂♂, 6 ♀♀).

**Host plant.** *Alangium platanifolium* (Sieb. et Zucc.) Harms.

**Distribution.** China (Jiangsu, Zhejiang, Guangdong and Guizhou), Burma.

**Remarks.** The host plant information for *Usana lineolalis* presented in this paper was retrieved from the collectors.

### ***Usana oblongincisa* sp. nov.**

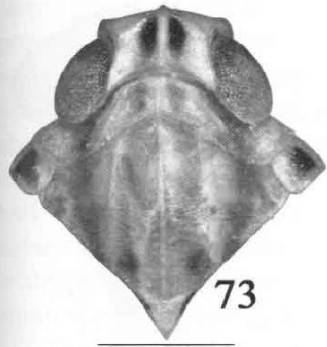
(Figs 17–20, 85–96)

**Measurements.** Body length (from apex of vertex to tip of forewing): male 5.0–6.0 mm (n = 50), female 5.8–6.5 mm (n = 22); forewing length: male 4.1–5.1 mm (n = 50), female 4.7–5.5 mm (n = 22).

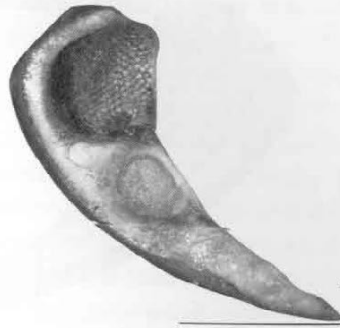
**Coloration.** Yellow to yellowish brown. Head, thorax and abdomen yellow. Eyes yellow to reddish brown, ocellus yellowish white (Fig. 86). Pronotum with ventral lobe with a dark brown spot (Figs 18, 20, 85). Forewing yellowish brown with a black marking at base, costal margin from its basal 1/5 to basal 1/3 of second costal cell with a longitudinal pale yellow stripe; clavus from its subbase to subapex with another one longitudinal pale yellow stripe between vein PCu and A<sub>2</sub>; each apical cell along apical margin with a dark marking between veins R<sub>1</sub> and Cu<sub>1a</sub> (Figs 17–20, 88). Hindwing pale brown, veins brown. Legs yellowish brown to pale yellow.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 1.6. Ratio length of frons in midline to maximum width 1.1, ratio maximum width to width at apex 1.6. Ratio length of postclypeus in midline to length of frons 0.5. Ratio of apical to subapical segment of rostrum 1.8. Ratio length of pronotum in midline to length of vertex 0.6. Mesonotum in midline 6.3 times longer than pronotum, 2.3 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 3.3. Hindwing with ratio of length to maximum width 1.8.

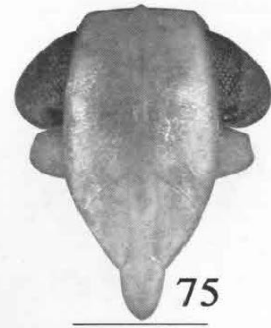
**Male genitalia.** Anal segment in dorsal view (Fig. 90) subelliptic with apical margin roundly concave in middle, basal margin rectangularly concave, ratio length to maximum width 1.2; anal stylet short with apex distinctly not exceeding apex of anal segment. Pygofer in lateral view (Fig. 91) with dorsal margin shorter than ventral margin, anterior margin broadly concave in middle, posterior margin slightly sinuate with a subtriangular process at dorsal 1/3; medioventral process of pygofer in ventral view (Fig. 92) entire, with subapex suddenly expanded, then narrowing apically, apical margin in middle incised as bursiform. Genital style with apical half



