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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

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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

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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 ($ps_{1\text{-}2}$) (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), *Paraplonobia* (*Anaplonobia*) *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 *f1* 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 Tetyranychidae 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, uncinate 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

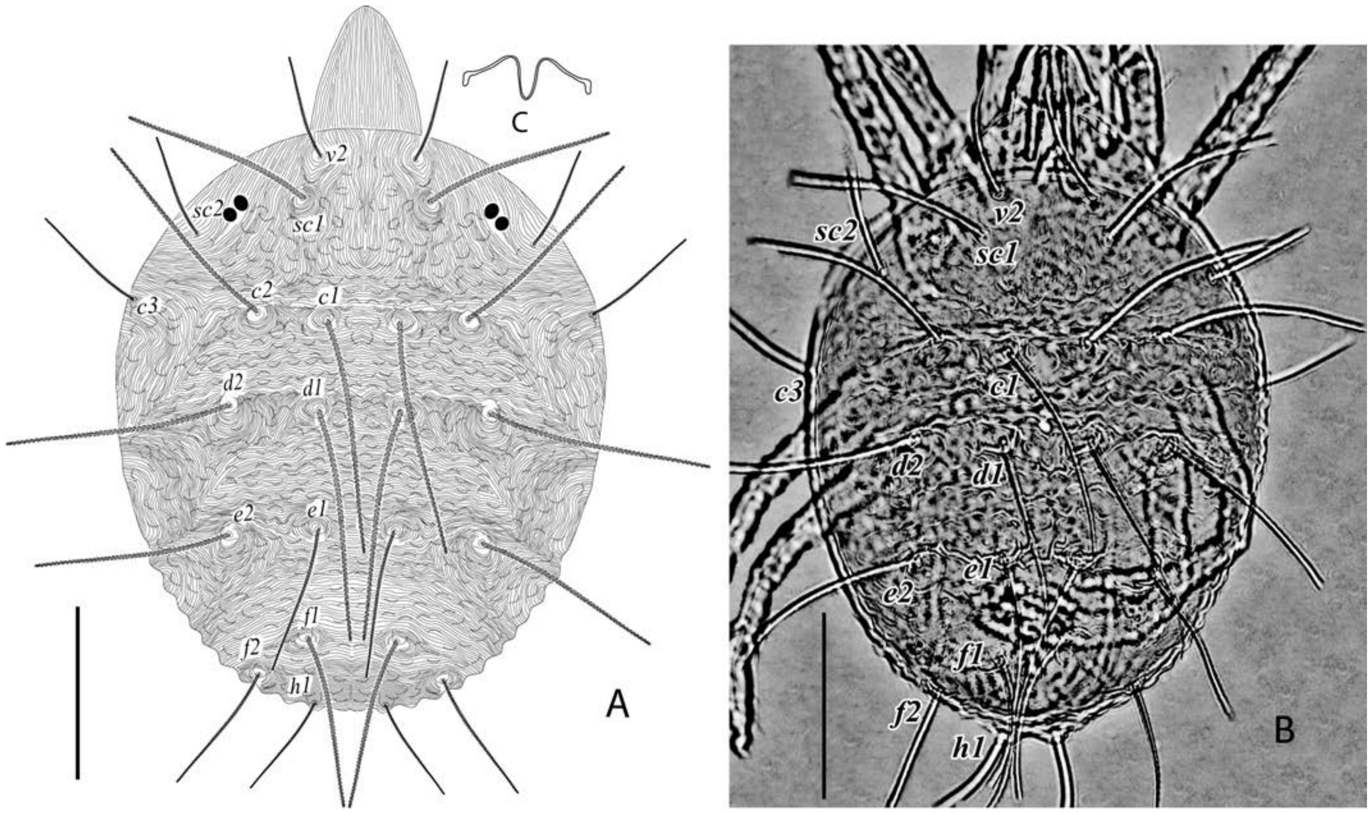

Figure 1 *Neotetranychus longisetus* **n. sp.**, adult female: A, B – Dorsum; C – Peritremes. Scalebar A, B = 100 μm.

