

# *Kuzinellus* (Acari: Phytoseiidae) from China

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## ABSTRACT

Two species of the genus *Kuzinellus* (Acari: Phytoseiidae) are known in China. We re-describe them based on types and fresh specimens and provide updated information and illustrations. It is the first time that *Kuzinellus trisetus* is recorded in Shanxi province.

**Keywords** Mesostigmata, Typhlodrominae, predatory mite**Zoobank** <http://zoobank.org/34DBCBDA-3436-4EA5-8E61-3B48BBCC793A>

## Introduction

As a family of valuable beneficial predators Phytoseiidae has received an increasing attention in the last three decades (Helle and Sabelis, 1985; Lindquist *et al.*, 1996; McMurtry and Croft, 1997; Sabelis and Van Rijn, 1997; Gerson *et al.*, 2003; Moraes *et al.*, 2004). To date more than 2,750 species have been described (Demite *et al.*, 2017) and some species are commercially produced for controlling spider mites, thrips and whiteflies. The genus *Kuzinellus* Wainstein, 1976 is relatively small and consists of about 51 described species (Demite *et al.*, 2017; Kamran *et al.*, 2017). Only two species of this genus are known from China, an Oriental species, *K. cervix* (Wu and Li, 1984) from Hubei province and a Palaearctic species, *K. trisetus* (Wu *et al.*, 1992) from Liaoning province. *Kuzinellus cervix* was subsequently found in Fujian, Hunan and Jiangxi (Wu *et al.*, 2009) but there was no record of *K. trisetus* from other provincial areas of the country. During a survey of phytoseiid mites of Shanxi province, *K. trisetus* was discovered from several localities. In this paper, we re-described both species based on the original types and fresh specimens of *K. trisetus*.

## Materials and methods

The type specimens of *Kuzinellus cervix* and *K. trisetus* loaned from Guangdong Institute of Entomology, Guangzhou and fresh specimens of *K. trisetus* collected from Shanxi were used for this study. Illustrations were made using a drawing tube attached to a Nikon differential interference contrast (DIC) microscope, which was also used for measuring and imaging of specimens. Images and illustrations were edited with Photoshop CS4. Measuring method follows Ma *et al.* (2016). All measurements are given in micrometers ( $\mu\text{m}$ ). The measurements for the holotype are followed into brackets by the range of measurements from paratypes or other specimens. The chaetotaxy of the idiosoma and legs follow Chant and McMurtry (2007) and Evans (1963), respectively, and the terminology of pore-like structures follows Beard (2001).

## Results

### Genus *Kuzinellus* Wainstein, 1976

*Kuzinellus* Wainstein, 1976: 699. Type species: *Paraseiulus kuzini* Wainstein, 1962: 139.

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Diagnosis — Dorsal idiosomal setal patterns 13A:8A, with 19 pairs of setae on the dorsal shield. Setae  $z_6$  and  $JV_2$  present,  $ZI$  absent. Ventrianal shield with 4 pairs of preanal setae. *Kuzinellus* can be distinguished from its closely related *Paraseiulus* Muma by having  $JV_2$  present and  $ZI$  absent. It differs from the other genus included in the tribe, Paraseiulini Wainstein (*Australiseius* Muma) by having  $ZI$  absent.

### ***Kuzinellus cervix* (Wu and Li, 1984)**

*Typhlodromus (Anthoseius) cervix* Wu and Li, 1984: 44; Moraes et al., 2004: 317; Chant and McMurtry, 2007: 152.

*Typhlodromus (Paraseiulus) cervix*; Wu, 1985: 86.

*Amblydromella cervix*; Moraes et al., 1986: 353.

*Typhlodromus cervix*; Wu and Lan, 1992: 1367; Hou, 1996: 13; Wu et al., 1997: 172.

*Kuzinellus cervix*; Wu et al., 2009: 330.