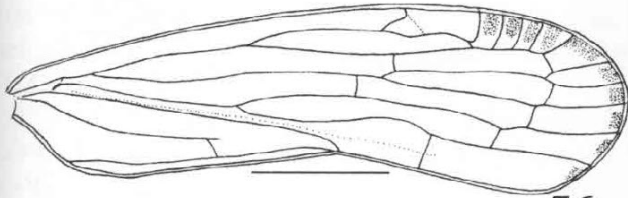
73



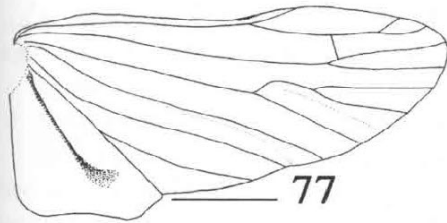
74



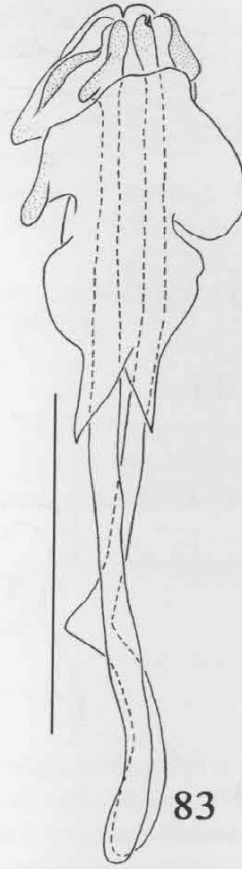
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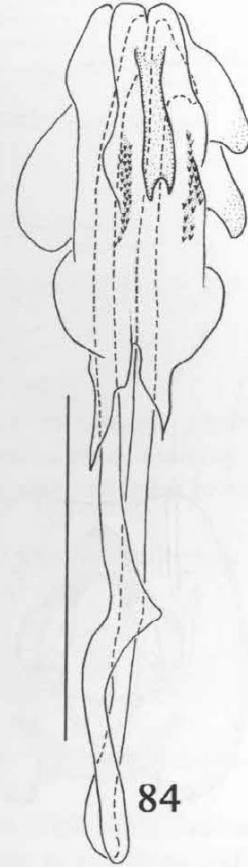
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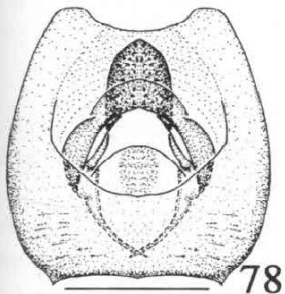