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),

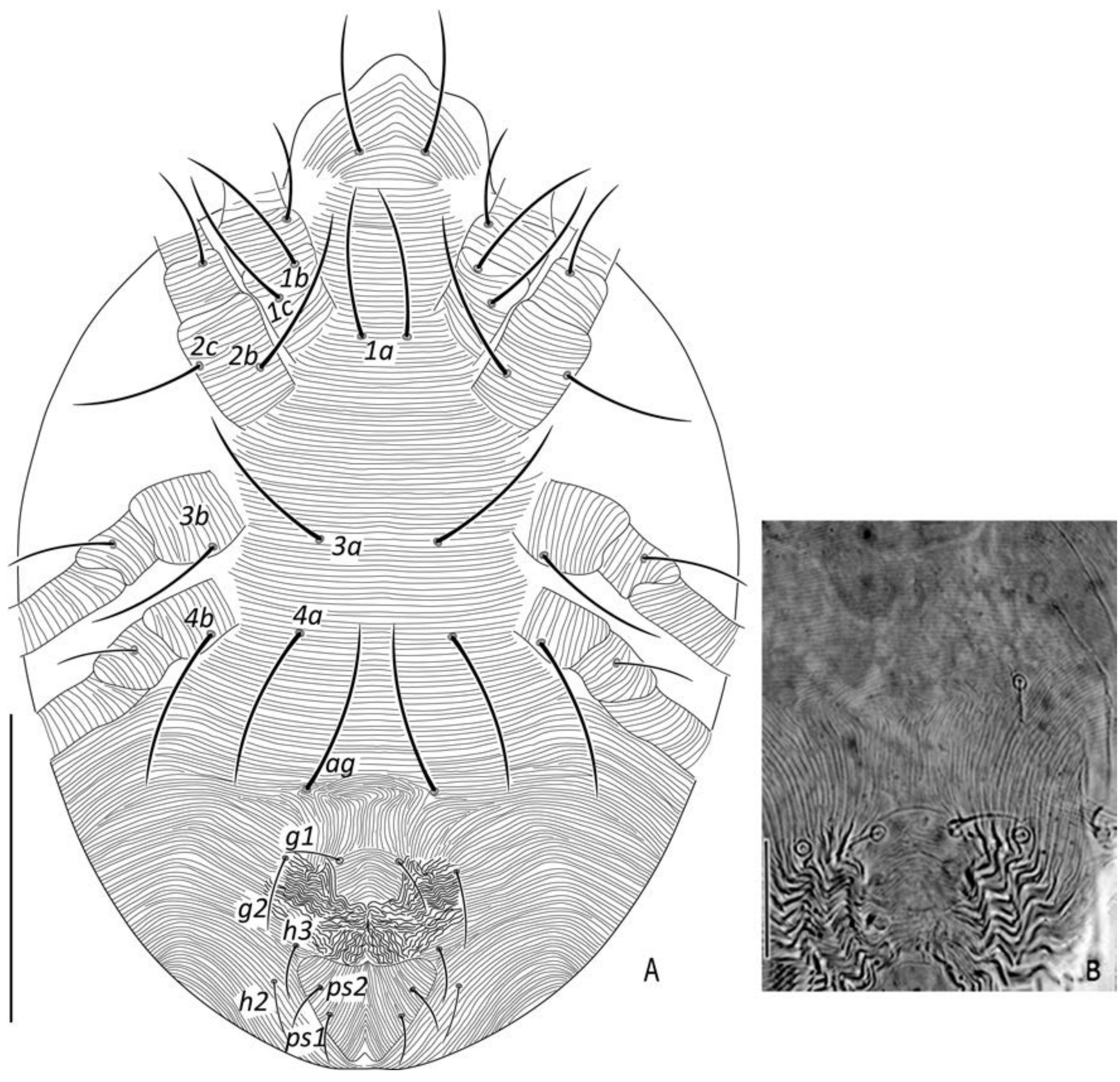

Figure 2 *Neotetranychus longisetus.* **n. sp.**, adult female: A – Venter; B – Genital area. Scalebar A, B = 100 μm.

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.