### **Redescription**

#### **ADULT FEMALE (n=2).**

Dorsum (Figures 1A, 2A) — Dorsal shield nearly oval, incised at level of  $R_1$ , reticulate throughout except area between  $S_4$  and  $S_5$ ; 325 (336) long, 200 (203) wide; all setae smooth except  $Z_5$  (barbed), bearing 11 pairs of discernible lyrifissures ( $id_{1a}$ ,  $id_4$ ,  $id_6$ ,  $idm_3$ ,  $idm_5$ ,  $idm_6$ ,  $is_1$ ,  $idl_2$ ,  $idl_3$ ,  $idl_4$  and  $idx$ ) and 4 pairs of solenostomes ( $gd_2$ ,  $gd_6$ ,  $gd_8$  and  $gd_9$ ). Muscle marks discernible, mainly on podosomal areas between  $z_2$  and  $j_4$ ,  $j_4$  and  $j_5$ ,  $j_5$  and  $z_5$ ,  $s_4$  and  $z_5$ ,  $z_5$  and  $j_6$ ,  $j_6$  and  $J_2$ ,  $S_2$  and  $S_4$ , and prior to  $J_5$ . Lateral setae  $r_3$  and  $R_1$  smooth, on soft membranous cuticle lateral to dorsal shield,  $r_3$  at level of  $z_4$ ,  $R_1$  at level of shield incisions. Peritremes extending forward to bases of  $j_1$ . Lengths of setae:  $j_1$  17 (17),  $j_3$  16 (17),  $j_4$  13 (12),  $j_5$  12 (12),  $j_6$  14 (14),  $z_2$  16 (16),  $z_3$  17 (16),  $z_4$  18 (19),  $z_5$  15 (16),  $z_6$  15 (15),  $s_4$  17 (19),  $s_6$  20 (20),  $J_2$  16 (16),  $J_5$  11 (12),  $Z_4$  19 (18),  $Z_5$  27 (29),  $S_2$  18 (20),  $S_4$  21 (21),  $S_5$  19 (21),  $r_3$  17 (21),  $R_1$  17 (18).

Ventral idiosoma (Figures 1B, 2B) — Sternal shield smooth (without reticulation), 56 (56–57) wide, anterior margin moderately convex, medial posterior margin vague, bearing 2 pairs of attenuate setae ( $st_1$ ,  $st_2$ ) and 2 pairs of lyrifissures ( $iv_1$ ,  $iv_2$ ),  $iv_1$  between  $st_1$  and  $st_2$ ,  $iv_2$  at corners of the posterior margin; setae  $st_3$  on soft cuticle,  $st_4$  on platelets. Genital shield smooth, 113 (120) long, 58 (60) wide. Lengths of setae:  $st_1$  19 (20),  $st_2$  13 (12),  $st_3$  19 (19),  $st_4$  15 (13),  $st_5$  11 (18). A thin and long transversal sclerite between genital and ventrianal shields, a pair of small plates between  $ZV_1$  and  $ZV_2$ . Ventrianal shield approximately pentagonal, smooth, anterior margin convex, with prominent waist at  $JV_2$  level, 116 (118) long, 75 (76) wide, with 4 pairs of pre-anal setae ( $JV_1$ ,  $JV_2$ ,  $JV_3$  and  $ZV_2$ ) and a pair of pores  $gv_3$  posteromedial to  $JV_2$ ; distance  $gv_3-gv_3$  18 (18), 4 pairs of setae ( $ZV_1$ ,  $ZV_3$ ,  $JV_4$  and  $JV_5$ ) and 3 pairs of lyrifissures on soft cuticle surrounding ventrianal shield. Primary metapodal plate 30 (32) long, 4 (4) wide, the secondary plate 8 (9) long, 2 (1) wide.

Calyx of insemination apparatus tubular (Figure 1D, 2D, 2E), 37 (39) long and 2 (2) wide, major duct long and slender, 34 long, 1 wide, minor duct thread-like, connecting to centre of atrium.

