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Previous volumes (2010-2018): 250 € / year (4 issues)

Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France

ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

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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# A new species and new records of Tetranychidae (Acari: Trombidiformes) from Saudi Arabia, with a key to world species of *Mixonychus* Ryke and Meyer

Eid Muhammad Khan<sup>a</sup>, Muhammad Kamran<sup>a</sup>, Fahad Jaber Alatawi<sup>a</sup>

<sup>a</sup> Acarology Laboratory, Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, 11451, P.O. Box 2460, Riyadh, Saudi Arabia.

## Original research

### ABSTRACT

The spider mite genus *Neotetranychus* Trägårdh is reported for the first time from Saudi Arabia (SA) based on *N. longisetus* n. sp., collected from *Heliotropium arbainense* (Boraginaceae). The new species is described and illustrated from the adult female, and three species, *Mixonychus* (*Bakerina*) *aculus* (Chaudhri), *Paraplonobia* (*Anaplonobia*) *harteni* (Meyer) and *Sonotetranychus daleae* (Tuttle and Baker) (Acari: Tetranychidae) are reported as new to the mite fauna of SA. *Mixonychus* (*B.*) *aculus* (Chaudhri) is re-described and illustrated based on adult female, collected from an exotic mesquite species from Mexico and Caribbean, *Prosopis juliflora* (Sw.) DC. (Fabaceae). Moreover, the species, *Evertella orissaensis* (Prasad) n. comb., is moved from the genus *Mixonychus* Ryke and Meyer to the genus *Evertella* Meyer and *Mixonychus* (*Bakerina*) *ganjuis* (Qian, Yuan and Ma) n. comb., is moved to the subgenus *Bakerina* Chaudhri from the subgenus *Mixonychus*. A key to the world species of the genus *Mixonychus* is also provided. Additionally, legs chaetotaxy of all known species of the genus *Mixonychus* is given.

**Keywords** *aculus*; *Bakerina*; *longisetus*; *Neotetranychus*; re-description; spider mites

**Zoobank** <http://zoobank.org/3302B394-5608-4184-8307-D6F66B951196>

## Introduction

*Mixonychus* Ryke and Meyer and *Neotetranychus* Trägårdh are small spider mite genera consisting of nineteen and ten species, respectively (Migeon and Dorkeld, 2006–2018). The economic importance of these two genera is not known yet.

Ryke and Meyer (1960) erected the genus *Mixonychus* based on type species *Mixonychus acaciae* Ryke and Meyer from South Africa. The genus *Mixonychus* is morphologically close to *Brevinychus* Meyer and *Evertella* Meyer. It can be differentiated from *Brevinychus* by longer empodial claws as compared to the pads of the true claw, whereas in the later empodial claws are short, and about as long as the pads of true claws. *Mixonychus* is different from *Evertella* by having 10 pairs of dorsal body setae as compared to nine pairs setae in latter (Meyer, 1987; Bolland *et al.*, 1998).

Chaudhri (1971) erected the genus *Bakerina* with the following characters states; the dorsal propodosoma medially with reticulations and hysterosoma with broken and irregular striations. Gutierrez (1985) treated *Bakerina* as a subgenus of genus *Mixonychus* and divided *Mixonychus* into three subgenera on the basis of dorsal integument ornamentation, namely *Mixonychus* Ryke and Meyer, *Bakerina* Chaudhri and *Tylonychus* Miller. Species in the subgenus *Mixonychus* have a dorsum with protuberances that form a reticulate pattern (four species); species of the subgenus *Tylonychus* have a striate dorsum with spinules, and lacking

Received 02 December 2018  
Accepted 05 November 2019  
Published 18 November 2019

Corresponding author  
Fahad Jaber Alatawi:  
falatawi@ksu.edu.sa

Academic editor  
Migeon, Alain

DOI  
10.24349/acarologia/20194349

ISSN 0044-586X (print)  
ISSN 2107-7207 (electronic)

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protuberances (four species); and species of the subgenus *Bakerina* have a dorsum with simple striations, lacking protuberances and spinules (eleven species) (Bolland *et al.*, 1998; Migeon and Dorkeld, 2006–2018). Most of the species belonging to the genus *Mixonychus* have been reported from Asia, Africa, Australia and the Americas. Recently, *Mixonychus* (*B.*) *murrayae* (Gao and Ma), *M. (B.) nanchangensis* (Ma and Yuan) and *M. (B.) ganjuis* (Qian, Yuan and Ma), from China, were re-described and illustrated (Yi and Jin, 2017). To date, there is no key for the species of *Mixonychus* in the world.

The genus *Neotetranychus* is characterized by having the empodium split distally, long dorsal body setae set on tubercles, cuticle of the female opisthosoma with varying morphology including patterns of strong striae or clusters of stellate or reticulate protuberances, female with two pairs of pseudoanal setae ( $ps_{1,2}$ ) (Meyer, 1987; Bolland *et al.*, 1998). Not including the new species proposed here, the genus is comprised of ten nominal species, five of them reported from Central or South America (*N. peniculus* Aranda, *N. raphidoseta* Aranda, *N. granifer* Feres and Flechtmann, *N. asper* Feres and Flechtmann, *N. gloriosus* Estebanes and Baker), two from Europe (the type species *N. rubi* Tragardh, and *N. rubicola* Bagdasarian), one species each from Africa (*N. decorus* Meyer and Bolland), Australia (*N. victoriae* Davis) and Thailand (*N. lek* Flechtmann). A key to the all previously known species of *Neotetranychus* was provided by Flechtmann (2013).

Thirty tetranychid mite species belonging to twelve genera have been reported previously from SA (Alatawi and Kamran, 2018; Kamran *et al.*, 2018). In the present study two genera; *Mixonychus* (*Bakerina* Chaudhri), and *Neotetranychus* Trägårdh, also three species *M. (B.) aculus* (Chaudhri), *Paraplombia* (*Anaplombia*) *harteni* (Meyer) and *Sonotetranychus daleae* (Tuttle and Baker) are recorded for the first time from SA. *Neotetranychus longisetus* **n. sp.**, is described and illustrated based on adult females collected from a native species of *Heliotropium arbainense* (Boraginaceae). In addition, *Mixonychus* (*B.*) *aculus* (Chaudhri), is re-described and illustrated based on specimens collected from an exotic mesquite species (native to Mexico, South America and the Caribbean), *Prosopis juliflora* (Sw.) DC. (Fabaceae). *Evertella orissaensis* (Prasad) is **n. comb.**, transferred from *Mixonychus* to the genus *Evertella* Meyer as opisthosomal setae *fl* absent, and *Mixonychus* (*B.*) *ganjuis* (Qian, Yuan and Ma) **n. comb.**, is moved to the subgenus *Bakerina* (from subgenus *Mixonychus*) as it lacks clusters of protuberances on the dorsal integument. A key and details of the legs chaetotaxy, is provided for the world species of the genus *Mixonychus*.

## Materials and methods

Spider mites were collected from a diversity of host plants in different localities across Saudi Arabia during 2016–2018. The mite specimens were collected by shaking the aerial parts over a piece of white paper. The mites moving on paper were collected with the help of camel hair brush and preserved in small vials containing 70% ethanol, then mounted in Hoyer's medium under a stereomicroscope (SZX10, Olympus®, Tokyo, Japan). The specimens were examined and identified under a phase contrast microscope (BX51, Olympus®, Japan) using diagnostic keys and available literature. Different mite body parts were imaged using an auto-montage software system (Syncroscopy, Cambridge, UK) attached with phase contrast microscope (DM2500, Leica®, Germany) and then drawn with Adobe Illustrator (Adobe System Inc., San Jose, CA, USA). All measurements are given in micrometers (µm). The morphological terminology used in this study followed Lindquist (1985). Legs setal counts are presented as the number of tactile setae followed by the number of solenidia and eupathidia in parentheses. The body measurements are presented for the holotype followed by the range for the paratypes in parentheses when types were examined. All collected specimens, including type specimens of the new species have been deposited at King Saud University Museum of Arthropods (KSMA, Acarology section), Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.

## Results

### Family Tetranychidae Donnadieu

### Subfamily Tetranychinae Berlese

### Tribe Tetranychini Reck

### Genus *Neotetranychus* Trägårdh

Type species: *Neotetranychus rubi* Trägårdh, 1915: 33.