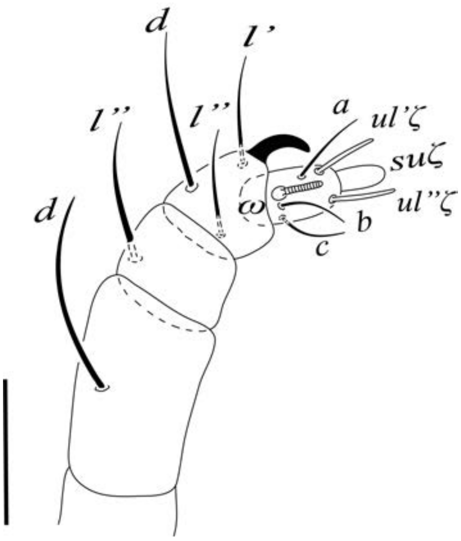

Figure 3 *Neotetranychus longisetus.* **n. sp.**, adult female: Palp. Scalebar = 50 µm.

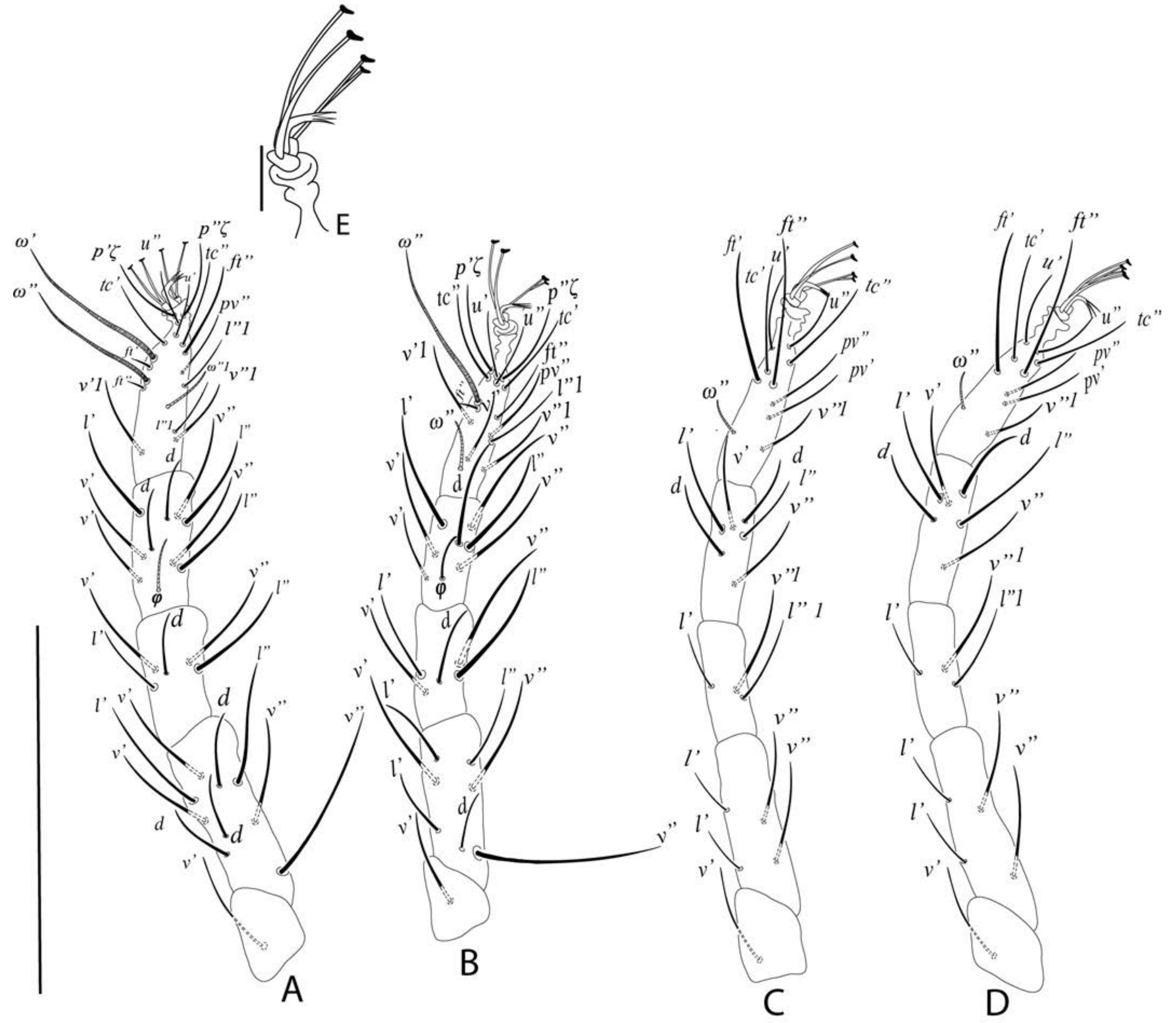

Figure 4 *Neotetranychus longisetus* **n. sp.**, adult female: A – Leg I; B – Leg II; C – Leg III; D – Leg IV; E – Leg I Empodium. Scalebar A-D = 100 μm, E = 10 μm.

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 arbainense* (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 *suζ* 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,