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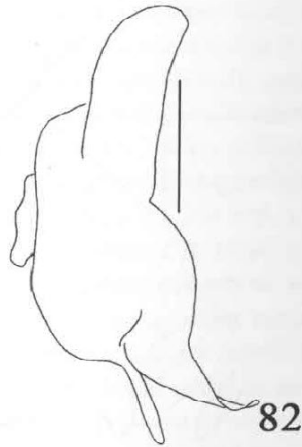
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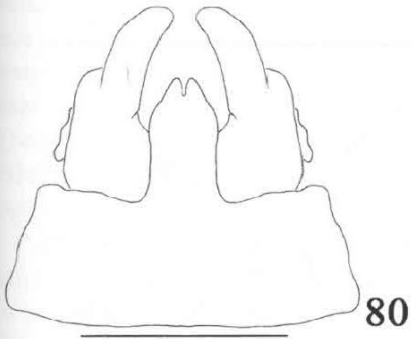
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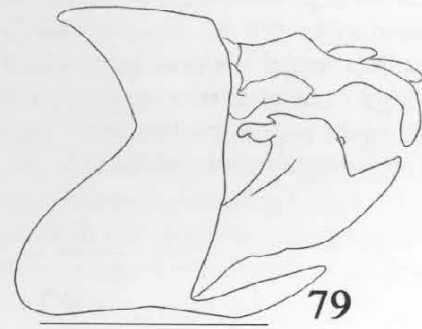
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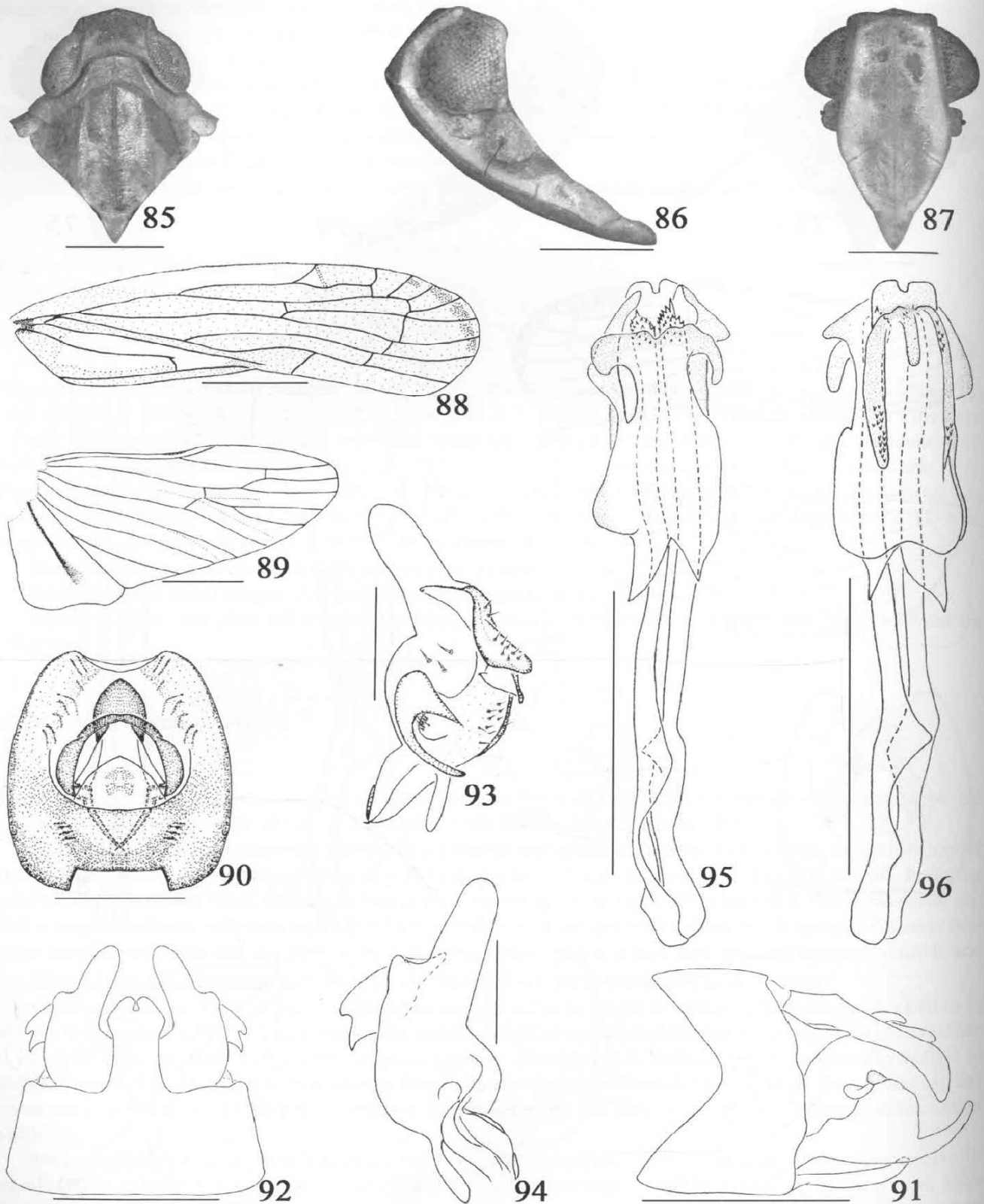