**Diagnosis** — Based on the Pritchard and Baker (1955) and Meyer, 1987.

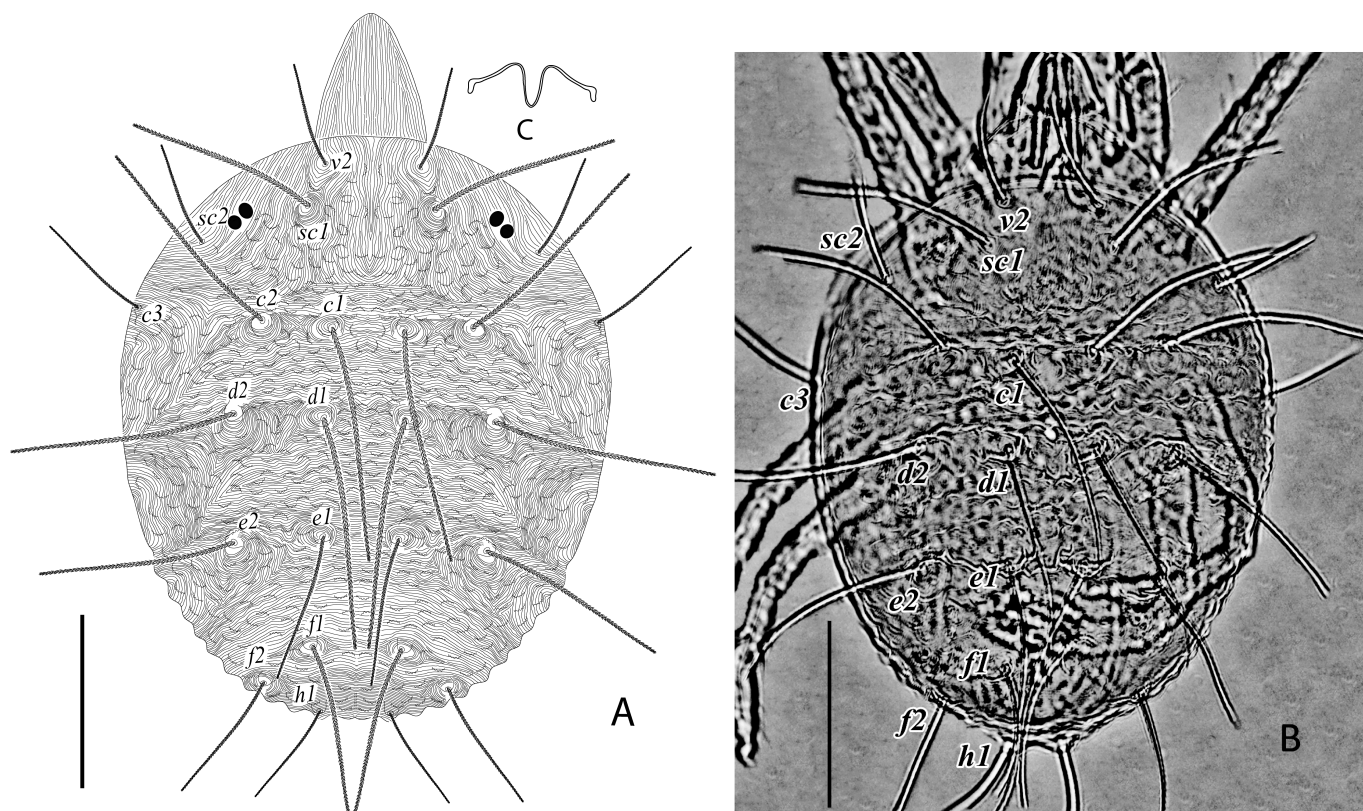
Female: Dorsal body setae long and set on strong tubercles; opisthosomal integument mostly with transverse striae, wrinkled or reticulated clusters; legs empodia curved, uncinata and undivided along most of its length, with distal tip divided into pairs of fine hairs; two pairs of pseudoanal setae ( $ps_{1-2}$ ).

### *Neotetranychus longisetus* n. sp.

(Figures 1–4)

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**Diagnosis** (Based on adult female) — Propodosoma medially with longitudinal striae; hysterosoma medially with transverse striae and laterally with longitudinal to oblique striae; striae encircling bases of each dorsal seta, forming concentric rings; cuticle with rows of regular, shallow, scallop-shaped projections; dorsal body setae acicular, of even thickness along length, finely serrated, inserted on distinct tubercle; most of the dorsal setae twice as long as



**Figure 1** *Neotetranychus longisetus* n. sp., adult female: A, B – Dorsum; C – Peritremes. Scalebar A, B = 100 μm.

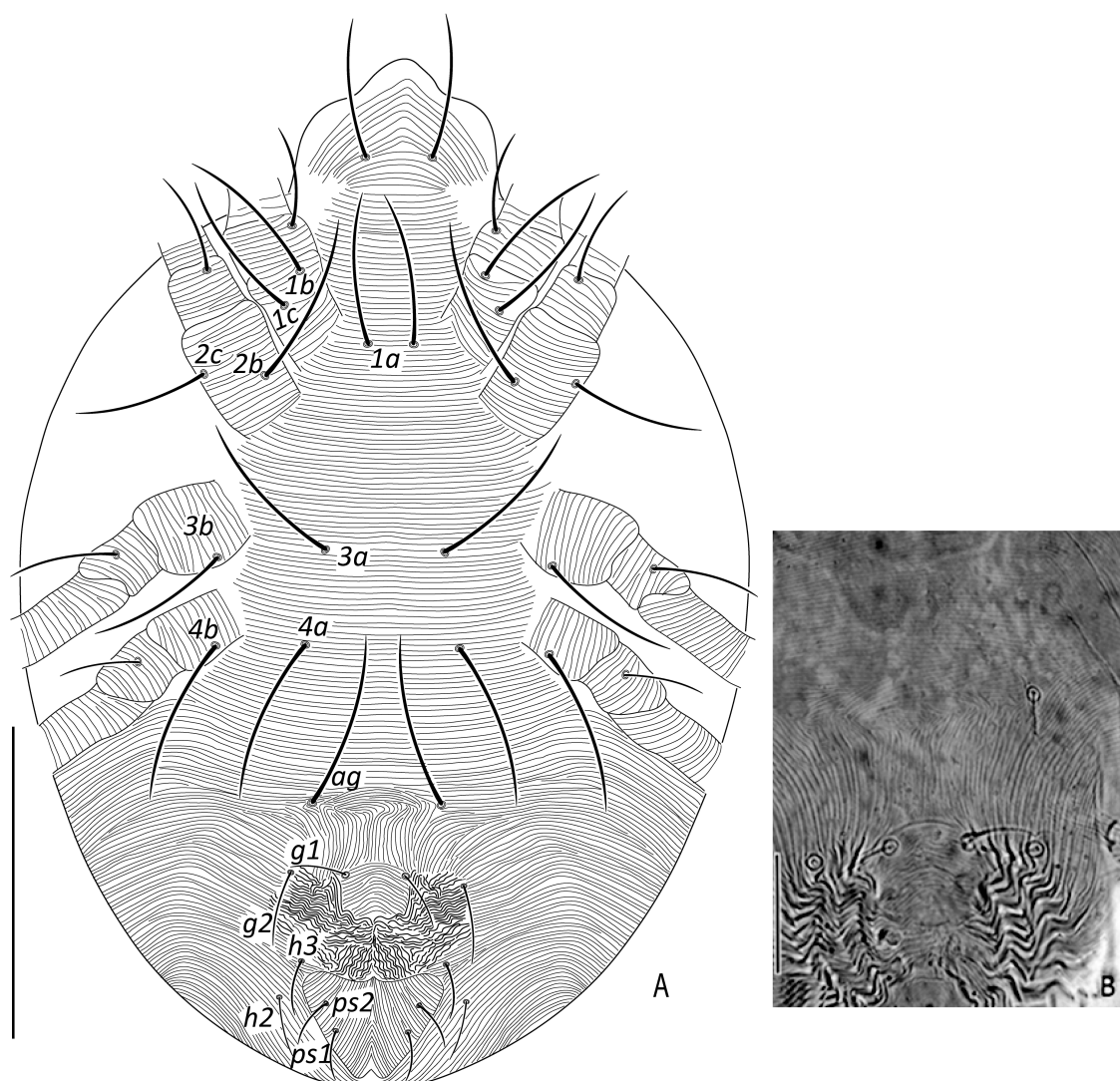


the distance to base of setae next consecutive row, dorsocentral setal pairs *c1*, *d1*, *e1* and *f1* subequal distance apart.

#### Description of the Adult female (n = 12)

Length of idiosoma (excluding gnathosoma) 331 (315–345), (including gnathosoma) 404 (390–420), maximum width at the level of row *c* setae 263 (255–270).