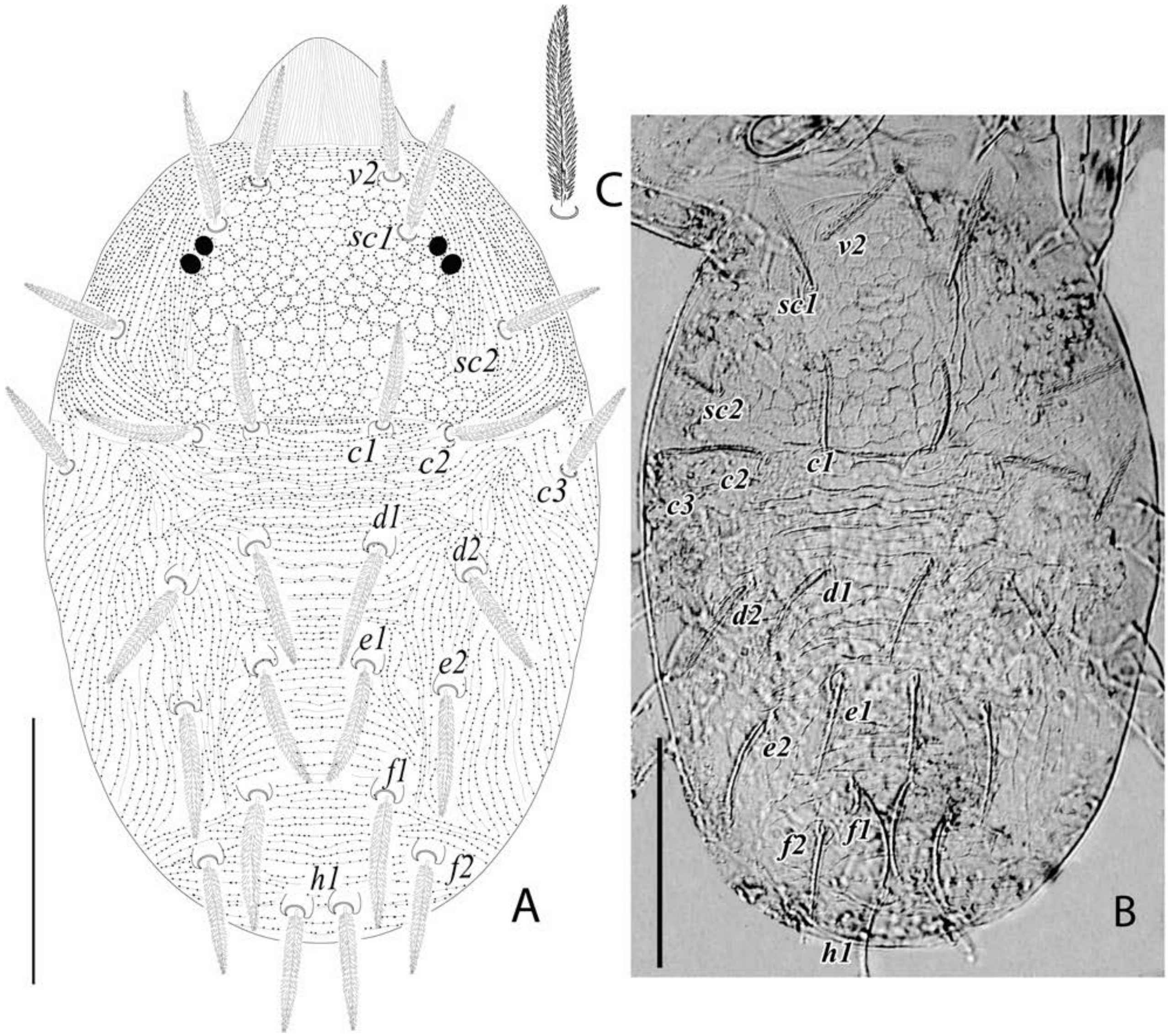

Figure 5 *Mixonychus* (*Bakerina*) *aculus* (Chaudhri), adult female: A, B – Dorsum; C – Dorsal seta. Scalebar A, B = 100 μm.

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), *Platycladus 