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To cite this version:
Min Ma, Qing-Hai Fan, Sheng-Cai Li. Kuzinellus (Acari: Phytoseiidae) from China. Acarologia, Acarologia, 2018, 58 (4), pp.786-794. 10.24349/acarologia/20184274. hal-01871202

HAL Id: hal-01871202
https://hal.archives-ouvertes.fr/hal-01871202
Submitted on 10 Sep 2018

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Previous volumes (2010-2016): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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Kuzinellus (Acari: Phytoseiidae) from China

Min Ma\textsuperscript{a}, Qing-Hai Fan\textsuperscript{b}, Sheng-Cai Li\textsuperscript{a}

\textsuperscript{a} College of Agronomy, Shanxi Agriculture University, Taigu, China.
\textsuperscript{b} Plant Health & Environment Laboratory, Ministry for Primary Industries, Auckland, New Zealand.

**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

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**Introduction**

As a family of valuable beneficial predators Phytoseiidae has received an increasing attention in the last three decades (Helle and Sabelis, 1985; Lindquist \textit{et al}., 1996; McMurtry and Croft, 1997; Sabelis and Van Rijn, 1997; Gerson \textit{et al}., 2003; Moraes \textit{et al}., 2004). To date more than 2,750 species have been described (Demite \textit{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 \textit{et al}., 2017; Kamran \textit{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 \textit{et al}., 1992) from Liaoning province. *Kuzinellus cervix* was subsequently found in Fujian, Hunan and Jiangxi (Wu \textit{et al}., 2009) but there was no record of *K. trisetus* from other provincial areas of the country. During a survey of phytoseid 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 \textit{et al}. (2016). All measurements are given in micrometers (μm). 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.
Diagnosis — Dorsal idiosomal setal patterns 13A:8A, with 19 pairs of setae on the dorsal shield. Setae z6 and JV2 present, Z1 absent. Ventrianal shield with 4 pairs of preanal setae. *Kuzinellus* can be distinguished from its closely related *Paraseiulus* Muma by having JV2 present and Z1 absent. It differs from the other genus included in the tribe, *Paraseiulini* Wainstein (*Australiseius* Muma) by having Z1 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 (Paraseius) 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 R1, reticulate throughout except area between S4 and S5; 325 (336) long, 200 (203) wide; all setae smooth except Z5 (barbed), bearing 11 pairs of discernible lyrifissures (id1a, id4, id6, idm3, idm5, idm6, is1, id12, id13, id4 and idx) and 4 pairs of solenostomes (gd2, gd6, gd8 and gd9). Muscle marks discernible, mainly on podosomal areas between z2 and j4, j4 and j5, j5 and z5, s4 and z5, z5 and j6 and j2, S2 and S4, and prior to J5. Lateral setae r3 and R1 smooth, on soft membranous cuticle lateral to dorsal shield, r3 at level of z4, R1 at level of shield incisions. Peritremes extending forward to bases of j1. Lengths of setae: j1 17 (17), j3 16 (17), j4 13 (12), j5 12 (12), j6 14 (14), z2 16 (16), z3 17 (16), z4 18 (19), z5 15 (16), z6 15 (15), s4 17 (19), s6 20 (20), J2 16 (16), J5 11 (12), Z4 19 (18), Z5 27 (29), S2 18 (20), S4 21 (21), S5 19 (21), r3 17 (21), R1 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 (st1, st2) and 2 pairs of lyrifissures (iv1, iv2), iv1 between st1 and st2, iv2 at corners of the posterior margin; setae st3 on soft cuticle, st4 on platelets. Genital shield smooth, 113 (120) long, 58 (60) wide. Lengths of setae: st1 19 (20), st2 13 (12), st3 19 (19), st4 15 (13), st5 11 (18). A thin and long transversal sclerite between genital and ventrianal shields, a pair of small plates between ZV1 and ZV2. Ventrianal shield approximately pentagonal, smooth, anterior margin convex, with prominent waist at JV2 level, 116 (118) long, 75 (76) wide, with 4 pairs of pre-anal setae (JV1, JV2, JV3 and ZV2) and a pair of pores gv3 posteromedial to J12; distance gv3-gv3 18 (18), 4 pairs of setae (ZV1, ZV3, JV4 and JV5) 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 z6 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 st4 and iv2 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 R1; 399 (390–414) long, greatest width 221 (211–228), 208-218 wide, reticulate throughout except area between Z4 and S5; all setae smooth except Z5 (barbed). Dorsal shield with 14 pairs of discernible lyrifissures (id1a, id2, id4, id6, idm2, idm3, idm4, idm5, idx, is1, idl2, idl3 and idl4) and 6 pairs of solenostomes (gd2, gd4, gd6, gd8 and gd9). Muscle marks discernible, mainly on dorsal shield between dorsal setae and median setae, and anterior to J5. Lateral setae r3 and R1 smooth, on soft membranous cuticle laterad of dorsal shield, r3 at level between z4 and s4, R1 at level of shield incisions. Peritremes extending forward to bases of j1. Lengths of setae: j1 18 (16–22), j3 16 (14–17), j4 14 (12–15), j5 13 (12–14), j6 14 (13–15), z2 15 (13–17), z3 16 (16–18), z4 17 (16–18), z5 15 (13–16), z6 15 (13–18), s4 18 (15–20), s6 21 (20–21), J2 19 (17–20), J5 12 (11–13), Z4 21 (20–23), Z5 27(25–30), S2 20 (20–22), S4 21 (19–24), S5 19 (18–20), r3 19 (17–21), R1 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 (st1, st2) and 2 pair of lyrifissures (iv1, iv2), iv1 close to st1, iv2 at corners of posterior margin; setae st3 and st4 on membranous cuticle. Genital shield smooth, 128 (124–132) long, 60 (54–62) wide. Lengths of setae: st1 23 (20–24), st2 21 (20–21), st3 21 (18–23), st4 20 (16–21), st5 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 – Dorasl 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., 27.VIII.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: Jiaocheng, Panguquangu 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 Kuzienllus 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)
Acknowledgements

We would like to thank Dr Zhi-Qiang Zhang (Landcare Research, New Zealand) for his critical comments on a preliminary version of this manuscript. We appreciate Misses Bing-Qian Su and Meng-Jiao Yin for their assistance in the collection of specimens.

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