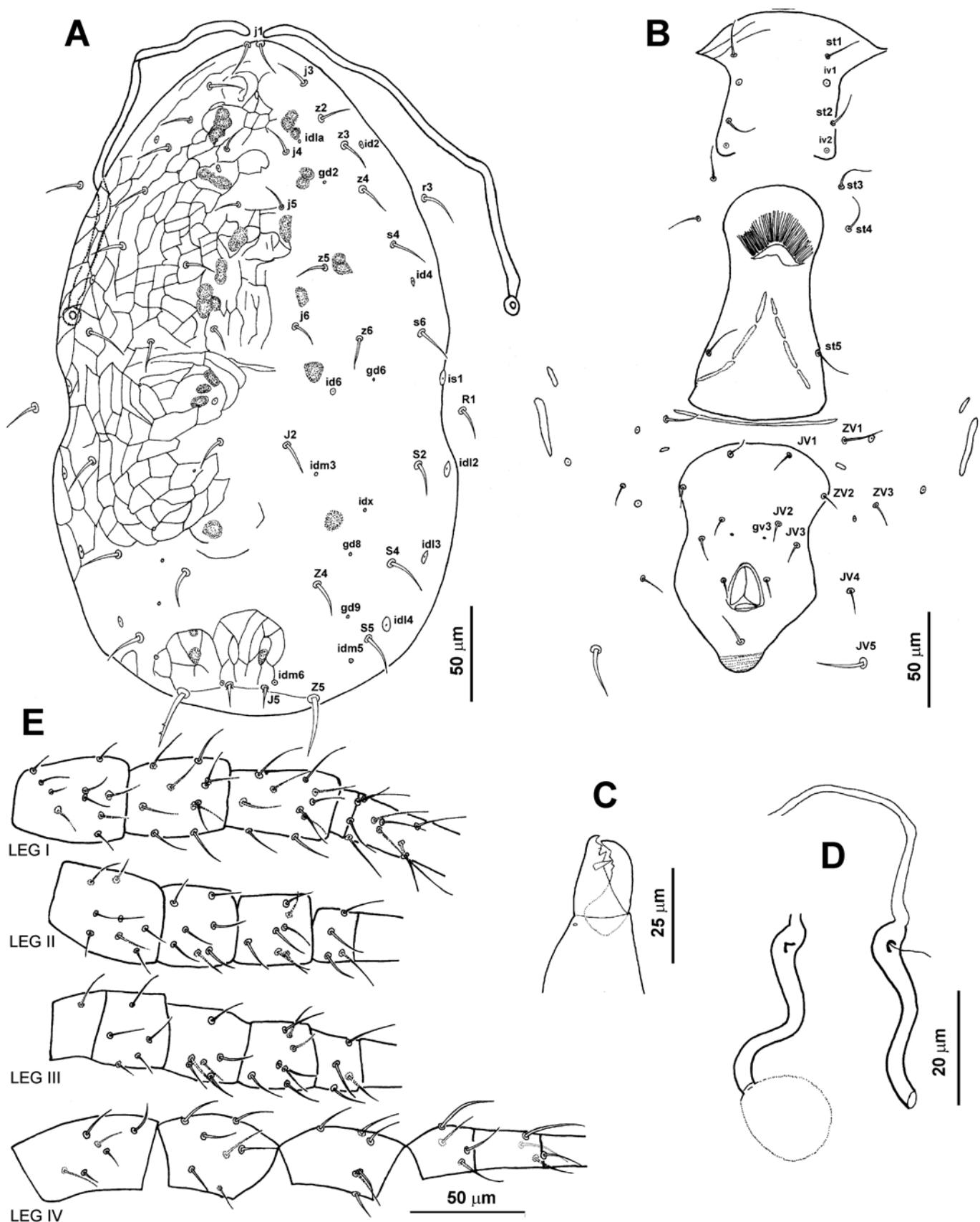
Gnathosoma — Chelicera (Figure 1C, 2C) with movable digit 25 (26) long, bearing 2 teeth, fixed digit 25 (27) long, bearing 3 discernible teeth, terminal two next to each other.

Leg lengths (I–IV): 299 (307), 232 (233), 230 (269) and 289 (344). Legs I, II and III without macrosetae. Basitarsus and telotarsus of leg IV (Figure 1E) each with a smooth macroseta, 20 (20) and 25 (31) long, respectively.

