

ORIGINAL ARTICLE

Two new species and one deutogyne of *Rhyncaphytoptus* (Acari: Eriophyoidea: Diptilomiopidae) from Wanglang Nature Reserve, China

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Abstract Two new species, *Rhyncaphytoptus dipeltus* **sp. nov.** infesting *Dipelta floribunda* (Caprifoliaceae) and the protogyne and deutogyne of *R. schifilus* **sp. nov.** infesting *Sorbus setschwanensis* (C.K. Schneider) Koehne (Rosaceae), are described and illustrated. All mites are vagrant on the undersurfaces of leaves of host plants, respectively.

Key words Eriophyoid mites, new specie, deutogyne, Sichuan Province.

1 Introduction

Eriophyoid mites sometimes have two forms in adult female, namely protogyne and deutogyne. The protogyne female is considered as the primary type for the taxonomy of eriophyid mite (Keifer, 1942), while the deutogyne female is treated as overwintering type, which is not used as a generic concept (Amrine *et al.*, 2003). The morphological structure of both types are usually similar, but some obvious different by the body color yellow or white in protogyne and red in deutogyne, and the ventral annuli sculptured with microtubercles in protogyne and smooth in deutogyne.

The deutogyne and protogyne female are generally sympatric and infesting the same host plants. Presently, the deutogyne females of 65 eriophyoid mites species were reported. In China, the deutogyne of *Tegolophus celtis* was firstly reported (Guo *et al.*, 2015).

The genus *Rhyncaphytoptus* (Diptilomiopidae, Rhyncaphytoptinae) was erected by Keifer in 1939, with some distinctive features, such as: gnathosoma large and projecting straight down, scapular tubercles on rear shield margin, scapular setae (*sc*) projecting up and forward, tarsal empodium (*em*) entire and so on. About 80 species are arranged in the genus all over the world (Amrine *et al.*, 2003), of which 45 species occur in China (Hong *et al.*, 2010; Li *et al.*, 2012; Li *et al.*, 2015).

During a field survey for insects in Wanglang Nature Reserv, Pingwu County, Sichuang Province, China in August 2016, a few eriophyid mites specimens from leaves of wild trees were collected. Among them, a new species, *Rhyncaphytoptus dipeltus* **sp. nov.**, is identified from *Dipelta floribunda* Maxim., another species, with two forms, which were presumed to be the protogyne and deutogyne types of *Rhyncaphytoptus schifilus* **sp. nov.** were observed from *Sorbus setschwanensis*.

2 Materials and methods

The mites were collected, cleared and mounted on glass slides according to Kuang (1995). Specimens were measured

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following de Lillo *et al.* (2010). Morphological terminology and generic classification follow Amrine *et al.* (2003). Specimens were examined with an Olympus microscope (BX51) and made digital images by a CCD. All measurements are in micrometers (μm) and are lengths when not specified. The range of the paratypes follow the measurements of the holotype. All illustrations were prepared with the software Adobe Photoshop CS 8.0®. Type specimens are deposited in the Laboratory of Plant Protection, School of Modern Agriculture and Biotechnology, Ankang University, Ankang city, Shaanxi Province, China.