**Dorsum** (Figures 1A-C) — Dorsal integument entirely striated, striae longitudinal on propodosoma, striae transverse medially and longitudinal to oblique laterally on hysterosoma; cuticle with rows of regular, shallow, scallop-shaped projections (Figures 1A-B); dorsum with 13 pairs of setae; seta *c3* inserted at lateral margin of body, often situated ventrally; setae *v2*, *sc2*, *c3* and *h1* shorter than other dorsal setae, almost equal in length; dorsocentral setal pairs *c1*, *d1*, *e1* and *f1* subequal distance apart. Length of dorsal setae: *v2* 63 (60–65), *sc1* 110 (107–114), *sc2* 63 (60–65), *c1* 142 (135–148), *c2* 126 (120–130), *c3* 65 (62–68), *d1* 142 (138–150), *d2* 129 (120–135), *e1* 89 (84–93), *e2* 123 (120–128), *f1* 105 (100–120), *f2* 84 (80–90), *h1* 63 (60–68); distance between dorsal setae: *v2*–*v2* 53 (50–55), *sc1*–*sc1* 68 (65–70), *sc2*–*sc2* 205 (200–210), *c1*–*c1* 42 (39–43), *c2*–*c2* 126 (120–135), *c3*–*c3* 263 (250–280), *d1*–*d1* 42 (39–45), *d2*–*d2* 147 (140–155), *e1*–*e1* 37 (35–42), *e2*–*e2* 131 (127–140), *f1*–*f1* 37 (35–40),



**Figure 2** *Neotetranychus longisetus*. n. sp., adult female: A – Venter; B – Genital area. Scalebar A, B = 100  $\mu$ m.

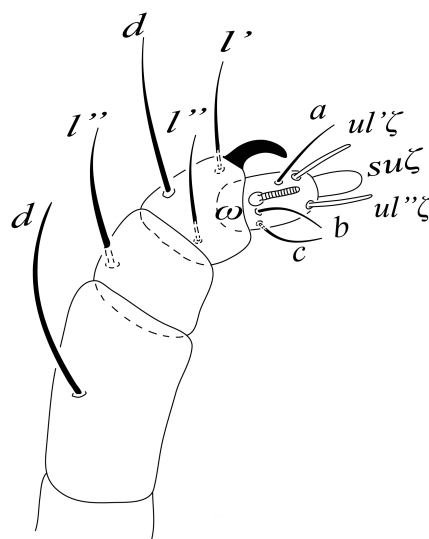
*f2-f2* 108 (104–115), *h1-h1* 27 (25–30), *v2-sc1* 23 (21–25), *sc1-sc2* 63 (60–65), *sc2-c3* 74 (70–80), *sc2-c2* 53 (50–58), *sc2-c1* 84 (81–90), *c1-c2* 42 (38–45), *c2-c3* 71 (68–74), *c1-d1* 54 (50–58), *c2-d2* 58 (56–61), *d1-e1* 68 (66–72), *d2-e2* 68 (65–74), *e1-f1* 58 (53–60), *e2-f2* 74 (72–78), *f1-h1* 42 (39–45), *f2-h1* 55 (52–58), *h2* 21 (19–22), *h3* 26 (24–28), *h2-h2* 25 (23–26), *h3-h3* 45 (40–45).

**Venter** (Figures 2A–B) — Ventral idiosoma with transverse striations from setae *1a* to just anterior to *ag*, pregenital area with transverse to arching striation (Figure 2B); striations on venter without lobes. Length of ventral setae: *1a* 53 (51–55), *3a* 55 (52–58), *4a* 53 (50–55), *1b* 63 (60–65), *1c* 53 (51–56), *2b* 58 (55–60), *2c* 42 (39–44), *3b* 50 (50–52), *4b* 53 (50–55); distance between inter-coxal and coxae setae: *1a-1a* 26 (25–28), *1b-1c* 11 (10–12), *3a-3a* 53 (50–55), *4a-4a* 63 (60–65); aggenital setae: *ag* 55 (53–57), *ag-ag* 62 (60–65); two pairs of genital setae: *g1* 27 (25–29), *g2* 32 (31–34), *g1-g1* 26 (23–28), *g2-g2* 70 (65–74); two pairs of pseudoanal setae: *ps1* 16 (15–18), *ps2* 15 (13–16), *ps1-ps2* 6 (5–7), *ps1-ps1* 32 (30–35), *ps2-ps2* 21 (20–23).

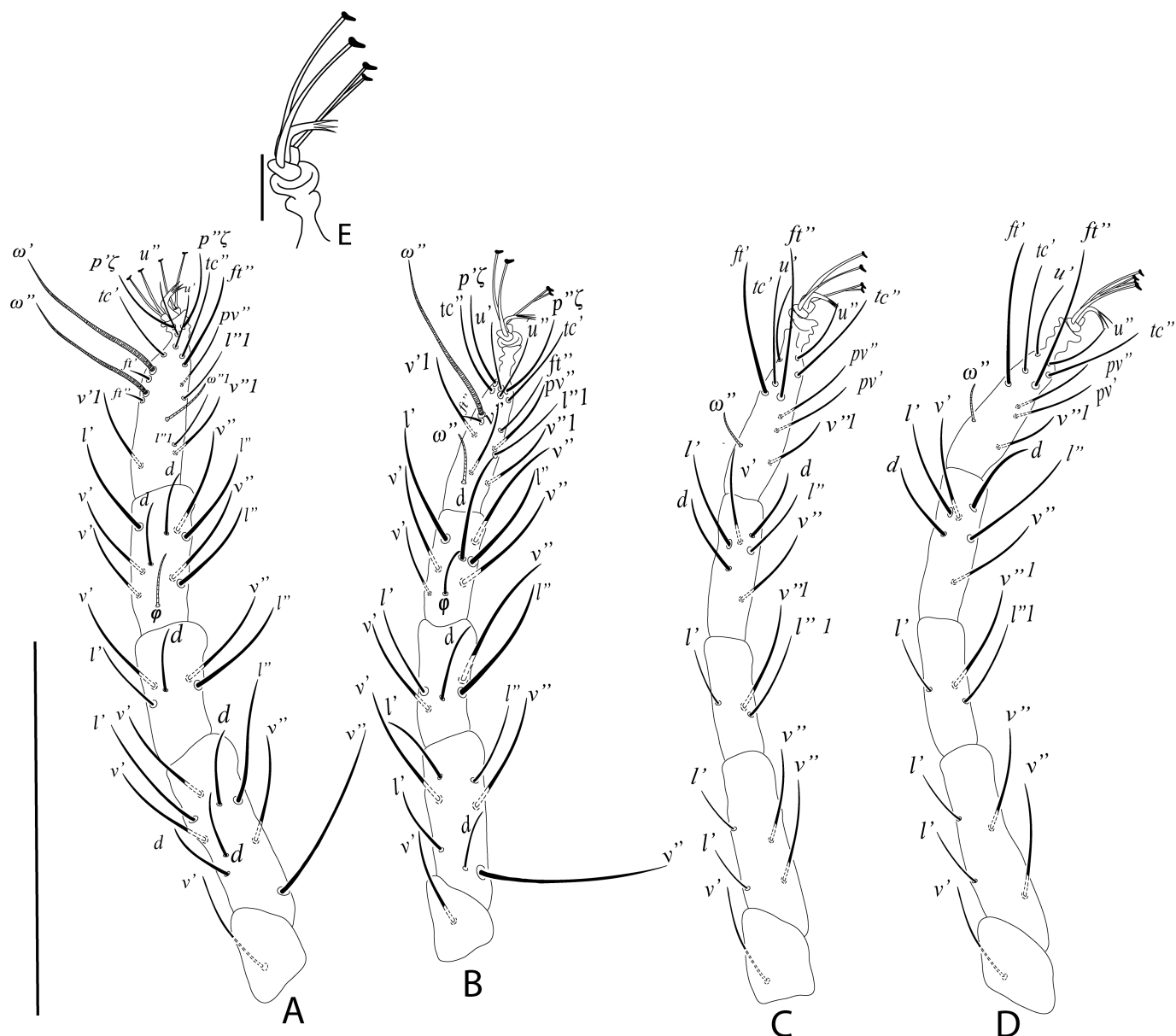
**Gnathosoma** (Figure 3) — Ventral infracapitular setae *m* 50 (48–53), *m-m* 35 (33–37). Palp femur and genu each with one seta, *d* 28 (26–29), *l'* 18 (16–19); palp tibia with three setae, *d* 22 (19–22), *l''* 16 (15–18), *l'* 15 (15–16) and a palp tibial claw; palp tarsus 14 long, 11 wide, with three simple setae *a* 10 (9–11), *b* 7 (7–9), *c* 8 (7–10), three eupathidia *suζ* 7 (6), *ul''ζ* = *ul'ζ* 6 (5–7), a solenidion *ω* 5 long; stylophore with weak anterior notch; peritremes terminating in short hook, like a golf-club (Figure 1C); terminal sensillum of palp tarsus conical, long, pointed about three times as long as wide (Figure 3).