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79

**FIGURES 73–84.** *Usana lineolalis* Distant, 1906. 73. Head and thorax, dorsal view; 74. Head, lateral view; 75. Face; 76. Forewing; 77. Hindwing; 78. Anal segment, dorsal view; 79. Male genitalia, lateral view; 80. Pygofer and genital style, ventral view; 81. Left genital style, dorsal view; 82. Left genital style, ventral view; 83. Aedeagus, dorsal view; 84. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 76–77); 0.5 mm (Figs 73–75, 79–80, 83–84); 0.2 mm (Figs 78, 81–82).



**FIGURES 85–96.** *Usana oblongincisa* sp. nov. 85. Head and thorax, dorsal view; 86. Head, lateral view; 87. Face; 88. Forewing; 89. Hindwing; 90. Anal segment, dorsal view; 91. Male genitalia, lateral view; 92. Pygofer and genital style, ventral view; 93. Left genital style, dorsal view; 94. Left genital style, ventral view; 95. Aedeagus, dorsal view; 96. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 88–89); 0.5 mm (Figs 85–87, 91–92, 95–96); 0.2 mm (Figs 90, 93–94).



straight, apex roundly convex, basal half about 2 times wider than the apical half, dorsal margin gives rise to 2 large sharp processes and a short, larger blunt process; inner surface near anterior margin with a slender finger-like process, directed outwards (Figs 93–94). Aedeagus with phallobase in dorsal view (Fig. 95) with dorsal lobe with apical margin slightly sinuate and concave in middle, each side of apex respectively with a bent lateroapical process with its apical margin roundly convex, directed basad, the left one slender and long, the right one large and short; ventral lobe in ventral view (Fig. 96) with both sides at subapex abruptly ridged, hence extending along lateral margins to basal 1/3, the left side becoming a much longer finger-like process, with the surface of its apical half with some teeth, the right side with a few teeth near its base and apex, a long process gives rise to middle of subapex, with its apical margin roundly convex, directed basad; left lateral lobe near subapex with a short process with its apical margin roundly convex, and right lateral lobe at apical 1/3 with a broad obtuse process (Figs 95–96). Apex of phallic appendage with one big spine and many small teeth (Fig. 95).

**Type material.** Holotype: ♂, CHINA, **Guangxi:** Chongzuo, Nonggang National Natural Reserve (22°30'N, 106°58'E), Karst scrubland, 8 May 2012, light trap, Z.-H. Fan. Paratypes, **Guangxi:** 1 ♂, 1 ♀, same data as holotype; 5 ♂♂, 3 ♀♀, Nonggang National Natural Reserve (22°30'N, 106°58'E), Karst scrubland, 6–8 May 2012, H. Li (4 ♂♂, 2 ♀♀), N.-N. Yang (1 ♂), X.-F. Yu (1 ♀); 1 ♂, Longzhou, Shiwandashan National Forest Park (21°54'N, 107°54'E), north tropical monsoon forest, 3–4 May 2012, Z.-H. Fan. **Guizhou:** 32 ♂♂, 13 ♀♀, Zhelou (24°92'N, 105°83'E), Ceheng, scrubland, 26 August 2012, J.-K. Long (16 ♂♂, 4 ♀♀), W.-B. Zheng (6 ♂♂, 5 ♀♀), S.-Y. Xu (10 ♂♂, 4 ♀♀); 1 ♂, Dayi (25°21'N, 106°06'E), Wangmo, scrubland, 21–23 August 2012, J.-K. Long. **Hainan:** 8 ♂♂, 6 ♀♀, Jianfengling National Natural Reserve (18°41'N, 108°48'E), scrubland, 5–6 April 2013, J.-K. Long, Y.-B. Zhang and J.-C. Xing.

**Etymology.** The species name is derived from the Latin words “*oblong*” and “*incisus*”, which refer to the anal segment in dorsal view with basal margin rectangularly concave (Fig. 90).

**Host plant.** *Alangium platanifolium* (Sieb. et Zucc.) Harms.

**Distribution.** China (Guangxi, Guizhou, Hainan).

**Remarks.** *Usana oblongincisa* is similar to *U. demochares* but differs from the latter in: pronotum with ventral lobe with a dark brown spot (without spot in *U. demochares*); forewing yellowish brown with a black marking at base, costal margin and clavus respectively with a longitudinal pale yellow stripe (forewing pale yellowish brown but without such marking and stripe in *U. demochares*).

The host plant information for *Usana oblongincisa* presented in this paper was retrieved from the collectors.