3 Results

Eriophyoidea Nalepa, 1898

Diptilomiopidae Keifer, 1944

Rhyncaphytopinae Roivainen, 1953

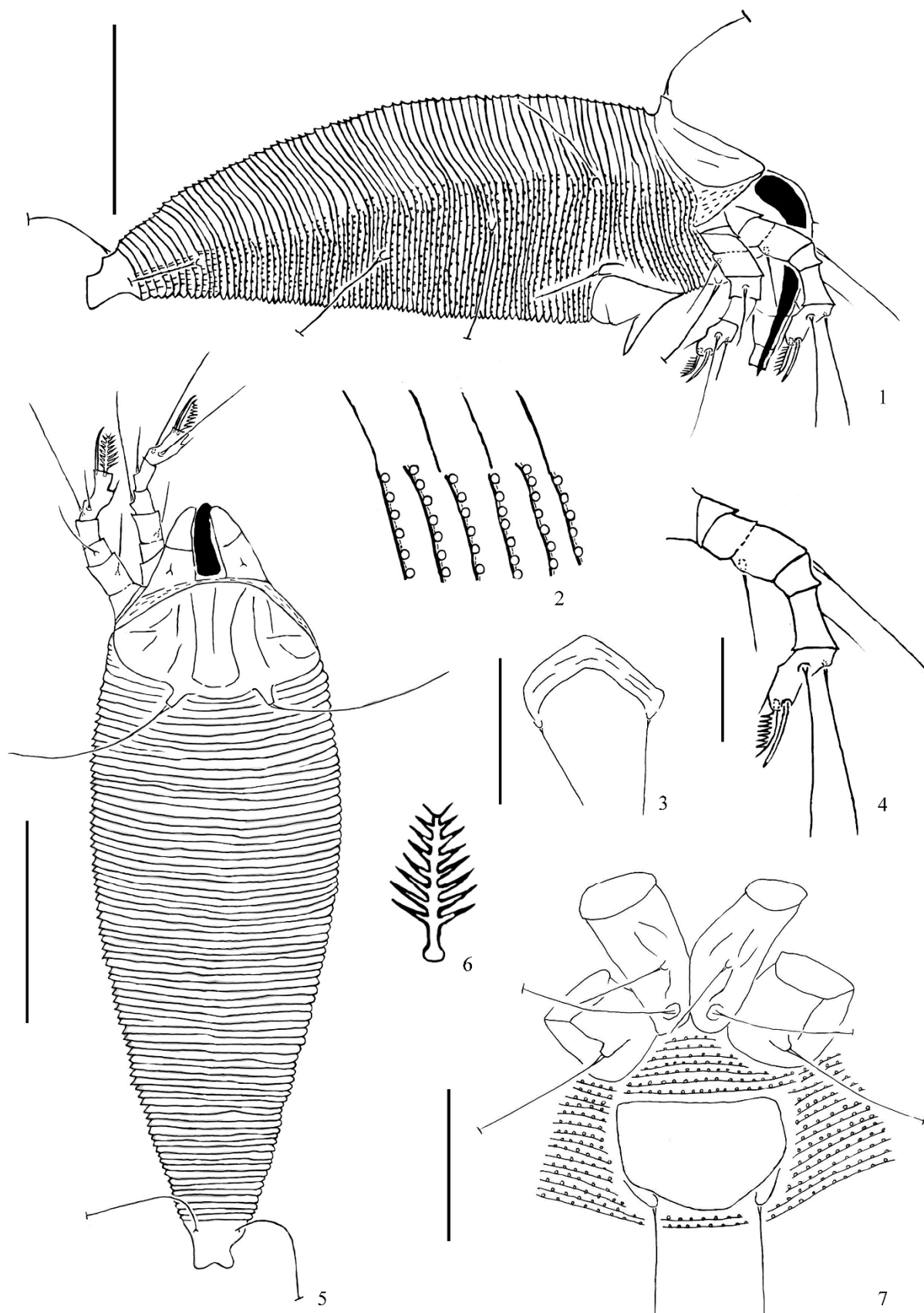
Rhyncaphytopus Keifer, 1939

Rhyncaphytopus dipeltus sp. nov. (Figs 1–7)

Diagnosis. Body fusiform, color light yellowish. Gnathosoma large and projecting straight down; prodorsal shield without anterior shield lobe. Median line and submedian lines incomplete, admedian lines complete. Scapular tubercles on rear shield margin, scapular setae (*sc*) projecting up and forward. Coxisternal plates with few lines, prosternal apodeme present. Legs with tarsal empodium simple, 8-rayed, tarsal solenidion unknobbed. Opisthosoma with 70–72 dorsal annuli, smooth; and 89–99 ventral annuli with rounded microtubercles except caudal 10–11 ventral annuli with elongated microtubercles. Setae *h1* absent. Female genitalia coverflap smooth.

Description. Female ($n = 10$). Body fusiform, 190 (138–190), 85 (50–85) wide, 60 (60–68) thick; light yellowish in color. Gnathosoma 50 (48–54), projecting straight down; dorsal pedipalp genual setae (*d*) 10 (10), pedipala coxal setae (*ep*) 3 (2–3). Prodorsal shield 30 (30–35), 48 (48–65) wide, frontal lobe lack. Shield design with median line and submedian lines incomplete, admedian lines complete. Scapular tubercles on rear shield margin, 25 (12–25) apart; scapular setae (*sc*) 45 (40–45), projecting up and forward. Coxigenital region with 7(6–7) microtuberculated semiannuli. Coxal plates I with few lines and II smooth, anterolateral setae on coxisternum I (*Ib*) 12 (10–15), 10 (10–14) apart; proximal setae on coxisternum I (*Ia*) 35 (32–45), 4 (4–7) apart; proximal setae on coxisternum II (*2a*) 60 (45–60), 20 (20–30) apart; prosternal apodeme 5(5–7). Leg I 47 (41–49), trochanter 4 (4–5), femur layered, 15 (10–15), basiventral femoral setae (*bv*) 15 (15–18); genu 5 (5–6), antaxial genual setae (*l''*) 30 (27–30); tibia 10 (10), paraxial tibial setae (*l'*) 12 (7–12), located 1/2 from dorsal base; tarsus 13 (12–13), paraxial fastigial tarsal setae (*ft'*) 30 (30–35), antaxial fastigial tarsal setae (*ft''*) 31 (31–35), paraxial unguinal tarsal setae (*u'*) 5 (5–6); tarsal empodium (*em*) entire, 10 (10–11), 8-rayed; tarsal solenidion (ω) 11 (11–12), unknobbed. Leg II 45 (39–48), trochanter 4 (4–5), femur layered, 15 (10–15), basiventral femoral setae (*bv*) 18 (15–20); genu 5(5–6), antaxial genual setae (*l''*) 15 (15–20); tibia 8 (8–9); tarsus 13 (12–13), paraxial fastigial tarsal setae (*ft'*) 10 (10–12), antaxial fastigial tarsal setae (*ft''*) 31 (30–35), paraxial unguinal tarsal setae (*u'*) 5 (5–6); tarsal empodium (*em*) entire, 10 (10–11), 8-rayed; tarsal solenidion (ω) 11 (11–12), unknobbed. Opisthosoma with 72 (70–72) dorsal annuli, smooth; ventrally with 95 (89–99) semiannuli, with rounded microtubercles except caudal 10–11 ventral annuli with elongated microtubercles; setae *c2* 27 (25–35) on ventral annulus 19–20, 70 (52–70) apart; setae *d* 60 (45–60) on ventral annulus 37–38, 52 (45–52) apart; setae *e* 35 (32–50) on ventral annulus 55–56, 26 (22–26) apart; setae *f* 40 (35–40) on 9th ventral annulus from rear, 25 (20–25) apart. Setae *h1* absent; setae *h2* 80 (80–110), 10 (10) apart. Female genitalia 14 (14–20), 22 (22–28) wide, coverflap smooth, setae *3a* 15 (12–15), 15 (15–19) apart.