**Legs** (Figures 4A–E) — Length of legs I–IV (without coxae): 184 (175–190), 173 (165–180), 191 (184–199), 200 (190–210) respectively; leg I 184 (175–190): trochanter 16 (14–17), femur 58 (55–61), genu 37 (35–38), tibia 37 (35–40), tarsus 37 (35–42); leg II 173 (165–180): trochanter 16 (15–17), femur 53 (51–58), genu 37 (34–39), tibia 42 (39–45), tarsus 42 (38–44); leg III 191 (184–199): trochanter 24 (23–26), femur 47 (45–49), genu 34 (31–36), tibia 42 (40–45), tarsus 42 (40–45); leg IV 200 (190–210): trochanter 21 (20–22), femur 47 (43–50), genu 37 (35–39), tibia 42 (40–45), tarsi 53 (50–55). Chaetotaxy on legs I–IV (solenidia in parentheses): coxae 2–1–1–1, trochanter 1–1–1–1; femora 9–7–4–4; genua 5–5–3–3; tibiae 9(1ω)–7(1ω)–6–6; tarsi 11(3ζ, 2ω)–9 (3ζ, 2ω)–8(1ω)–8(1ω).

**Male and immature stages** Unknown.



**Figure 3** *Neotetranychus longisetus*. n. sp., adult female: Palp. Scalebar = 50 μm.



**Figure 4** *Neotetranychus longisetus* n. sp., adult female: A – Leg I; B – Leg II; C – Leg III; D – Leg IV; E – Leg I Empodium. Scalebar A-D = 100  $\mu$ m, E = 10  $\mu$ m.

**Etymology** — The specific epithet refers to the length of dorsocentral setae which are comparatively longer than that of other species.

**Material examined** — Holotype female and 11 paratypes females, *Heliotropium arabianense* (Boraginaceae), Taif, 21°21.151'N, 040°19.515'E, elevation 1843 m, 11 September 2017, coll. E. M. Khan and M. U. Rehman. One Holotype female (KSMA-ARL-19/5) and 11 paratypes female (KSMA-ARL-19/6-16) has been deposited at King Saud University Museum of Arthropods (KSMA, Acarology section), Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.

**Remarks** — *Neotetranychus longisetus* n. sp., is different from all other species of *Neotetranychus* by entire dorsum striated and with scallop-shaped structures. However, the new species resembles *N. lek* Flechtmann 2013. *Neotetranychus lek* has longitudinal striae between opisthosomal setae *e1-e1* vs. transverse striae on *N. longisetus* n. sp., femur and genu

III each 4 setae vs. 4 and 3 on *N. longisetus* and femur and genu IV each with 3 setae vs. 4 and 3 setae on *N. longisetus* **n. sp.**.

## New records for Saudi Arabia

### Genus *Mixonychus* Ryke and Meyer

#### *Mixonychus* (*Bakerina*) *aculus* (Chaudhri)

*Bakerina aculus* Chaudhri, 1971: 197–199.

#### Re-description of adult female (n = 6)

(Figures 5–8)

Idiosoma oval—Length of body (excluding gnathosoma) 340–353, (including gnathosoma) 407–428, width of idiosoma at the level of setae *c* series 202–215.

**Dorsum** (Figures 5A–C) — Prodorsum bearing 3 pairs of lanceolate, finely barbed setae with blunt tips (*v2*, *sc1*, *sc2*). Propodosoma dorsomedially with lobed striae forming a strong reticulate pattern medially, with longitudinal laterally. Hysterosoma with 10 pairs of setae (*c1*–3, *d1*–2, *e1*–2, *f1*–2, *h1*), similar in shape to prodorsal setae. Opisthosoma medially with widely separated, lobed, transverse striae, laterally longitudinal to irregular. Dorsal idiosomal setae narrowly lanceolate, finely barbed (Figure 5C), just reaching the bases of setae next consecutive row, except setae *c1* slightly shorter than distance to next setal row. Striae with irregularly shaped lobes. Length of dorsal body setae: *v2* 38–43, *sc1* 49–53, *sc2* 36–42, *c1* 37–46, *c2* 41–47, *c3* 40–45, *d1* 40–46, *d2* 44–50, *e1* 44–49, *e2* 49–53, *f1* 47–52, *f2* 38–41, *h1* 44–48; distance between dorsal setae: *v2*–*v2* 48–53, *sc1*–*sc1* 60–65, *sc2*–*sc2* 135–145, *v2*–*sc1* 20–22, *c1*–*c1* 50–53, *c2*–*c2* 95–100, *c3*–*c3* 178–190, *d1*–*d1* 42–46, *d2*–*d2* 106–117, *e1*–*e1* 33–39, *e2*–*e2* 92–99, *f1*–*f1* 44–47, *f2*–*f2* 70–77, *h1*–*h1* 15–16, *v2*–*sc1* 20–25, *sc1*–*sc2* 60–65, *sc2*–*c3* 50–56, *sc2*–*c2* 40–47, *sc2*–*c1* 53–59, *c1*–*c2* 19–23, *c2*–*c3* 48–54, *c3*–*d2* 51–55, *c1*–*d1* 49–52, *c2*–*d2* 54–59, *d1*–*e1* 45–50, *d1*–*d2* 31–35, *d2*–*e2* 49–53, *d2*–*e1* 46–50, *e1*–*f1* 46–53, *e1*–*e2* 32–36, *e2*–*f2* 62–68, *f1*–*h1* 40–47, *f1*–*f2* 25–27, *f2*–*h1* 33–38.

**Venter** (Figure 6) — Idiosoma ventrally with transverse striations from setae *1a* to *4a*, oblique or longitudinal in pre-genital area; striations on venter without lobes; length of inter-coxal and coxae setae, setae on coxae III and IV are serrate: *1a* 43–47, *3a* 41–44, *4a* 31–34, *1b* 51–55, *1c* 33–37, *2b* 41–46, *2c* 19–23, *3b* 27–30, *4b* 30–34; distance between inter-coxal and coxae setae: *1a*–*1a* 31–35, *1b*–*1c* 10–12, *2b*–*2c* 18–20, *3a*–*3a* 50–55, *4a*–*4a* 60–65, *1a*–*3a* 81–88, *3a*–*4a* 40–45, *4a*–*ag* 47–52; aggenital setae: *ag* 33–37, *ag*–*ag* 42–49; two pairs of genital setae: *g1* 27–31, *g2* 24–26, *g1*–*g1* 28–30, *g2*–*g2* 46–53, *g1*–*g2* 14–16, *ag*–*g1* 20–22, *ag*–*g2* 27–29; two pairs of anal setae: *ps1* 11–13, *ps2* 10–12, *ps1*–*ps2* 11–13, *ps1*–*ps1* 15–17, *ps2*–*ps2* 16–18; para anal setae two pairs: *h2* 15–17, *h3* 16–18, *h2*–*h2* 10–12, *h2*–*h3* 33–38.