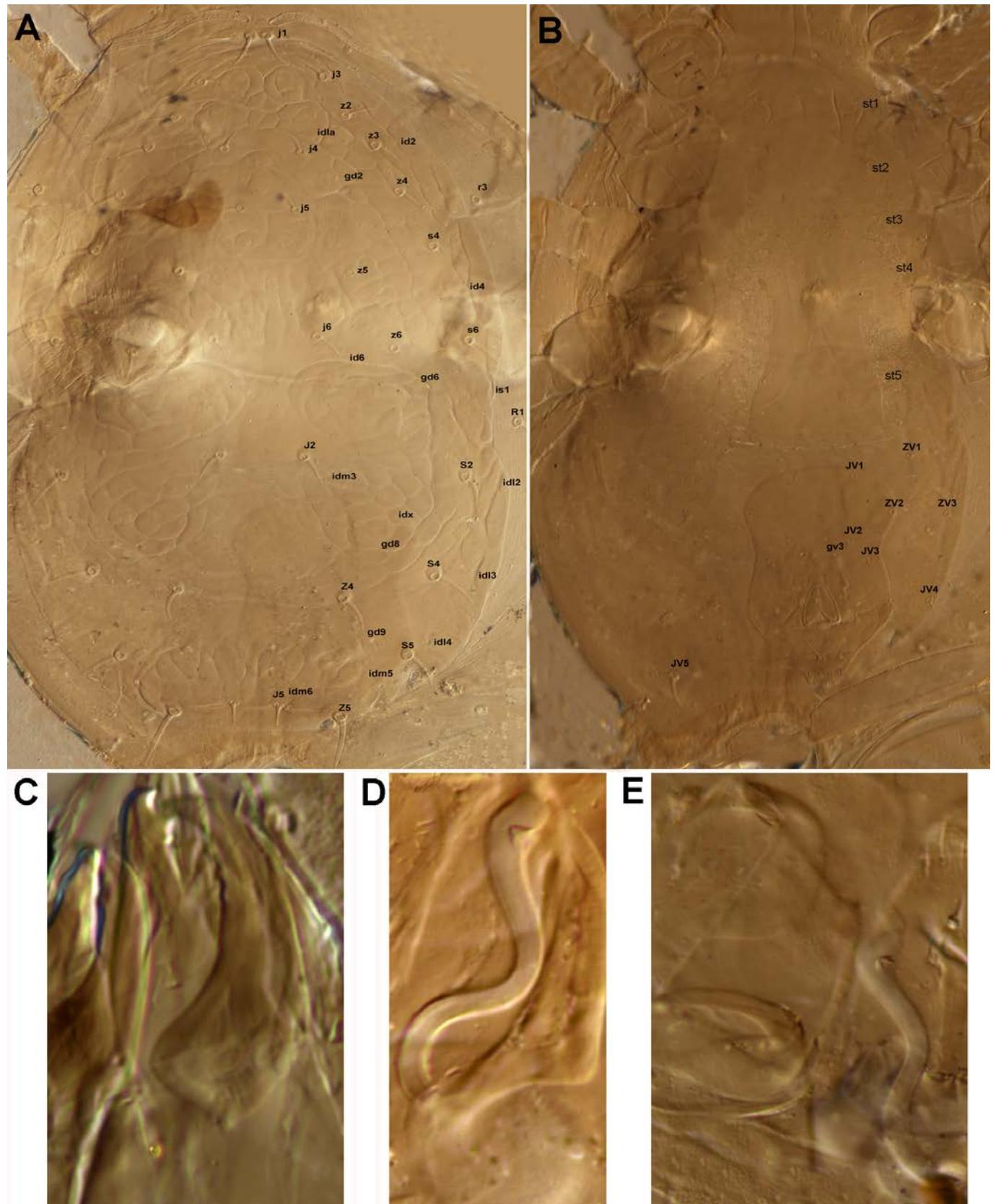
**ADULT MALE.** Unknown.

### **Material examined**

Holotype female, Hubei: Shiyan, Shennongjia National Nature Reserve, *Pinus massoniana*, 15.VIII.1981, collected by Wei-nan Wu and Zhao-quan Li. Paratype: 1 female, same data



**Figure 1** *Kuzinellus cervix* Wu and Li, 1984 (female). A – Dorsal idiosoma; B – Ventral idiosoma; C – Chelicera; D – Insemination apparatus; E – Legs.



**Figure 2** *Kuzinellus cervix* Wu and Li, 1984 (female). A – Dorsal idiosoma; B – Ventral idiosoma; C – Chelicerae; D & E – Insemination apparatus.

as holotype. Both specimens are deposited at the Guangdong Institute of Applied Biological Resources, Guangdong, China.

## Distribution

China: Fujian (Wu, 1985; Zhang and Lin, 1987), Hubei (Wu and Li, 1984), Hunan (Wu and Lan, 1992), Jiangxi (Hou, 1996).