Male ($n = 8$). Body fusiform, 130–160, 50–55 wide, 50–55 thick; Gnathosoma 48–50, projecting straight down; dorsal pedipalp genual setae (*d*) 8, pedipala coxal setae (*ep*) 3. Prodorsal shield design pattern as female, 30, 40 wide. Scapular tubercles on rear shield margin, 11–13 apart; scapular setae (*sc*) 38–42, projecting up and forward. Coxigenital region with 6–7 microtuberculated semiannuli. Coxal plates with anterolateral setae on coxisternum I (*Ib*) 10, 8–9 apart; proximal setae on coxisternum I (*Ia*) 25–30, 4 apart; proximal setae on coxisternum II (*2a*) 30–40, 13–15 apart; prosternal apodeme 5–6. Leg I 36–40, trochanter 3–4, femur layered, 10, basiventral femoral setae (*bv*) 13–15; genu 4–5, antaxial genual setae (*l''*) 25; tibia 8–10, paraxial tibial setae (*l'*) 8–10; tarsus 11, paraxial fastigial tarsal setae (*ft'*) 29, antaxial fastigial tarsal setae (*ft''*) 30, paraxial unguinal tarsal setae (*u'*) 5–6; tarsal empodium (*em*) entire, 8, 8-rayed; tarsal solenidion (ω) 10, unknobbed. Leg II 36–38, trochanter 3–4, femur layered, 10, basiventral femoral setae (*bv*) 10–13; genu 4–5, antaxial genual setae (*l''*) 10–13; tibia 8; tarsus 11, paraxial tarsal setae (*ft'*) 10, antaxial tarsal setae (*ft''*) 30, paraxial unguinal tarsal setae (*u'*) 5–6;



Figures 1–7. *Rhyncaphytoptus dipeltus* sp. nov., female (except Fig. 3). 1. Lateral view. 2. Lateral opisthosoma (enlarged). 3. Genital region of male. 4. Leg I. 5. Dorsal view. 6. Empodium (enlarged). 7. Coxal-genital region. Scale bars: 1, 5 = 50 μ m; 3, 4, 7 = 20 μ m.

tarsal empodium (*em*) entire, 8, 8-rayed; tarsal solenidion (ω) 10, unknobbed. Opisthosoma with 65–70 dorsal annuli, smooth; ventrally with 88–90 semiannuli, with rounded microtubercles except caudal 9–10 ventral annuli with elongated microtubercles; setae *c*2 15–18 on ventral annulus 14–15, 40 apart; setae *d* 45–50 on ventral annulus 30–31, 25–30 apart; setae *e* 30–40 on ventral annulus 48–49, 18 apart; setae *f* 30–35 on 9th ventral annulus from rear, 15–18 apart. Setae *hl* absent; setae *h*2 50–60, 10 apart. Male genitalia 20 wide, setae *3a* 10–15, 12 apart.

Material examined. Holotype, female, from *Dipelta floribunda* Maxim. (Caprifoliaceae), Wanglang Nature Reserve (32°00'03"N, 104°02'01"E; elev. 2815 m), Pingwu, Sichuan, China, 16 August 2016, coll. Manchao Xie. Paratypes, 9 females, 8 males, with the same data as holotype.

Relation to host. Vagrant on the undersurfaces of leaves, no obvious damage seen.