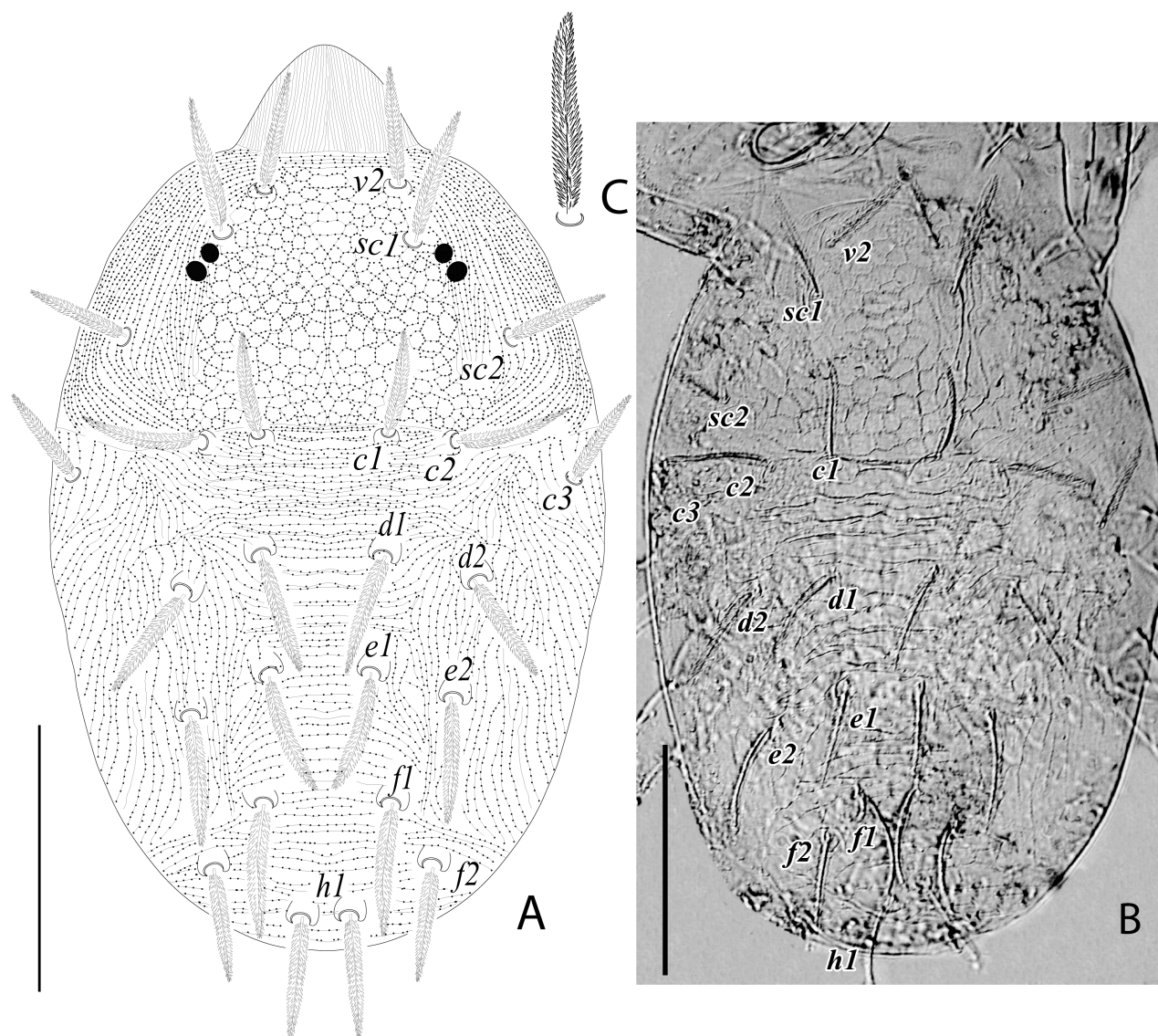
**Gnathosoma** (Figure 7) — Ventral infracapitular setae *m* 35–39, *m*–*m* 19–21. Palp femur and genu each with one seta, *d* 32–35, *l*'' 23–25; palp tibia with three setae, *d* 20–22, *l*' 17–19, *l*' 15–16 and a palp tibial claw; palp tarsus 14 long, 11 wide, with three simple setae *a* 8–10, *b* 9–10, *c* 10–12, three eupathidia *su*ζ 5–6, *ul*''ζ = *ul*'ζ 7–9, a solenidion *ω* 11 long; peritremes terminating in hooked; terminal sensillum of palp tarsus conical, long, pointed about 3 time long as wide to the base.

**Legs** (Figures 8A–D) — Length of legs I–IV (without coxae): 216–230, 165–180, 186–199, 224–240, respectively; leg I: trochanter 13–16, femur 75–83, genu 35–38, tibia 52–55, tarsus 40–45; leg II: trochanter 10–12, femur 55–59, genu 31–34, tibia 30–35, tarsus 38–44; leg III: trochanter 25–28, femur 49–53, genu 31–35, tibia 40–45, tarsus 45–48; leg IV: trochanter 20–22, femur 61–65, genu 35–39, tibia 50–55, tarsi 56–60; legs chaetotaxy on I–IV (solenidia in parenthesis): coxae: 2–2–1–1, trochanter 1–1–1–1; femora 8/7–6–4–4/3; genua 5–5–3–3; tibiae 9(1ω)–7–6–7; tarsus 11(3ζ, 2ω)–9 (3ζ, 2ω)–8(1ω)–8(1ω).

**Male and immature stages** Unknown.

**Material examined** — Four females, *Prosopis juliflora* (Fabaceae) (native to Mexico, South America, and the Caribbean), Alhasa 27°55.0143'N, 047°66.8970'E, 21 April 2018,





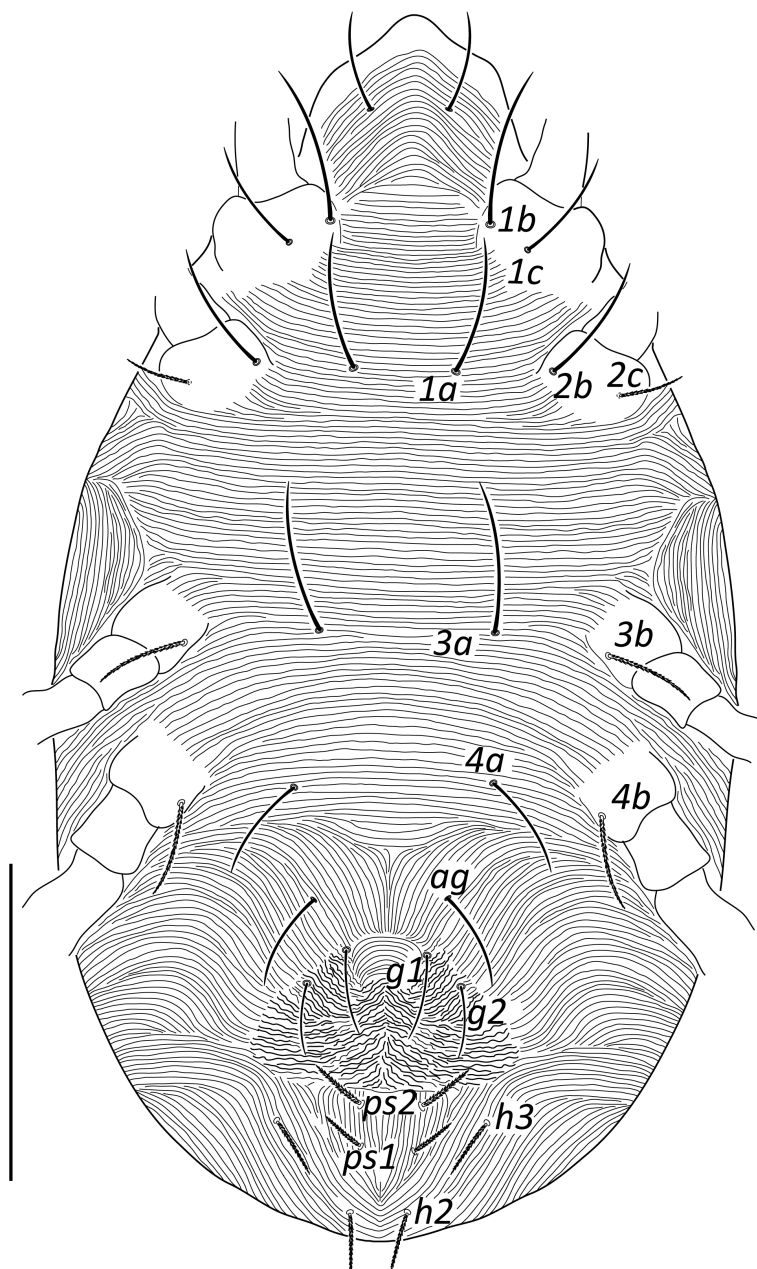
**Figure 5** *Mixonychus (Bakerina) aculus* (Chaudhri), adult female: A, B – Dorsum; C – Dorsal seta. Scalebar A, B = 100  $\mu$ m.

coll. M. Kamran, J. H. Mirza and H. M. Saqib. Four females (KSMA-ARL-19/16-20) have been deposited at King Saud University Museum of Arthropods (KSMA, Acarology section), Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.

**Distribution** — Pakistan (Chaudhri, 1971) and SA in present study.

**Known hosts** — *Senegalia modesta* (syn. *Acacia modesta*, Mimosaceae) (native to India, Pakistan and Afghanistan), *Albizia lebbeck* (paratypes host, Mimosaceae) (native to Indomalay region, Papua New Guinea and northern Australia), *Platyclusus orientalis* (Cupressaceae) (native to Korea and northern China), *Salvadora oleoides* (Salvadoraceae) (paratypes host; native to India, Pakistan and southern Iran), *Vachellia nilotica* (syn. *Acacia arabica*) (Mimosaceae) holotype host (native to Africa, Middle East and India) (Chaudhri, 1971; Chaudhri *et al.*, 1974).

**Remarks** — We could not find the type specimens of *M. (B.) aculus* from the depository. The specimens of *M. (B.) aculus* collected from Saudi Arabia are morphologically similar to the original description except minor differences in length of dorsal and ventral body setae; v2



**Figure 6** *Mixonychus (Bakerina) aculus* (Chaudhri), adult female: Venter. Scalebar = 100  $\mu$ m.

38–43 vs. 42, *sc1* 49–53 vs. 57 *sc2* 36–42 vs. 47, *c1* 37–46 vs. 44, *c2* 41–47 vs. 47 *d1* 40–46 vs. 52, *d2* 44–50 vs. 49, *e1* 44–49 vs. 52, *e2* 49–53 vs. 49, *f1* 47–52 vs. 52, *f2* 38–41 vs. 47, *h1* 44–48 vs. 49; *1a* 43–47 vs. 39, *3a* 41–44 vs. 42, *4a* 31–34 vs. 36 and solenidia on both tarsi III and IV 10–12 vs. 16 in original description.