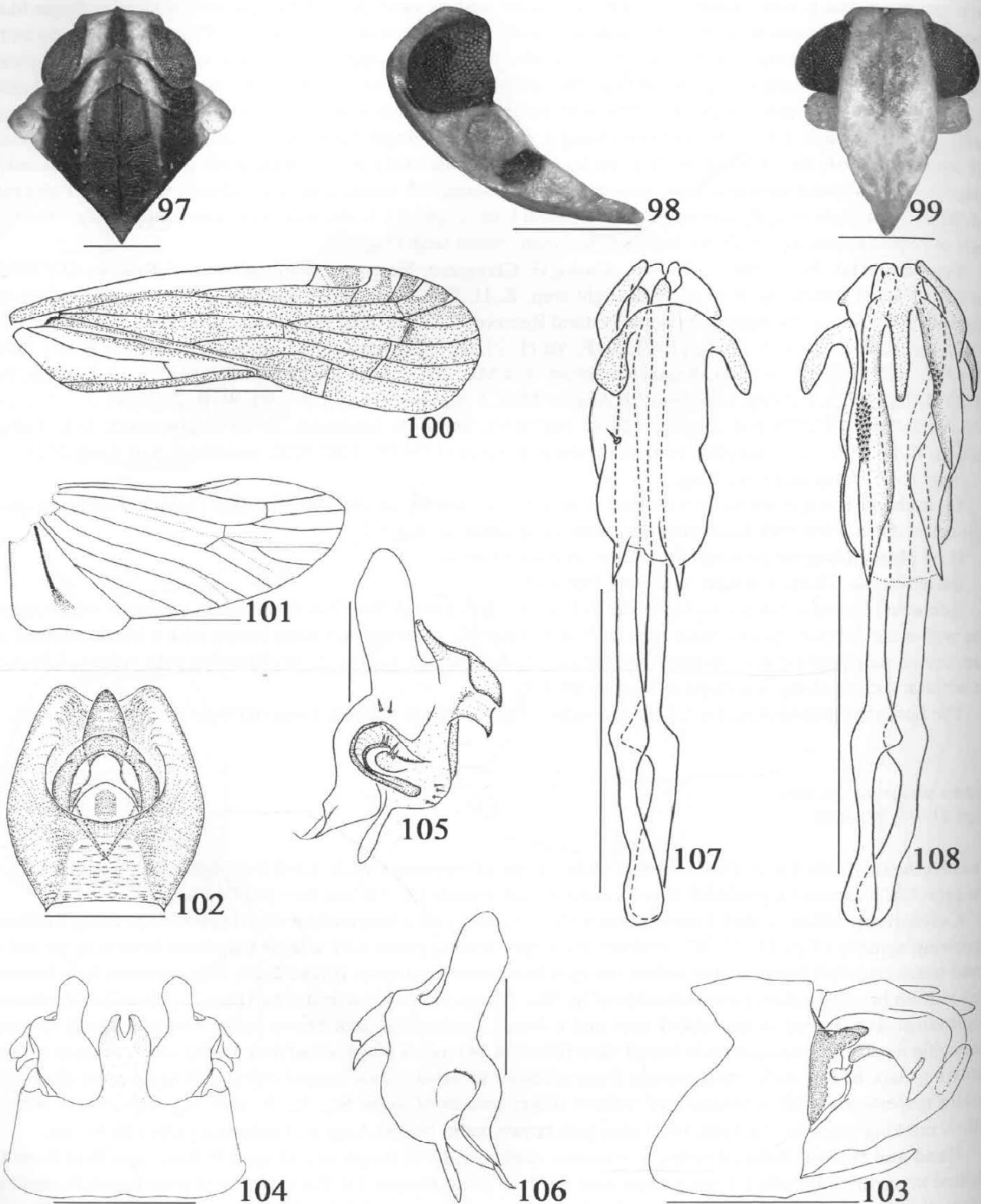
### *Usana unispina* sp. nov.