Etymology. The specific designation *dipeltus* is derived from the generic name of the host plant, *Dipelta*, by adding the postfix, *us*, masculine of the gender.

Remarks. The species is the first eriophyid mite described on *Dipelta floribunda* Maxim. By the similar prodorsal shield and the similar host plants from the family Caprifoliaceae, the new species is similar to *R. lonicerae* Kuang & Zhao, 1987, but distinguished with the latter by the scapular tubercles on rear shield margin (scapular tubercles ahead of rear shield margin in *R. lonicerae*), and the tarsal empodium 8-rayed (6-rayed in *R. lonicerae*).

***Rhyncaphytoptus schifilus* sp. nov.** (Figs 8–20)

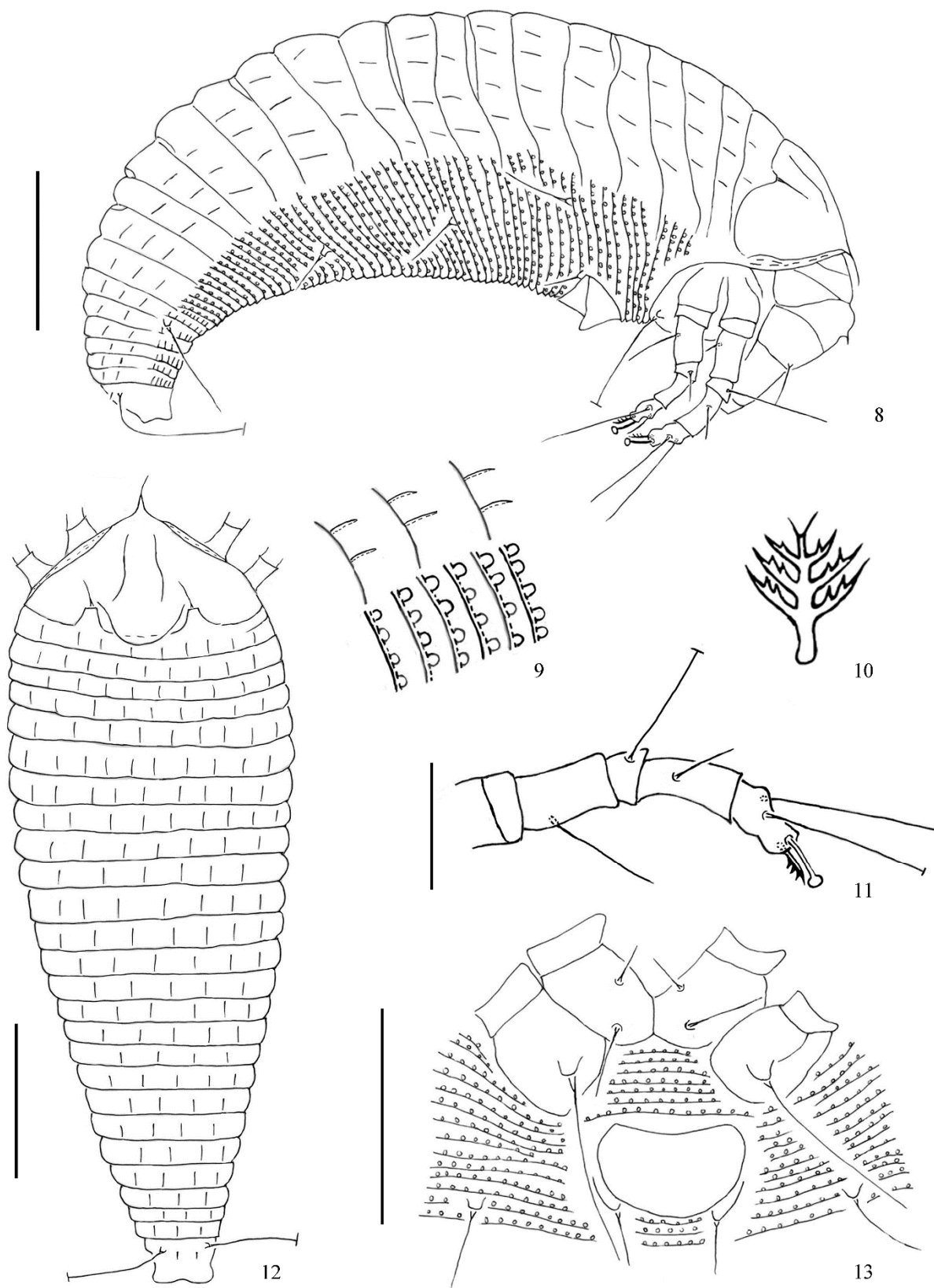
Diagnosis. Body fusiform, color light yellowish. Gnathosoma large and projecting straight down; prodorsal shield anterior lobe taper, a projecting filament on the apex, admedian lines present. Scapular tubercles on rear shield margin, scapular setae (*sc*) projecting forward. Coxisternal plates smooth. Legs with tarsal empodium simple, 4-rayed, tarsal solenidion knobbed large. Opisthosoma with 22–25 dorsal annuli ornamented with longitudinal lines and 63–67 ventral annuli with round microtubercles. Setae *hl* present. Female genitalia coverflap smooth.