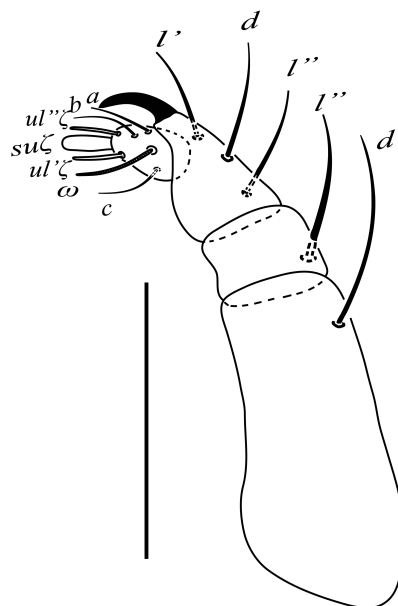
### Genus *Sonotetranychus* Tuttle, Baker and Abbatiello

#### *Sonotetranychus daleae* (Tuttle and Baker)

*Anatetranychus daleae* Tuttle and Baker, 1968: 110.

*Sonotetranychus daleae* (Tuttle and Baker), Tuttle, Baker and Abbatiello, 1976: 70.

**Material examined** — Two females, *Vachellia nilotica*, Taif, 21°30.112'N, 040°29.118'E,



**Figure 7** *Mixonychus (Bakerina) aculus* (Chaudhri), adult female: Palp. Scalebar = 50  $\mu$ m.

elevation 1483 m, 11 September 2017, coll. E. M. Khan and M. U. Rehman; two females, *Vachellia nilotica*, Taif, 21°20.474'N, 040°19.325'E, elevation 1838 m, 11 September 2017, coll. E. M. Khan and M. U. Rehman; five females, *Vachellia nilotica*, Taif, 21°14.372'N, 040°31.135'E, elevation 1618 m, 13 September 2017, coll. E. M. Khan and M. U. Rehman. Nine females (KSMA-ARL-19/20-29) have been deposited at King Saud University Museum of Arthropods (KSMA, Acarology section), Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.

**Distribution** — Mexico, Pakistan, Taiwan and United States of America (Migeon and Dorkeld, 2006–2018).

**Known hosts** — *Dalea formosa* (Fabaceae) (the type host, native to southwestern USA and Mexico), *Psorothamnus emoryi* (Fabaceae) (native to southern USA and Mexico) and *Vachellia nilotica* (Mimosaceae) (Migeon and Dorkeld, 2006–2018).

### Subfamily Bryobiinae Berlese

#### Tribe Hystrichonychini Pritchard and Baker

#### Genus *Paraplonobia* Wainstein

#### Subgenus *Anaplonobia* Wainstein

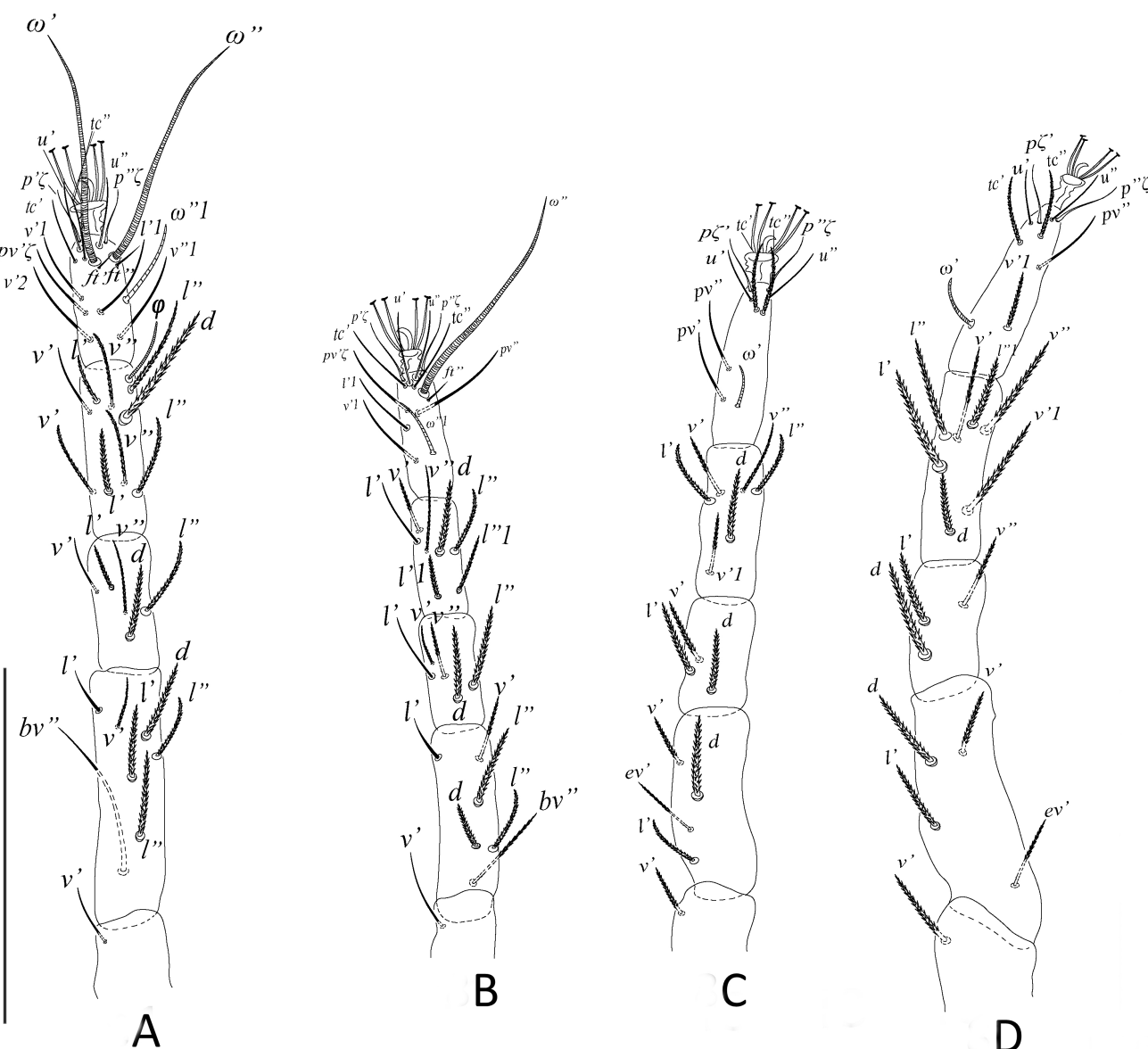
#### *Paraplonobia (Anaplonobia) harteni* (Meyer)

*Neopetrobia harteni* Meyer, 1996: 9.

**Material examined** — Four females, *Indigofera spinosa* (Leguminosae) (native to the region and northeast Africa), Taif, 21°33.926'N, 040°07.260'E, elevation 643 m, 15 October 2016, coll. M. U. Rehman and M. Kamran. Four females (KSMA-ARL-19/29-33) have been deposited at King Saud University Museum of Arthropods (KSMA, Acarology section), Department of Plant Protection, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia.

**Distribution** — Yemen (Meyer, 1996).

**Known hosts** — Unknown plant species (Meyer, 1996).



**Figure 8** *Mixonychus (Bakerina) aculus* (Chaudhri), adult female: A – Leg I; B – Leg II; C – Leg III; D – Leg IV. Scalebar A-D = 100  $\mu$ m.

## New combination

***Evertella orissaensis* (Prasad, 1975), n. comb.**

*Bakerina orissaensis* Prasad, 1975: 18–20.

*Mixonychus (Bakerina) orissaensis* (Prasad): Bolland *et al.*, 1998: 86.

**Distribution** — India.

**Known hosts** — *Allium* sp., (Amaryllidaceae), *Artocarpus heterophyllus* (Moraceae) (Prasad, 1975).

**Remarks** — *Evertella* was erected by Meyer (1987) to accommodate *Mixonychus* (*Mixonychus*) *koegasensis* (Meyer, 1974). Like *Mixonychus* (*Mixonychus*), *Evertella* is characterized by having the dorsal integument finely striate and with protuberances that produce a reticulate appearance, and a simple claw-like empodium. *Evertella* was separated from *Mixonychus*



because of dorsal opisthosomal setae *fl* are absent (present in *Mixonychus*).

Prasad 1975 described the dorsal integument of *Bakerina orissaensis* as striate with comparatively large, round punctations, and Bolland *et al.* (1998) placed *B. orissaensis* within *Mixonychus* (*Bakerina*) due to the striate dorsum and overlooked the absence of seta *fl* in *B. orissaensis* which distinguish *Evertella* from *Mixonychus*. Therefore, due to absence of *fl* seta, *Mixonychus* (*Bakerina*) *orissaensis* is transferred from *Mixonychus* (*Bakerina*) to *Evertella*.