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*

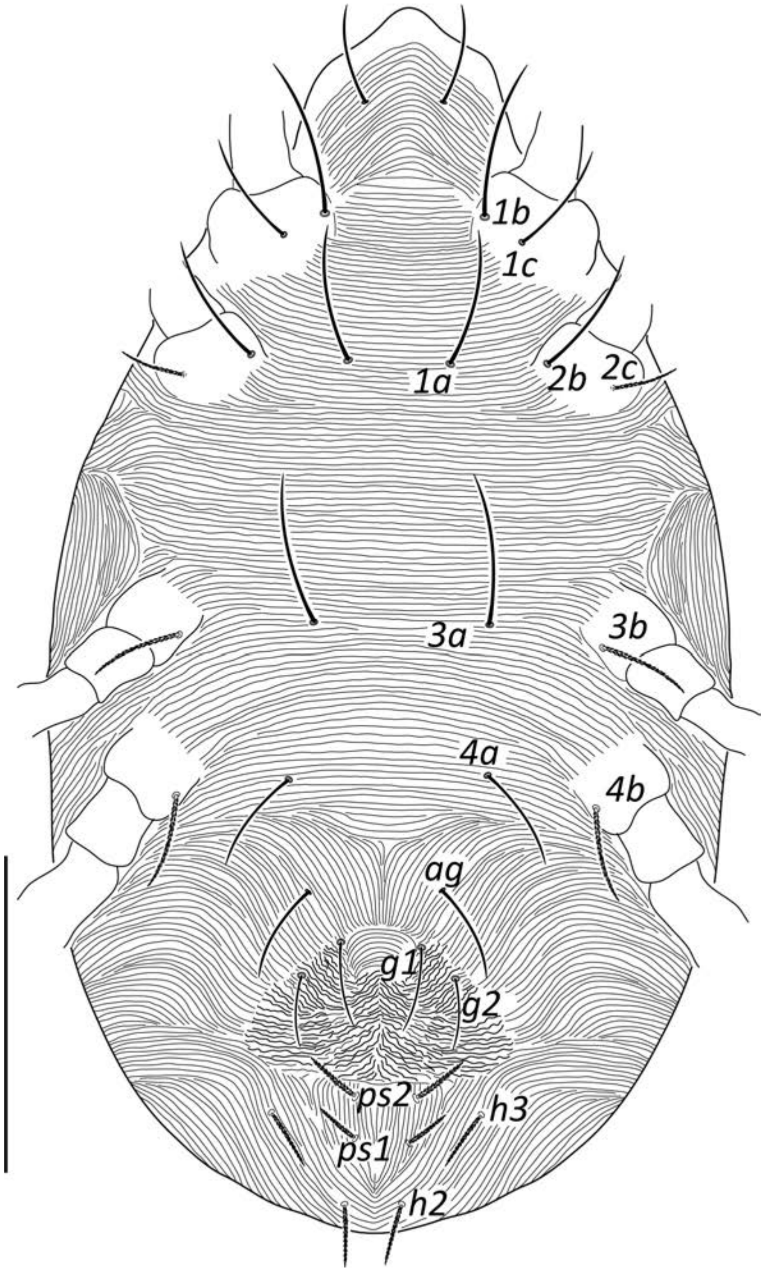

Figure 6 *Mixonychus* (*Bakerina*) *aculus* (Chaudhri), adult female: Venter. Scalebar = 100 μm.