Description. Protogyne (Figs 8–13). Female ($n=8$). Body fusiform, 235 (195–260), 85 (83–85) wide, 85 (83–88) thick; yellowish in color. Gnathosoma 49 (49–50), projecting straight down; dorsal pedipalp genual setae (*d*) 13 (12–13), pedipala coxal setae (*ep*) 3 (2–3). Prodorsal shield 36 (30–36), 70 (70) wide, anterior shield lobe taper, a projecting filament on the apex, 5 (5–6). Shield design with admedian lines present. Scapular tubercles on rear shield margin, 26 (24–26) apart; scapular setae (*sc*) 12 (10–12), projecting forward. Coxigenital region with 6 (6–7) microtuberculated semiannuli. Coxal plates smooth, anterolateral setae on coxisternum I (*lb*) 8 (7–10), 11 (10–12) apart; proximal setae on coxisternum I (*la*) 15 (10–15), 10 (10–12) apart; proximal setae on coxisternum II (*2a*) 40 (40–43), 28 (28–32) apart; prosternal apodeme 7 (6–7). Leg I 47 (44–47), trochanter 4 (3–4), femur 15 (15), basiventral femoral setae (*bv*) 16 (15–16); genu 5 (5), antaxial genual setae (*l'*) 30 (28–30); tibia 13 (12–13), paraxial tibial setae (*l'*) 10 (8–10), located 1/3 from dorsal base; tarsus 10 (9–10), paraxial fastigial tarsal setae (*ft'*) 28 (28–30), antaxial fastigial tarsal setae (*ft''*) 30 (29–30); tarsal empodium (*em*) entire, 5 (5), 4-rayed; tarsal solenidion (ω) 5 (5–6), with a big knob. Leg II 45 (42–46), trochanter 4 (3–4), femur 15 (15), basiventral femoral setae (*bv*) 17 (15–18); genu 5 (5), antaxial genual setae (*l''*) 10 (10–12); tibia 11 (10–12); tarsus 10 (9–10), paraxial fastigial tarsal setae (*ft'*) 8 (5–8), antaxial fastigial tarsal setae (*ft''*) 29 (29–30); tarsal empodium (*em*) entire, 5 (5), 4-rayed; tarsal solenidion (ω) 5 (5–6), with a big knob. Opisthosoma with 25 (22–25) dorsal annuli, sculptured with longitudinal lines on margin annuli; ventrally with 63 (63–67) semiannuli, with rounded microtubercles except caudal 7–8 ventral annuli with elongated microtubercles; setae *c*2 18 (18–20) on ventral annulus 12, 65 (57–65) apart; setae *d* 15 (15–20) on ventral annulus 25, 36 (35–40) apart; setae *e* 11 (10–13) on ventral annulus 43, 23 (20–23) apart; setae *f* 30 (30–40) on 6th ventral annulus from rear, 27 (27–32) apart. Setae *hl* 2 (2), 8 (8) apart; setae *h*2 100 (80–100), 10 (10) apart. Female genitalia 16 (16–18), 30 (30–32) wide, coverflap smooth, setae *3a* 11 (10–12), 16 (15–20) apart.

Male. Not seen.

Deutogyne (Figs 14–20). Female ($n=11$). Body fusiform, 150–235, 75–85 wide, 80–83 thick; orange in color. Gnathosoma 48–50, projecting straight down; dorsal pedipalp genual setae (*d*) 13–15, pedipala coxal setae (*ep*) 3. Prodorsal shield subtriangular, 35–38, 58–60 wide, design with admedian and submedian lines present. Anterior shield lobe taper, with a projecting filament on the apex, 5–6. Shield Scapular tubercles on ahead of rear shield margin, 22–25 apart; scapular setae (*sc*) 10–12, projecting forward. Coxal plates smooth, anterolateral setae on coxisternum I (*lb*) 8–12, 6–10 apart; proximal setae on coxisternum I (*la*) 14–16, 6–9 apart; proximal setae on coxisternum II (*2a*) 30–40, 20–30 apart; prosternal apodeme 5–6. Leg I 41–46, trochanter 4–5, femur 11–12, basiventral femoral setae (*bv*) 15–17; genu 5, antaxial genual setae (*l''*) 25–28; tibia 12–14, paraxial tibial setae (*l'*) 5–7, located 1/3 from dorsal base; tarsus 9–10, paraxial fastigial tarsal setae (*ft'*) 19–20, and antaxial fastigial tarsal setae (*ft''*) 20–22; tarsal empodium (*em*) 5, entire, 4-rayed; tarsal solenidion (ω) 6, knobbed large. Leg II 38–43, trochanter 4–5, femur 11–12, basiventral femoral setae (*bv*) 15–20; genu 5, antaxial genual setae (*l''*) 8–10; tibia 10–11; tarsus 9–10, paraxial fastigial tarsal setae (*ft'*) 5–7, antaxial fastigial tarsal setae (*ft''*) 20–22;