(Figs 21–24, 97–108)

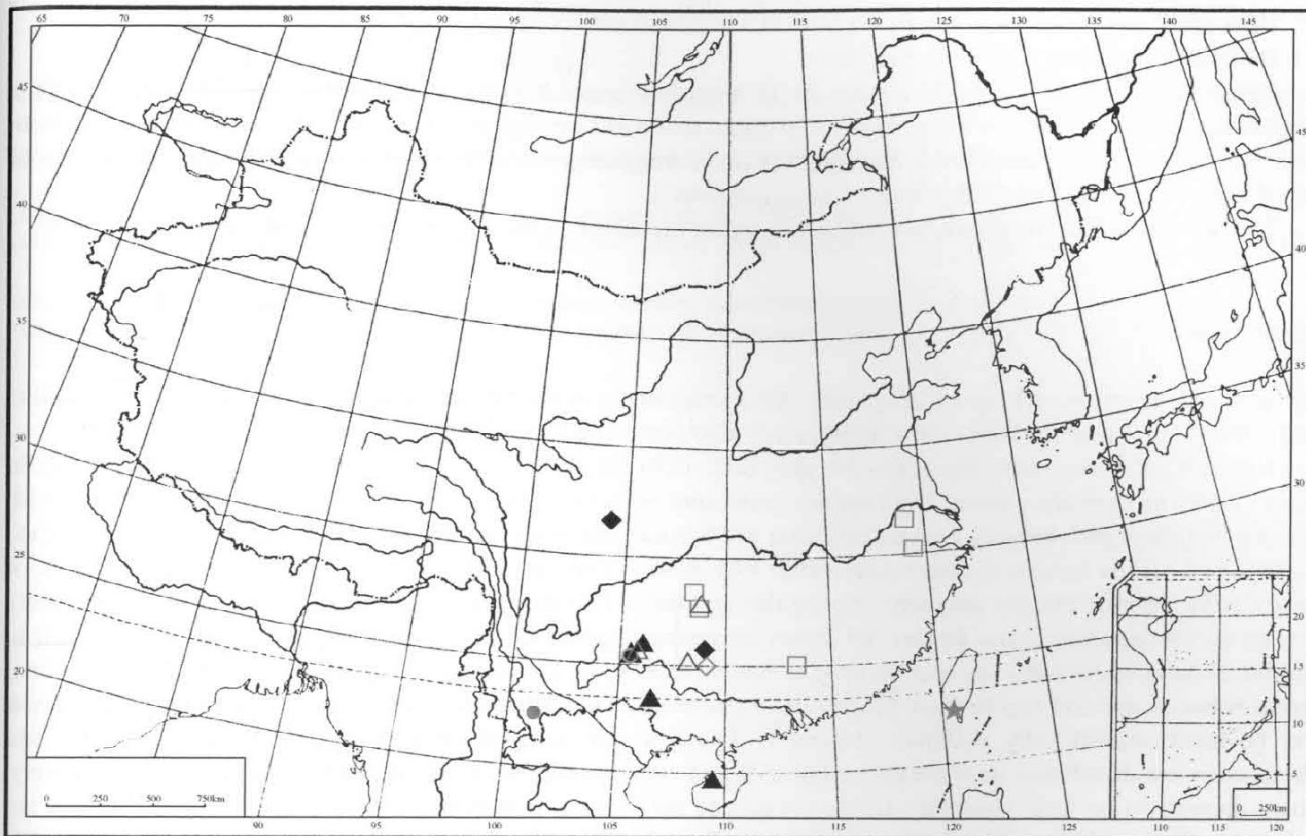
**Measurements.** Body length (from apex of vertex to tip of forewing): male 5.2–5.6 mm (n = 29), female 5.6–6.4 mm (n = 33); forewing length: male 4.4–4.8 mm (n = 29, female 4.8–5.0 mm (n = 33).

**Coloration.** Yellow to dark brown. Head yellow, vertex with a longitudinal dark brown stripe along midline, narrowing apically (Figs 21, 23, 97); rostrum with apex brown; genae with a short transverse brown stripe and a broad transverse dark brown stripe before the eyes and beneath antennae (Figs 22, 24, 98); antennae light brown; eyes reddish brown, ocellus yellowish white (Fig. 98). Thorax yellow, in dorsal view (Figs 21, 23, 97) with a broad longitudinal dark brown stripe behind eyes and a broad longitudinal dark brown stripe between lateral carinae, narrowing anteriorly; mesonotum in lateral view (Figs 22, 24) with a longitudinal dark brown stripe beneath tegula. Forewing dark brown with costal margin from subbasal to basal 1/3 of second costal cell and clavus along the middle respectively with a longitudinal yellow stripe; apexes of veins Sc<sub>2</sub>, R<sub>1</sub>, R<sub>s</sub> and M<sub>1a</sub> respectively with a yellow marking (Figs 21–24, 100). Hindwing pale brown, veins brown. Legs and abdomen yellowish brown.