## Habitat

*Fragaria × ananassa* (Hou, 1996), *Hyllostachys heterocycla* (Zhang and Lin, 1987), *Pinus massoniana* (Wu and Li, 1984; Wu, 1985).

## Remarks

In their original description Wu and Li (1984) miscounted the number of dorsal setae, overlooked  $z_6$  and incorrectly illustrated the sternal shield. Wu *et al.* (1997) corrected these mistakes. In 2009 Wu *et al.* transferred this species from *Typhlodromus (Anthoseius)* to *Kuzinellus*. We herein confirm their corrections and changes. Apart from these we have noted and illustrated the following characters which were not presented in the original and subsequent publications (Wu and Li, 1984; Wu *et al.*, 1997; 2009): lyrifissures, gland openings and muscle marks on idiosoma; atrium, major and minor ducts of insemination apparatus, and legs I–III. The second tooth of the fixed digit of chelicera is very small and situated next to the apical tooth. The margins of the platelets bearing  $st_4$  and  $iv_2$  were not discernible in the long preserved specimens. This species was originally described as *Typhlodromus (Anthoseius) cervix* and listed as such in the catalog of Moraes *et al.* (1986) and in the Phytoseiidae database of Demite *et al.* (2017), which would need to be updated.

## ***Kuzinellus trisetus* (Wu, Lan & Zhang, 1992)**

*Typhlodromus trisetus* Wu *et al.*, 1992: 48; Wu *et al.*, 1997: 173.

*Amblydromella (Amblydromella) triseta*; Denmark and Welbourn, 2002: 307.

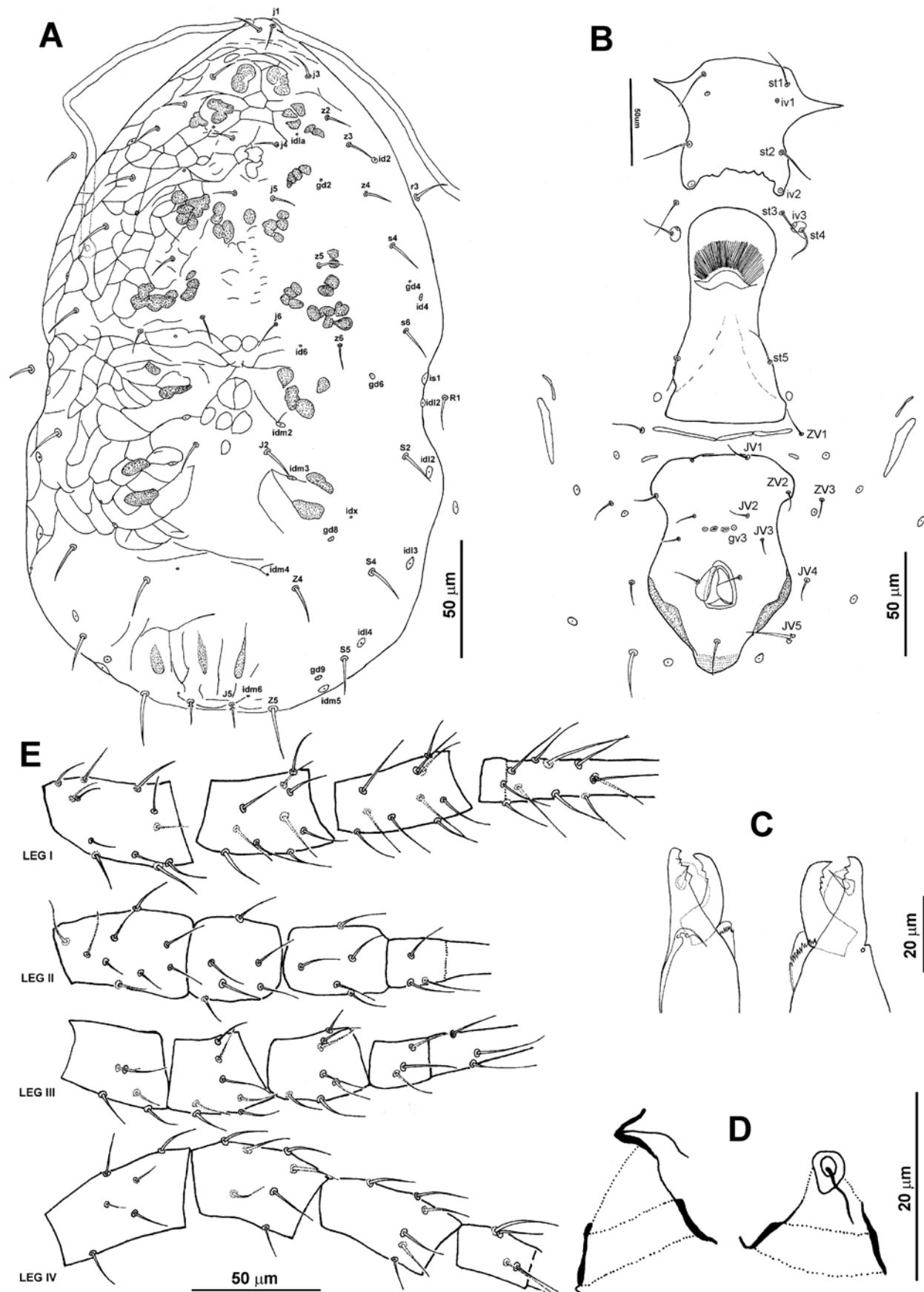
*Kuzinellus trisetus*; Moraes *et al.*, 2004: 274; Wu *et al.*, 2009: 331.