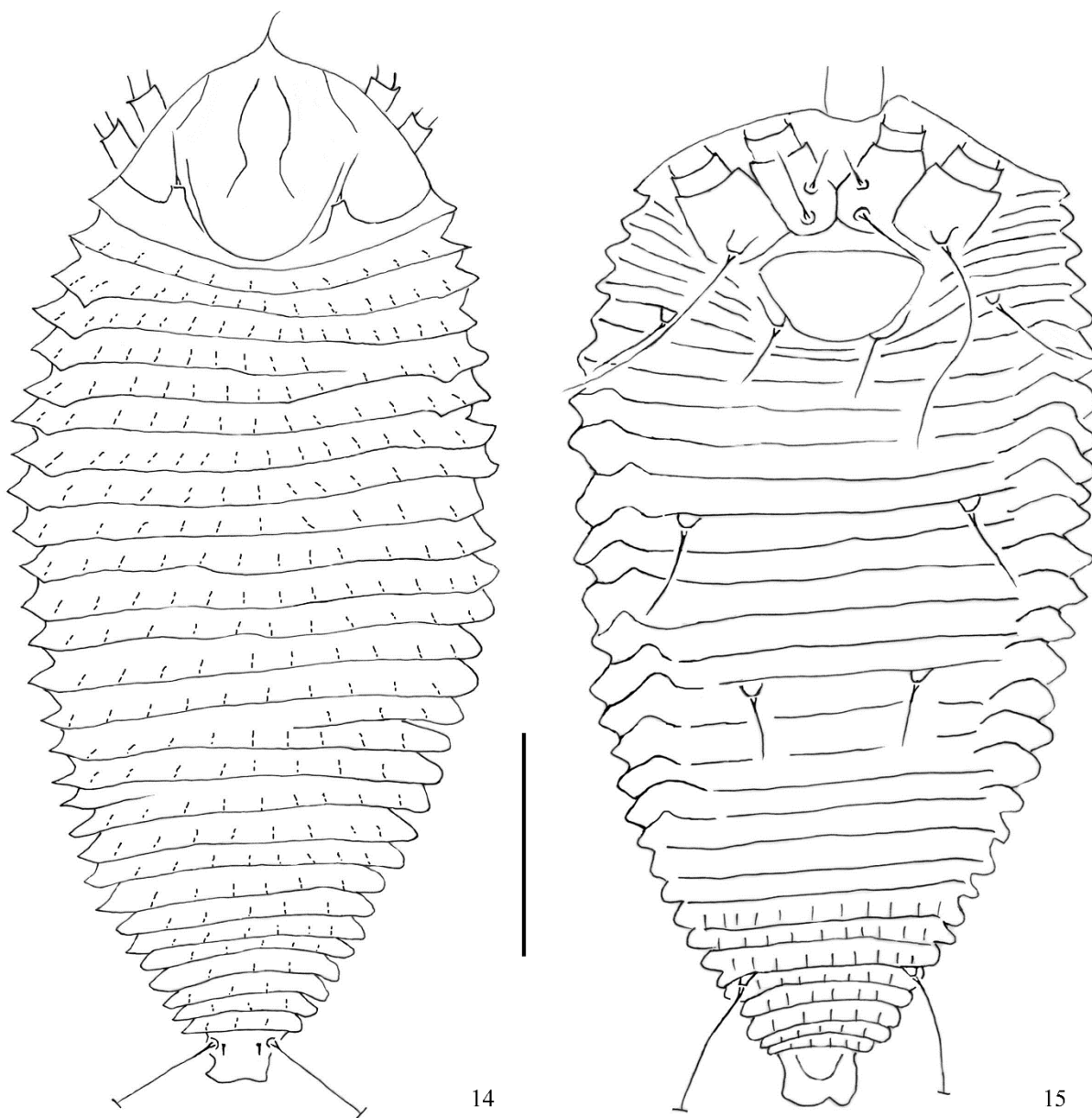
tarsal empodium (*em*) 5, entire, 4-rayed; tarsal solenidion (ω) 6, knobbed large. Opisthosoma with 27–30 dorsal annuli, smooth; ventrally with 32–36 semiannuli, smooth except caudal 8–9 ventral annli with elongated microtubercles; setae *c*2



Figures 8–13. Protogyne of *Rhyncaphytoptus schifilus* **sp. nov.**, female. 8. Lateral view. 9. Lateral opisthosoma (enlarged). 10. Empodium (enlarged). 11. Leg I. 12. Dorsal view. 13. Coxal-genital region. Scale bars: 8, 12–13 = 50 μ m; 11 = 20 μ m.