**Head and thorax.** Ratio of vertex at posterior margin width to length in midline 1.8. Ratio length of frons in midline to maximum width 1.1, ratio maximum width to width at apex 1.6. Ratio length of postclypeus in midline to length of frons 0.7. Ratio of apical to subapical segment of rostrum 1.3. Ratio length of pronotum in midline to length of vertex 0.7. Mesonotum in midline 6.2 times longer than pronotum, 2.5 times longer than pronotum and vertex combined. Forewing with ratio of length to maximum width 2.9. Hindwing with ratio of length to maximum width 2.0.



**FIGURES 97–108.** *Usana unispina* sp. nov. 97. Head and thorax, dorsal view; 98. Head, lateral view; 99. Face; 100. Forewing; 101. Hindwing; 102. Anal segment, dorsal view; 103. Male genitalia, lateral view; 104. Pygofer and genital style, ventral view; 105. Left genital style, dorsal view; 106. Left genital style, ventral view; 107. Aedeagus, dorsal view; 108. Aedeagus, ventral view. Scale bars: = 1 mm (Figs 100–101); 0.5 mm (Figs 97–99, 103–104, 107–108); 0.2 mm (Figs 102, 105–106).



**FIGURE 109.** Geographic distribution of *Usana* species in China: *U. aspergilliformis* sp. nov. (○); *U. concava* sp. nov. (●); *U. congjiangensis* sp. nov. (◇); *U. fissura* sp. nov. (Δ); *U. lineolalis* (□); *U. oblongincisa* sp. nov. (▲); *U. unispina* sp. nov. (◆); *U. yanonis* (★).

**Male genitalia.** Anal segment in dorsal view (Fig. 102) with apical margin broadly concave in middle, maximum width at basal half, ratio length to maximum width 1.3, anal stylet with apex just not exceeding apex of anal segment; in lateral view (Fig. 103) with apical half much more slender than basal half, bent ventrally. Pygofer in lateral view (Fig. 103) with dorsal margin shorter than ventral margin; anterior margin subangular concave at dorsal 1/3; posterior margin subtruncate with inner posteriorly gives rise to 2 stubby processes; medioventral process of pygofer in ventral view (Fig. 104) with apical 1/4 branching into 2 small processes. Genital style with apex roundly convex, ratio width of apical half to width of basal half 0.5, dorsal margin gives rise to 2 short sharp processes and a slender sharp process; inner surface near anterior margin with a finger-like process distinctly longitudinally dehiscent from basal to subapical, directed outwards (Figs 105–106). Aedeagus with phallobase in dorsal view (Fig. 107) with dorsal lobe with its apical margin roundly convex, each side of apex respectively with a bent lateroapical process with apical margin roundly convex, directed basad, the left one slender, finger-like, the right one large and clinging the dorsal lobe, of which surface with a single big spine in the middle, near left margin; ventral lobe in ventral view (Fig. 108) with inner margins of both sides ventrally ridged, of which the left with a longitudinal group of teeth near outer margin, and the right with a longitudinal group of teeth along inner margin; subapical surface in middle gives rise to a long process with its apical margin broadly convex, directed basad; left lateral lobe at subapex with a short process with apical margin rounded (Figs 107–108). Apex of phallic appendage with one big spine.

**Type material.** Holotype: ♂, CHINA, **Guizhou:** Leishan, Leigongshan National Natural Reserve (26°20'N, 108°17'E), scrubland, 9–11 July 2011, J.-K. Long. Paratypes, **Guizhou:** 28 ♂♂, 31 ♀♀, same data as holotype, J.-K. Long (11 ♂♂, 14 ♀♀), W.-B. Zheng (10 ♂♂, 13 ♀♀), Z.-M. Chang (7 ♂♂, 4 ♀♀). **Sichuan:** 1 ♂, Chaping (31°40'N, 104°17'E), Mianyang, scrubland, 20–22 July 2010, Z.-M. Chang.