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,

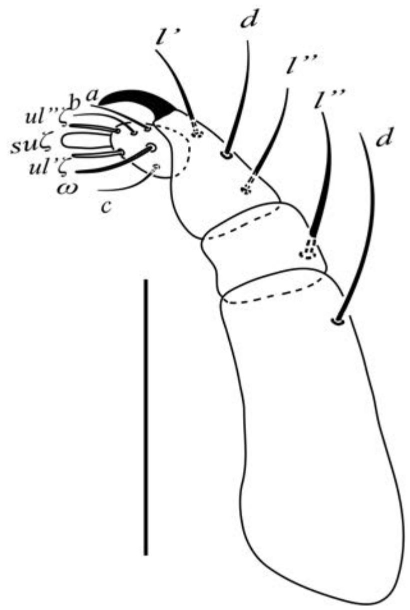

Figure 7 *Mixonychus* (*Bakerina*) *aculus* (Chaudhri), adult female: Palp. Scalebar = 50 µm.

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).

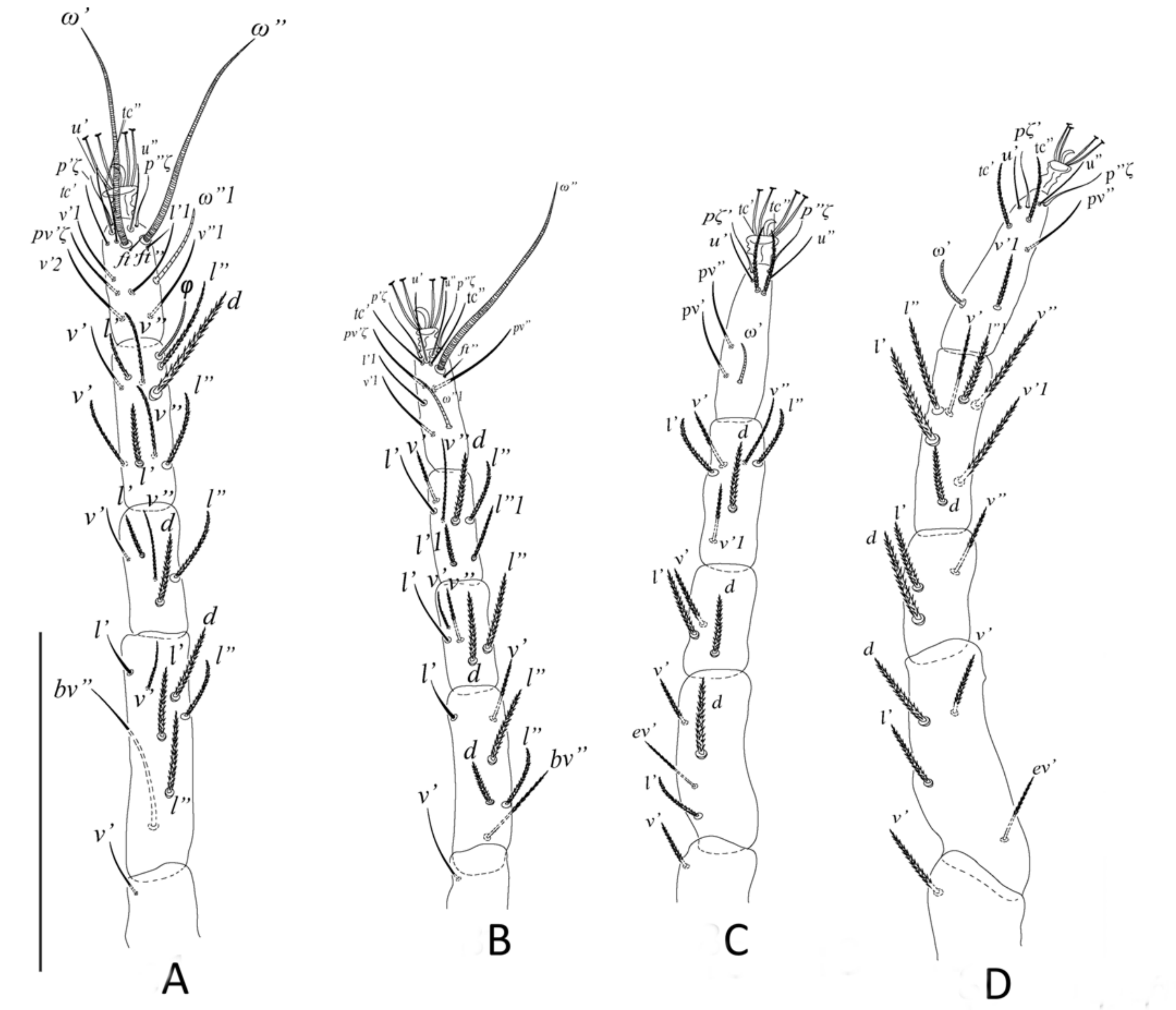

Figure 8 *Mixonychus* (*Bakerina*) *aculus* (Chaudhri), adult female: A – Leg I: B – Leg II; C – Leg III; D – Leg IV. Scalebar A-D = 100 µm.

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 *f1* 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 *f1* in *B. orissaensis* which distinguish *Evertella* from *Mixonychus*. Therefore, due to absence of *f1* 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 chaeototaxy 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
			***Mixonychus* (*Mixonychus*)**		
acaciae	8−6−3−2	5−5−3−3	(1or 3φ)−5−5−5	12(1 or 2ω+2dup.)−10(1ω +1dup.) −9(1ω)−9(1ω)	Meyer, 1974
neoacaciae	7−5−3−2	5−5−3−3	8(1φ)−5−5−5	9(1ω)−9(1ω)−9−9	Smiley & Baker, 1995
dulcis	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
			***Mixonychus* (*Tylonychus*)**		
cruzae	9−8−4−4	5−5−4−4	9(1φ)−8−6−7	11(1ω+2dup.)−10(1ω+1dup.)−5(1ω)−?	Corpuz-Raros, 1978
tasmaniensis	?	?	6(1φ)−5 −4−4	? −?−7(1ω)−7(1ω)	Miller, 1966
transvaalensis	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
jayaraji	7−7−4−4	5−5−3−3	9−7−7−6	11(2dup.)−9(1dup.)−7−7	Karuppucchamy & Mohanasundaram,1987