## ***Mixonychus* (*Bakerina*) *ganjuis* (Qian, Yuan and Ma, 1980), n. comb.**

*Mixonychus* (*Mixonychus*) *ganjuis* Qian, Yuan and Ma, 1980: 80.

*Mixonychus* (*Mixonychus*) *ganjuis* Qian, Yuan and Ma; Yi and Jin, 2017: 1296–1301.

**Distribution** — China.

**Known hosts** — *Amelanchier* sp., (Rosaceae), *Citrus reticulata* (Rutaceae) (Yi and Jin 2017).

**Remarks** — The species *M. (B.) ganjuis* having dorsal integument striated, without lumps and spinules, which was misplaced previously in the subgenus *Mixonychus* (Yi and Jin, 2017), is transferred from subgenus *Mixonychus* to subgenus *Bakerina*.

**Table 1** Legs chaetotaxy of world species of the genus *Mixonychus* based on literature (tarsal setal counts are presented as total number of tactile setae and eupathidia (total number of solenidia + number of duplex pairs).

Species	Femora	Genua	Tibiae	Tarsi	Reference
<i>Mixonychus</i> ( <i>Mixonychus</i> )					
<i>acaciae</i>	8–6–3–2	5–5–3–3	(1 or 3φ)–5–5–5	12(1 or 2ω+2dup.)–10(1ω+1dup.)–9(1ω)–9(1ω)	Meyer, 1974
<i>neoacaciae</i>	7–5–3–2	5–5–3–3	8(1φ)–5–5–5	9(1ω)–9(1ω)–9–9	Smiley & Baker, 1995
<i>dulcis</i>	8–6–3–2	5–5–3–3	8 or 9(1φ)–5–5–5	12(1ω+2dup.)–10(1ω+1dup.)–9(1ω)–9(1ω)	Meyer, 1974
<i>Mixonychus</i> ( <i>Tylonychus</i> )					
<i>cruzae</i>	9–8–4–4	5–5–4–4	9(1φ)–8–6–7	11(1ω+2dup.)–10(1ω+1dup.)–5(1ω)–?	Corpus-Raros, 1978
<i>tasmaniensis</i>	?	?	6(1φ)–5–4–4	?–?–7(1ω)–7(1ω)	Miller, 1966
<i>transvaalensis</i>	6–5–3–2	5–5–3–3	8(1φ)–7–5–6	9(1ω+2dup.)–9(1ω+1dup.)–7(1ω)–7(1ω)	Meyer, 1974
<i>jayaraji</i>	7–7–4–4	5–5–3–3	9–7–7–6	11(2dup.)–9(1dup.)–7–7	Karuppuchamy & Mohanasundaram, 1987
<i>Mixonychus</i> ( <i>Bakerina</i> )					
<i>aculus</i>	8–6–4–4	5–5–3–3	10–7–6–7	*15–12–9–9	Chaudhri, 1971
	8/7–6–4–4/3	5–5–3–3	9(1ω)–7–6–7	11(3ζ, 2ω)–9(3ζ, 2ω)–8(1ω)–8(1ω)	Present Study
<i>aestiva</i>	7–6–4–4	5–5–4–3	9(1φ)–8(1φ)–5–7	10(1ω+2dup.)–10–9–9	Tseng, 1990
<i>carracis</i>	8–6–4–4	5–5–3–3	9(1φ)–7–7–6	*14–12–10–10	Chaudhri, 1971
<i>citraeus</i>	7 or 6–6–3–2	5 or 4–5–3–3	7 or 6(1φ)–6 or 5(1φ)–5–5	9(1ω+2dup.)–9 or 10(1ω+1dup.)–7(1ω)–7(1ω)	Flechtmann & Mesa, 2016
<i>ganjuis</i>	9–7–4–4	5–5–4–4	9(1φ)–8–6–7	14(1ω+2dup.)–11(1ω+1dup.)–9(1ω)–9(1ω)	Yi & Jin, 2017
<i>lepidus</i>	8–6–4–4	5–5–3–3	10–7–6–7	*15–12–9–9	Chaudhri, 1971
<i>murrayae</i>	9–7–4–4	5–5–4–3	9(1φ)–8–6–7	14(1ω+2dup.)–11(1ω+1dup.)–9(1ω)–9(1ω)	Yi & Jin, 2017
<i>nanchangensis</i>	9–7–4–4	5–5–4–4	9(1φ)–8–6–7	14(1ω+2dup.)–11(1ω+1dup.)–9(1ω)–9(1ω)	Yi & Jin, 2017
<i>normalis</i>	8–6–4–4	5–5–3–3	9(1φ)–7–6–7	*14–12–10–10	Chaudhri, 1971
<i>thailandicus</i>	9 or 7–7–4–4	5–5–4 or 3–3	9(1φ)–8–6–6	9 or 8(1ω)–7(1ω)–9(1ω)–9(1ω)	Tangkanasing, 1988
<i>ziolanensis</i>	8–7–5–4	5–5–4–3	8(1φ)–8–6–7	8(1ω+2dup.)–8(1ω+1dup.)–9(1ω)–8(1ω)	Lo & Ho, 1989

\*Total setae on tarsi with duplex setae and solenidia as mentioned in description.

? No information found in relative description.

## Key to world species of the genus *Mixonychus* Ryke and Meyer (Based on adult female)

1. Dorsal integument with small protuberances forming a reticulate pattern or producing the appearance of a reticulate pattern ..... subgenus *Mixonychus* Ryke and Meyer – 2  
— Dorsal integument without protuberances; integument with/without spinules present ..... 4
2. Length of dorsal body setae less than half the longitudinal distance to the setae in the next row; only dorsal opisthosomal setae *f2* and *h1* set on tubercles ..... *M. (M.) dulcis* Meyer, South Africa  
— Length of dorsal body setae more than half the longitudinal distance to the setae in the next row; almost all dorsal opisthosomal setae set on tubercles ..... 3
3. Femora I and II with 8 and 6 setae, respectively ..... *M. (M.) acaciae* Ryke and Meyer, South Africa  
— Femora I and II with 7 and 5 setae, respectively ..... *M. (M.) neoacaciae* Smiley and Baker, Yemen
4. Dorsal integument with spinules ..... subgenus *Tylonychus* Miller – 5  
— Dorsal integument without spinule ..... subgenus *Bakerina* Chaudhri – 8
5. Dorsal opisthosomal setae long, clearly longer than the bases of the setae in the next row . 6  
— Dorsal opisthosomal setae short, not reaching the bases of the setae in the next row. .... 7
6. Dorsal body setae set on strong tubercles; female propodosoma integument with simple striations; dorsal opisthosomal setae *f2* short, as compared to other dorsal setae ..... *M. (T.) tasmaniensis* (Miller), Australia  
— Dorsal body setae not set on tubercles; female propodosoma integument with a reticulate pattern; dorsal opisthosomal setae *f2* as long as other dorsal body setae ..... *M. (T.) jayaraji* (Karuppuchamy and Mohanasundaram), India
7. Dorsal body setae stout, rod shaped; genua III and IV with 3 setae; femora I–IV with 6–5–3–2 setae ..... *M. (T.) transvaalensis* (Meyer), South Africa  
— Dorsal body setae oblong, lanceolate; genua III and IV with 4 setae; femora I–IV with 9–8–4–4 setae ..... *M. (T.) cruzae* (Corpuz-Raros), The Philippines
8. Dorsal opisthosomal setae *d1*, *e1* as long as or longer than the distance to the bases of setae in the next row ..... 9  
— Dorsal opisthosomal setae *d1*, *e1* obviously shorter than the distance to the bases of the setae in the next row (approx. 2/3 the distance) ..... 14
9. Femora I and II with 9 and 7 setae, respectively; genua III and IV each with 4 setae ..... 10  
— Femora I and II with 8 and 6 setae, respectively; genua III and IV each with 3 setae ..... 11
10. Medial integument of propodosoma striated; dorsal setae gradually expanded distally (weakly clavate) ..... *M. (B.) ganjuis* (Qian, Yuan and Ma), China  
— Medial integument of propodosoma reticulated; dorsal setae not expanded distally, of even thickness along length ..... *M. (B.) nanchangensis* (Ma and Yuan), China
11. Dorsal body setae lanceolate; tibia I without lanceolate seta; tarsi III and IV with long solenidion (16 µm long) ..... 12  
— Dorsal body setae of even thickness along length, weakly to not tapering, with broadly blunt tips; tibia I with 3 lanceolate setae; tarsi III and IV with short solenidion (5 µm long) ..... 13