**Etymology.** The species name is derived from the prefix “uni-” and the Latin word “spina”, which refer to the aedeagus with phallobase in dorsal view with single spine on surface of dorsal lobe (Fig. 107).

**Host plant.** *Alangium platanifolium* (Sieb. et Zucc.) Harms.

**Distribution.** China (Guizhou, Sichuan).

**Remarks.** *Usana unispina* is similar to *U. congjiangensis* but differs from the latter in: vertex with a longitudinal dark brown stripe along midline (without stripe in *U. congjiangensis*); pronotum and mesonotum with areas between lateral carinae dark brown (yellow in *U. congjiangensis*); aedeagus with phallobase with surface of dorsal lobe with a big spine (without in *U. congjiangensis*).

The host plant information for *Usana oblongincisa* presented in this paper was retrieved from the collectors.

## Discussion

The genus *Usana* now consists of 10 species. All species occur in the Oriental region, primarily in southern China (Fig. 109). *Usana yanonis* is the most widespread, also occurring in the Palearctic region (Japan and Korea).

*Usana* is most similar to the genus *Phrygia* Stål, 1856 but differs from the latter in: frons slightly convex in lateral view (moderately convex in *Phrygia*); pronotum with lateral carinae distinct (obsolete in *Phrygia*), with anterior margin of disk broadly convex (truncate in *Phrygia*); forewing with vein M three-branched (four-branched in *Phrygia*). *Usana* is also similar to the genus *Opsiplanon* Fennah, 1945 but differs from the latter in: disk of vertex with anterior margin obtusely subangulately (about 130 degrees) or slightly convex (subrectangulately convex in *Opsiplanon*); eyes almost not excavate beneath (excavate in *Opsiplanon*); pronotum with length in midline as long as behind eyes (not as long as behind eyes in *Opsiplanon*), lateral lobe with a small longitudinal carina between eye and tegula (two carinae in *Opsiplanon*). The distributions of *Usana*, *Phrygia* and *Opsiplanon* are, however, significantly different. *Usana* is found in the Oriental and Palearctic regions. *Phrygia* and *Opsiplanon* are distributed in Neotropical (Brazil) and Nearctic regions (United States of America), respectively. There appears to be little similarity in host plants of the three genera either, although the hosts of *Phrygia* are unknown (Stål, 1856). *Opsiplanon nemorosus* Fennah, 1945 has been recorded resting on fiddlewood (Verbenaceae) (Fennah, 1945), and we documented that *Usana* is found on the host plant *Alangium platanifolium* (Sieb. et Zucc.) (Alangiaceae). Despite the differences, the habitat of all three genera are somewhat similar, they are mainly distributed in tropical zones, and to date are often found in scrubland, e.g. *Opsiplanon* (Fennah, 1945) and *Usana* (this paper).

Species of *Usana* can predominantly key out using obvious coloration differences. However, the more definitive character is male genitalia (see illustrations in this paper), especially the shape of the pygofer and phallobase. The descriptions of two species (*U. concave* and *U. congjiangensis*) are based only on one male specimen, but the specimens are natural and not parasitized.

The specimens examined in this paper were mainly found on angiosperms. Some specimens (including *U. aspergilliformis* sp. nov., *U. fissura* sp. nov., *U. lineolalis*, *U. oblongincisa* sp. nov. and *U. unispina* sp. nov.) were collected on the host plant *Alangium platanifolium* (Sieb. et Zucc.) Harms. However, the ecology of the remaining five species, including the species not described in this paper, are undocumented, and further research is required.

## Acknowledgements

We are grateful to all collectors of specimens. This work was supported by the National Natural Science Foundation of China (No. 31060290, 31093430), the Program of Science and Technology Innovation Talents Team, Guizhou Province (No. 20144001) and the International Science and Technology Cooperation Program of Guizhou (No. 20107005).

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