12–15 on ventral annulus 7, 50–60 apart; setae *d* 13–15 on ventral annulus 13, 35–40 apart; setae *e* 7–10 on ventral annulus 18, 20–21 apart; setae *f* 25–30 on 6th ventral annulus from rear, 23–27 apart. Setae *h1* 2, 8 apart; setae *h2* 70–100, 10 apart. Female genitalia 15–16, 25–30 wide, coverflap smooth, setae *3a* 9–10, 15–16 apart.

Male ($n=2$). Body fusiform, 130, 70 wide; Gnathosoma 46, projecting straight down; dorsal pedipalp genual setae (*d*) 10, pedipala coxal setae (*ep*) 2. Prodorsal shield subtriangular, 38, 47 wide, apex of anterior shield lobe with a projecting filament, 5. Scapular tubercles on ahead of rear shield margin, 20 apart; scapular setae (*sc*) 10, projecting forward. Coxal plates smooth, anterolateral setae on coxisternum I (*lb*) 6, 6 apart; proximal setae on coxisternum I (*la*) 10, 4 apart; proximal setae on coxisternum II (*2a*) 22, 18 apart; prosternal apodeme 3. Leg I 41, trochanter 5, femur 10, basiventral femoral setae (*bv*) 20; genu 5, antaxial genual setae (*l''*) 25; tibia 12, paraxial tibial setae (*l'*) 10, located 1/3 from dorsal base; tarsus 9, paraxial fastigial tarsal setae (*ft'*) 19, antaxial fastigial tarsal setae (*ft''*) 20; tarsal empodium (*em*) 5, entire, 4-rayed; tarsal solenidion (ω) 6, knobbed. Leg II 40, trochanter 5, femur 10, basiventral femoral setae (*bv*) 16; genu 5, antaxial genual setae (*l''*) 12; tibia 11; tarsus 9, paraxial fastigial tarsal setae (*ft'*) 7, antaxial fastigial tarsal setae (*ft''*) 20; tarsal empodium (*em*) 5, entire, 4-rayed; tarsal solenidion (ω) 6, knobbed. Opisthosoma with 26 dorsal annuli; ventrally with 27 semiannuli, smooth; setae *c2* 12 on ventral annulus 5, 50 apart; setae *d* 15 on ventral annulus 10, 36 apart; setae *e* 8 on ventral annulus 15, 20



Figures 14–15. Deutogyne of *Rhyncaphytoptus schifilus* **sp. nov.**, female. 14. Dorsal view. 15. Ventral view. Scale bars = 40 μm.

apart; setae *f* 28 on 5th ventral annulus from rear, 23 apart. Setae *h1* 3, 4 apart; setae *h2* 70–80, 6 apart. Male genitalia 20 wide, setae *3a* 10, 16 apart.