12. Dorsal opisthosomal setae *c1* (44  $\mu$ m) shorter than the distance *c1-d1* .....  
..... *M. (B.) aculus* (Chaudhri), Pakistan  
— Dorsal opisthosomal setae *c1* (60  $\mu$ m) reaching the base of setae *d1* .....  
..... *M. (B.) lepidus* (Chaudhri), Pakistan
  
13. Peritremes ending in simple unexpanded bulb; dorsal opisthosomal *f1* 70  $\mu$ m long and *f2* 44  $\mu$ m long ..... *M. (B.) carracis* (Chaudhri), Pakistan  
— Peritremes ending in an expanded bulb; dorsal opisthosomal setae *f1* 83  $\mu$ m long and *f2* 47  $\mu$ m long ..... *M. (B.) normalis* (Chaudhri), Pakistan
  
14. Dorsal body setae gradually expanding along length, elongate obovate; femur III with 3 or 4 setae ..... 15  
— Dorsal body setae of even thickness along length; femur III with 5 setae .....  
..... *M. (B.) ziolanensis* (Lo and Ho), Taiwan
  
15. Femur II with 6 setae; tibia III with 5 setae ..... 16  
— Femur II with 7 setae; tibia III with 6 setae ..... 17
  
16. Femur III with 3 setae; tibia II with 5 setae .....  
..... *M. (B.) citraeus* Flechtmann and Mesa, Colombia  
— Femur III with 4 setae; tibia II with 8 setae ..... *M. (B.) aestiva* (Tseng), Taiwan
  
17. Tibia IV with 7 setae ..... *M. (B.) murrayae* (Gao and Ma), China  
— Tibia IV with 6 setae ..... *M. (B.) thailandicus* (Tangkanasing), Thailand

## Acknowledgments

The authors wish to thank the Deanship of Scientific Research at the King Saud University, Riyadh for providing facilities and funds to complete this research work through the research project [RG– 1437–043]. We are also grateful to Dr. Carlos H.W. Flechtmann (University of Sao Paulo, Departamento de Entomologia e Acarologia, Brazil) for providing literature.

## References

- Alatawi F.J., Kamran M. 2018. Spider mites (Acari: Tetranychidae) of Saudi Arabia: two new species, new records and a key to all known species. J. Nat. Hist., 52(7-8): 429-455. doi:10.1080/00222933.2018.1434251
- Bolland H.R., Gutierrez J., Flechtmann C.H.W. 1998. World catalogue of the spider mite family (Acari: Tetranychidae). Leiden, Brill Boston Koln. p. 1-392.
- Chaudhri W.M. 1971. A new spider mite genus, *Bakerina*, (Acarina, Tenuipalpoidini), with the description of four new species. Pak. J. Zool., 3(2): 195-202.
- Chaudhri W.M., Akbar, S., Rasool A. 1974. Taxonomic studies of the mites belonging to the families Tenuipalpidae, Tetranychidae, Tuckerellidae, Caligonellidae, Stigmaeidae and Phytoseiidae. Uni. of Agric., Lyallpur, Pak., PL-480. Project on mites. p. 1-250.
- Corpuz-Raros L.A. 1978. New Philippine Tetranychoida. Kalikasan, Philippine Journal of Biology, 7: 211-230.
- Flechtmann C.H. 2013. A new species of *Neotetranychus* Trägårdh (Acari, Prostigmata, Tetranychidae) from Thailand with a key to world species. Persian J. Acarol., 2(1): 35-40.
- Flechtmann C.H.W., Mesa N.C. 2016. First record of the spider mite genus *Mixonychus* (Acari: Tetranychidae) from the Americas based on the description of a new species from Colombia. Persian J. Acarol., 2016, 5(4): 271-279. doi:10.22073/pja.v5i4.25450
- Gutierrez J. 1985. Spider mites. Their Biology, Natural Enemies and Control. Vol. 1A. 1.1.4 systematics. Ed. By: Helle W. Sabelis M.W. Elsevier Sci. Publ. B.V., Amsterdam, pp. 75-90.
- Hong X.Y., Zhang Z.Q., Lin G.Q. 2010. Tetranychidae of China: a review of progress, with a checklist. In: Zhang Z.Q., Hong X.Y., Fan, Q.H. (eds) Xin Jie-Liu Centenary: Progress in Chinese Acarology. Zoosymposia, 4: 133-150.

- Kamran M., Khan E.M., Alatawi F.J. 2018. The spider mites of the genus *Eutetranychus* Banks (Acari, Trombidiformes, Tetranychidae) from Saudi Arabia: two new species, a re-description, and a key to the world species. *ZooKeys*, (799): 47-88. doi:10.3897/zookeys.799.25541
- Karuppuchamy P., Mohanasundaram M. 1987. New species and records of tetranychid mites (Tetranychidae: Acarina) from India. *Entomon.*, 12: 89-94.
- Lindquist E.E. 1985. Spider mites. Their Biology, Natural Enemies and Control. Vol. 1A.1.1.1 External anatomy. Ed. By: Helle W. Sabelis M.W. Elsevier Sci. Publ. B.V., Amsterdam, pp. 3-28.
- Lo P.K.C., Ho C.C. 1989. A new species of spider mite from Taiwan (Acarina: Tetranychidae). *J. Taiwan Museum*, 42: 55-58.
- Ma E.P., Yuan Y.L. 1981. A new species of the genus *Bakerina* from China (Acari: Tetranychidae). *Entomotaxonomia*, 3: 71-74.
- Miller L.W. 1966. The tetranychid mites of Tasmania. *Proceedings of the Royal Society of Tasmania*, 100: 53-76.
- Meyer M.K.P.S. 1974. A revision of the Tetranychidae of Africa (Acari) with a key to the genera of the world. *Entomol. Mem. Dep. Agric. Tech. Serv., Repub. S. Afr.*, 36: 1-291.
- Meyer M.K.P.S. 1987. African Tetranychidae (Acari: Prostigmata) with reference to the world genera. *Entomol. Mem. Dep. Agric. Water Supply, Repub. S. Afr.*, 69: 1-175.
- Meyer, M.K.P.S. 1996. On some spider mites (Acari: Tetranychidae) of Yemen. *Fauna of Saudi Arabia*, 15: 5-19.
- Migeon A., Dorkeld F. 2006-2018. Spider Mites Web: a comprehensive database for the Tetranychidae [Internet]. [25 Spetember, 2018] Available from <http://www.montpellier.inra.fr/CBGP/spmweb>.
- Prasad V. 1975. Plant feeding mites of India (Acarina: Tetranychoidae): III. Genera *Bakerina*, *Mesobryobia*, *Panonychus* and *Porcupinychus*. *Int. J. of Acarol.*, 1(2): 18-25. doi:10.1080/01647957508683745
- Pritchard A.E., Baker E.W. 1955. A revision of the spider mite family Tetranychidae. *Te Pacific Coast Entomological Society* 2: 1-472. doi:10.5962/bhl.title.150852
- Qian Y.H., Yuan Y.L., Ma E.P. 1980. A new species of the genus *Mixonychus* from China (Acari: Tetranychidae). *J. Shanxi Uni.*, 2(2): 80-82.
- Ryke P.A.J., Meyer M.K.P.S. 1960. The parasitic and predacious mite fauna (Acarina) associated with *Acacia karroo* Hayne in the Western Transvaal. *Libro Homenaje al Dr. Eduardo Caballero y Caballero, Mexico D. F.*: 559-569.
- Smiley R.L., Baker E.W. 1995. A report on some tetranychid mites (Acari: Prostigmata) from Yemen. *Int. J. Acarol.*, 21(3): 135-164. doi:10.1080/01647959508684055
- Tangkanasing P. 1988. A new species of *Bakerina* Chaudhri from Thailand (Tetranychidae: Acari). *Int. J. Acarol.*, 14(1): 9-11. doi:10.1080/01647958808683798
- Tseng Y.H. 1990. A monograph of the mite family Tetranychidae (Acarina: Tronbidiformes) from Taiwan. *Taiwan Mus. special Publ.*, ser. n 9 Taipei, Rep. China, p. 1-226.
- Tuttle D.M., Baker E.W. 1968. Spider mites of southwestern United States and a revision of the family Tetranychidae. *Tuscon, Ariz., Uni. Ariz., Press*, p. 1-143.
- Tuttle D.M., Baker E.W., Abbatiello M.J. 1976. Spider mites of Mexico (Acari: Tetranychidae). *Int. J. Acarol.*, 2 (2): 1-102. doi:10.1080/01647957608683760
- Yi T.C., Jin D.C. 2017. Re-description of three species of *Mixonychus* (Acari, Tetranychidae) from China. *Syst. Appl. Acarol.*, 22(9): 1295-1315. doi:10.11158/saa.22.9.2