## Redescription

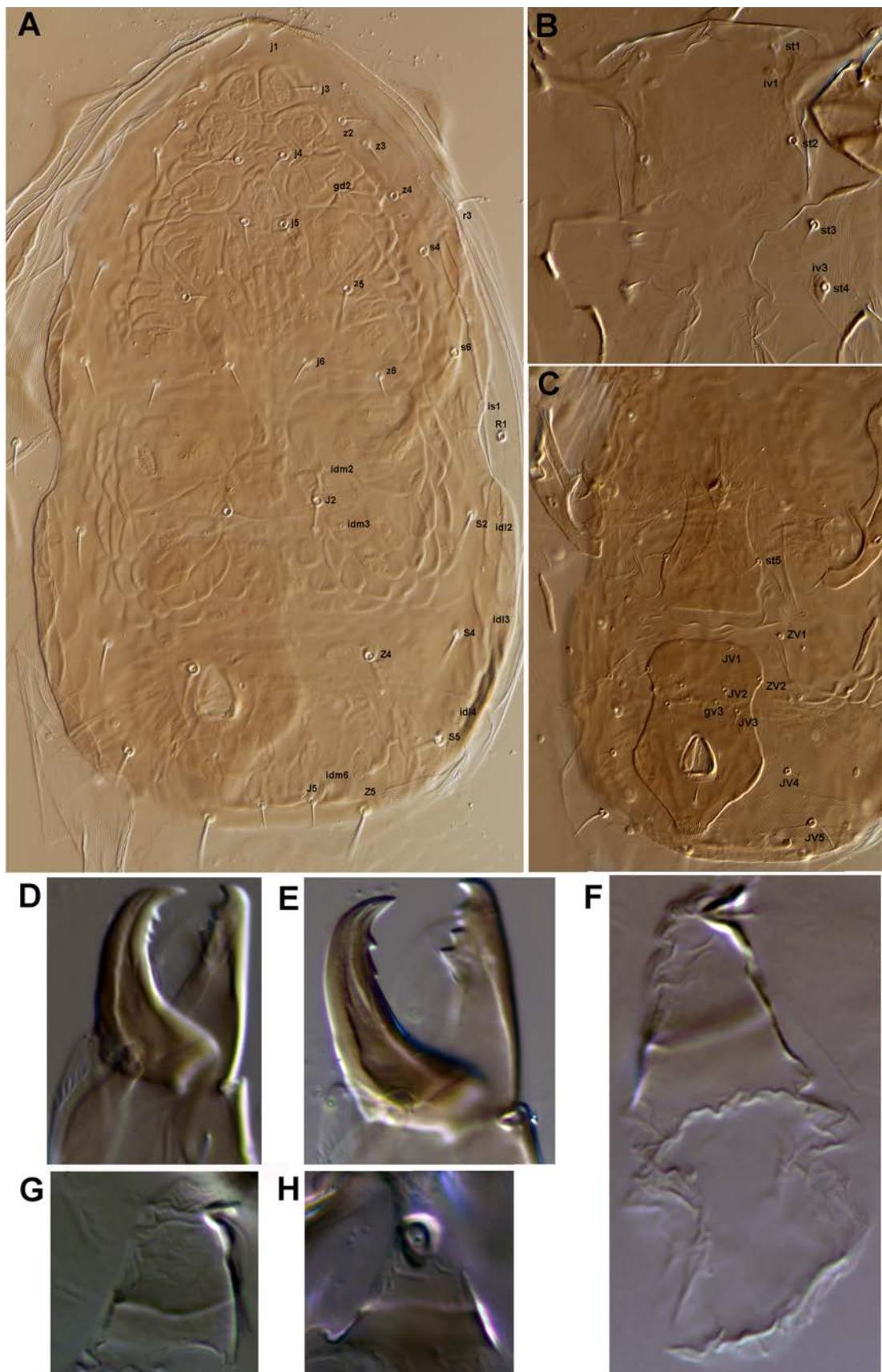
### ADULT FEMALE (n=5).