			***Mixonychus* (*Bakerina*)**		
aculus	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
aestiva	7−6−4−4	5−5−4−3	9(1φ)−8(1φ)−5−7	10(1ω+2dup.)−10−9−9	Tseng, 1990
carracis	8−6−4−4	5−5−3−3	9(1φ)−7−7−6	*14−12−10−10	Chaudhri, 1971
citraeus	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
ganjuis	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
lepidus	8−6−4−4	5−5−3−3	10−7−6−7	*15−12−9−9	Chaudhri, 1971
murrayae	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
nanchangensis	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
normalis	8−6−4−4	5−5−3−3	9(1φ)−7−6−7	*14−12−10−10	Chaudhri, 1971
thailandicus	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
ziolanensis	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 µm) shorter than the distance *c1−d1* . . . . ***M.* (*B.*) *aculus*** (Chaudhri), Pakistan
— Dorsal opisthosomal setae *c1* (60 µm) reaching the base of setae *d1* . . . . ***M.* (*B.*) *lepidus*** (Chaudhri), Pakistan

13. Peritremes ending in simple unexpanded bulb; dorsal opisthosomal *f1* 70 µm long and *f2* 44 µm long . . . . ***M.* (*B.*) *carracis*** (Chaudhri), Pakistan
— Peritremes ending in an expanded bulb; dorsal opisthosomal setae *f1* 83µm long and *f2* 47 µm 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

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