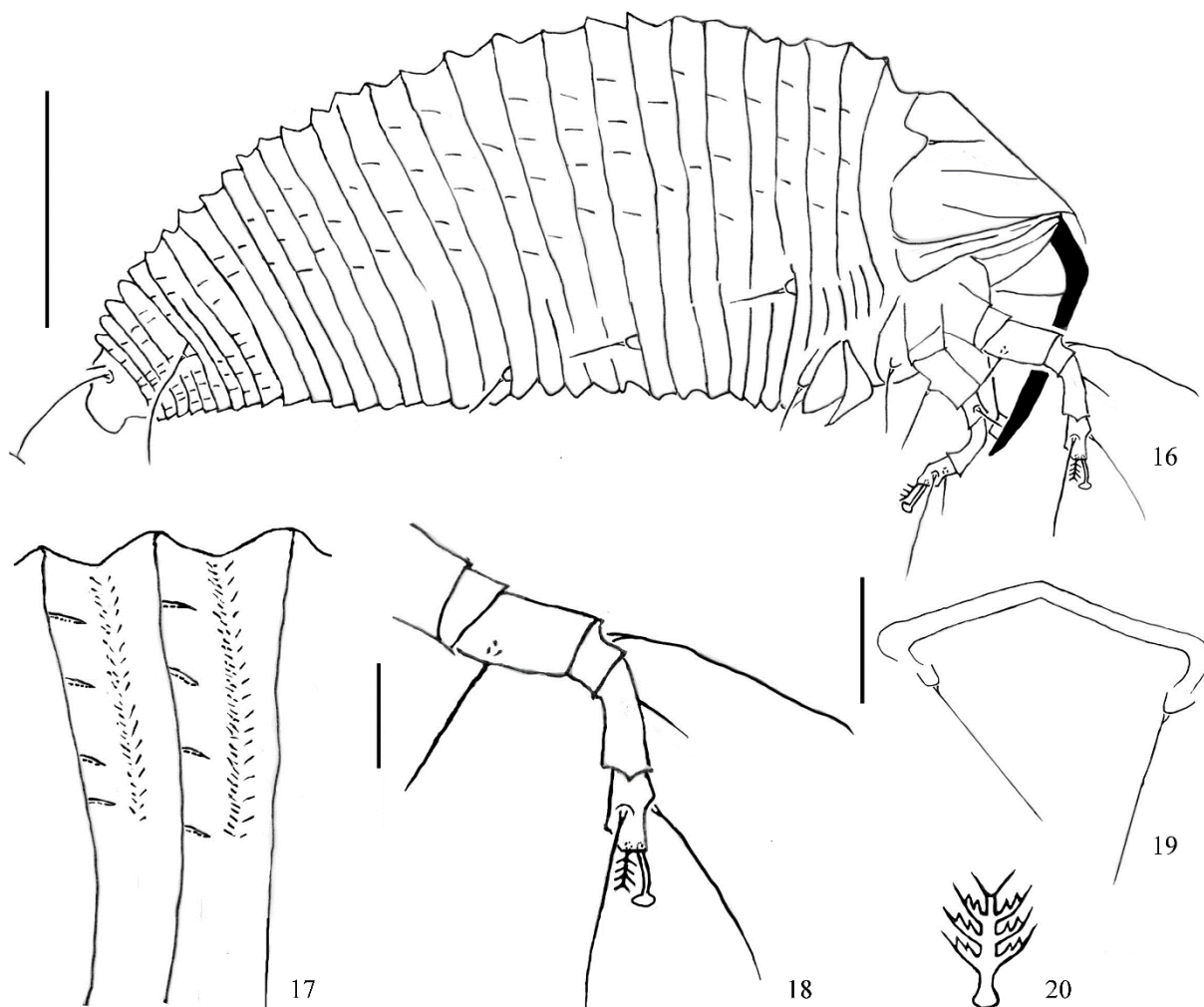
Material examined. Holotype, female, protogyne, from *Sorbus setschwanensis* (C.K. Schneider) Koehne (Rosaceae), Wanglang Nature Reserve (32°58'04"N, 104° 06'42"E, elev. 2529 m), Pingwu, Sichuan, China, 17 August 2016, coll. Manchao Xie. Paratypes, 7 females, protogyne, the same data as holotype; 11 females and 2 males, deutogyne, the same data as holotype.

Relation to host. Vagrant on the undersurfaces of leaves, no obvious damage seen.

Etymology. The specific designation *schifilus* is made up of *sch-i-fil-us*, *sch-* is derived from abbreviation of Sichuan; *fil-* is from the word filament, meaning the mite's important character; *us-* is as the gender masculine end.

Remarks. In Diptilomiopidae, the new species is the second eriophyoid mites reported on *Sorbus* spp. except *Diptacus sorbusis* Song, Xue & Hong, 2007 from Gansu Province. The new species is similar to *R. sorbi* Liro, 1943 by the shield design pattern and the coverflap of female genitalia smooth, but can be differentiated from the latter by the apex of anterior shield lobe with a projecting filament (without the projecting filament in *R. sorbi*), the dorsal annuli sculptured with longitudinal lines (smooth in *R. sorbi*), tarsal empodium 4-rayed (7-rayed in *R. sorbi*), tarsal solenidion with a big knob (unknobbed in *R. sorbi*).

By opisthosoma with annuli subequal dorsoventrally, the deutogyne mites can be easily recognized as the species of *Rhinophytoptus*. But the author infers that the mites are the deutogyne status of *R. schifilus* **sp. nov.** by following: (1) the mites were collected with the same data as the protogyne; (2) the two associated types were found in the same place and on the leaves of same host plant; (3) the morphological characteristics of the mites are similar to the protogyne type (such as, both of them are: prodorsal shield design with admedian lines present, anterior lobe taper, a projecting filament on apex;



Figures 16–20. Deutogyne of *Rhyncaphytoptus schifilus* **sp. nov.**, female (except Fig. 19). 16. Lateral view. 17. Lateral opisthosoma(enlarged). 18. Leg I. 19. Genital region of male. 20. Empodium (enlarged). Scale bars: 16=50 μ m; 18–19=10 μ m.

scapular setae projecting forward; legs with tarsal empodium simple, 4-rayed, tarsal solenidion knobbed large; female genitalia coverflap smooth; setae *h1* present, and so on); (4) the mite's opisthosoma with ventral annuli are smooth except caudal 8–9 ventral annuli with elongated microtubercles.

As a result, the new species, *R. schifilus* **sp. nov.**, exhibits two types here, protogyne type and deutogyne type, respectively.

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