Dorsum (Figures 3A, 4A)—Dorsal shield nearly oval, incised at level of  $R_1$ ; 399 (390–414) long, greatest width 221 (211–228), 208–218 wide, reticulate throughout except area between  $Z_4$  and  $S_5$ ; all setae smooth except  $Z_5$  (barbed). Dorsal shield with 14 pairs of discernible lyrifissures ( $id_{1a}$ ,  $id_2$ ,  $id_4$ ,  $id_6$ ,  $idm_2$ ,  $idm_3$ ,  $idm_4$ ,  $idm_5$ ,  $idm_6$ ,  $idx$ ,  $is_1$ ,  $idl_2$ ,  $idl_3$  and  $idl_4$ ) and 6 pairs of solenostomes ( $gd_2$ ,  $gd_4$ ,  $gd_6$ ,  $gd_8$  and  $gd_9$ ). Muscle marks discernible, mainly on dorsal shield between dorsal setae and median setae, and anterior to  $J_5$ . Lateral setae  $r_3$  and  $R_1$  smooth, on soft membranous cuticle laterad of dorsal shield,  $r_3$  at level between  $z_4$  and  $s_4$ ,  $R_1$  at level of shield incisions. Peritremes extending forward to bases of  $j_1$ . Lengths of setae:  $j_1$  18 (16–22),  $j_3$  16 (14–17),  $j_4$  14 (12–15),  $j_5$  13 (12–14),  $j_6$  14 (13–15),  $z_2$  15 (13–17),  $z_3$  16 (16–18),  $z_4$  17 (16–18),  $z_5$  15 (13–18),  $z_6$  15 (13–16),  $s_4$  18 (15–20),  $s_6$  21 (20–21),  $J_2$  19 (17–20),  $J_5$  12 (11–13),  $Z_4$  21 (20–23),  $Z_5$  27(25–30),  $S_2$  20 (20–22),  $S_4$  21 (19–24),  $S_5$  19 (18–20),  $r_3$  19 (17–21),  $R_1$  18 (17–20).

Ventral idiosoma (Figures 3B, 4B, 4C)—Sternal shield approximately as long as wide, 60 (57–65) long, 59 (56–62) wide, smooth, anterior margin straight, posterior margin have 2 corners, posterior margin medially smooth or zigzagged, bearing 2 pairs of attenuate setae ( $st_1$ ,  $st_2$ ) and 2 pair of lyrifissures ( $iv_1$ ,  $iv_2$ ),  $iv_1$  close to  $st_1$ ,  $iv_2$  at corners of posterior margin; setae  $st_3$  and  $st_4$  on membranous cuticle. Genital shield smooth, 128 (124–132) long, 60 (54–62) wide. Lengths of setae:  $st_1$  23 (20–24),  $st_2$  21 (20–21),  $st_3$  21 (18–23),  $st_4$  20 (16–21),  $st_5$  22 (21–23). A series of slender transversal sclerites present between genital and ventrianal



**Figure 3** *Kuzinellus trisetus* (Wu, Lan and Zhang, 1992) (female). A – Dorasli idiosoma; B – Ventral idiosima; C – Chelicerae; D – Insemination apparatus; E – Legs.



**Figure 4** *Kuzinellus trisetus* (Wu, Lan and Zhang, 1992) (female). A – Dorsal idiosoma; B – Sternal shield; C – Epigynal shield and ventrianal shield; D & E – Chelicerae; F, G & H – Insemination apparatus.

shields, a pair of small plates present between *ZV1* and *ZV2*. Ventrianal shield (Plate 1C) approximately pentagonal, smooth, anterior margin convex, with a prominent waist at level of *JV2*, 125 (122–130) long, 76 (64–80) wide, bearing 4 pairs of pre-anal setae (*JV1*, *JV2*, *JV3* and *ZV2*) and a pair of pores (*gv3*) posteromedial to *JV2*, distance *gv3-gv3* 21 (18–25), 4 pairs of setae (*ZV1*, *ZV3*, *JV4* and *JV5*) and 3 pairs of lyrifissures on soft cuticle surrounding ventrianal shield. Primary metapodal plate 39 (36–42) long, 5 (4–7) wide, the secondary plate 14 (13–15) long, 2 (2–3) wide.

Calyx of insemination apparatus (Figures 3D, 4F, 4G, 4H) U- or V-shaped with basal 1/2 to 2/3 membranous and thin, and apical 1/3 to 1/2 thick.

Gnathosoma — Chelicera (Figures 3C, 4D, 4E) with movable digit 25 (24–26) long, bearing 2 or 3 teeth, fixed digit 27 (25–28) long, bearing 3 discernible teeth, *pilus dentilis* thorn-shaped, 8 (6–9) long, opposing distal tooth of movable digit.

Leg lengths (I–IV): 356 (341–371), 290 (287–305), 298 (290–301), 390 (380–402). All legs without obvious macrosetae (Figure 3E).

**ADULT MALE.** Unknown.

### **Material examined**

Holotype female, 10 paratype females, Qianshan, Liaoning, ex *Larix* sp. 24.VII.1984, collected by Wei-nan Wu; 3 females, Ningwu, Luyashan National Nature Reserve, 38°44'34" N, 111°55'10" E, 2491 m, ex *Pinus* sp., 7.IX.2014, collected by Bing-Qian Su and Meng-Jiao Yin (accession no.: T14\_0268); 1 female, Huguan, Taihang Mountains Grand Canyon, Purple Mass of Mountain, 35°54'47" N, 113°29'44" E, 1446 m, ex *Viburnum mongolicum*, 6.X.2014, collected by Min Ma (T14\_0346); 1 female, same data as T14\_0346 except: 35°54'47" N, 113°29'44" E, 1454 m, *Spiraea trilobata*, 7.X.2014, (T14\_0347); 11 females, same data as T14\_0268 except: Jiaocheng, Pangquangou National Nature Reserve, 37°49'35" N, 111°27'56" E, 1793 m, 28.VIII.2014, (T14\_0191).

Holotype and paratypes are deposited in Guangdong Institute of Applied Biological Resources, Guangdong, China. Specimens collected from Shanxi are deposited in the Insect Ecology Laboratory, College of Agronomy, Shanxi Agriculture University, Taigu, China.

### **Distribution**

China: Henan (Lin *et al.*, 2010), Liaoning (Wu *et al.*, 1992), Shanxi (present paper).

### **Habitat**

Fern, *Dianthus* sp. (Lin *et al.*, 2010); *Larix* sp. (Wu *et al.*, 1992); *Pinus* sp.; *Spiraea trilobata*, *Viburnum mongolicum* (present paper).

### **Remarks**

This is the first report of *Kuzinellus trisetus* in Shanxi province. We have noted and illustrated the following characters which were not presented in the original publication (Wu *et al.*, 1992): lyrifissures, gland openings and muscle marks on idiosoma, and legs I–III. The detailed structure of the insemination apparatus is given to show the unevenness of the calyx. The number of teeth on the movable digit is variable, from two to three. The apical tooth on the fixed digit is sometimes bifurcate. The areas around *st4* and *iv2* were not discernible in the long preserved specimens.

### **Key to species of *Kuzinellus* Wainstein in China (female)**

1. Spermatheca with calyx elongate and tubular, uniformly sclerotized (Fig. 1D) .....  
..... *Kuzinellus cervix* (Wu and Li, 1984)
- Spermatheca with calyx short, U- or V-shaped, with basal 1/2 to 2/3 membranous (Fig. 2D)  
..... *Kuzinellus trisetus* (Wu, Lan and Zhang, 1992)

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