

Article

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A new species of *Agistemus* (Acari: Stigmaeidae) as a predatory agent of eriophyid mites in olive orchards in Guilan, Iran

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Abstract

A new species, *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei **sp. nov.** was collected from olive leaves and litter in olive orchards, *Olea europaea* L. (Oleaceae) in Manjil vicinity, Guilan province, Iran, is described and illustrated.

Key words: Predatory mite, prey, Stigmaeidae, phytophagous mite, biological control.

Introduction

The family Stigmaeidae (Acari: Raphignathoidea) is a large cosmopolitan group consisting of more than 32 genera and about 500 described species which *Agistemus* is the third richest genus of Stigmaeidae with 85 species (Stathakis *et al.* 2014), and mites of this genus are often found on aerial parts of plants. The genus *Agistemus* was erected by Summers (1960) based on type species *Caligonus terminalis* Quayle, 1912. Wood (1967) and Tseng (1982) suggested the genus *Agistemus* as a junior synonym of *Zetzellia* Oudemans, 1927, based on Gonzalez' (1965) observation that *Zetzellia mali* (Ewing) and *Agistemus striolatus* Gonzalez–Rodriguez went through similar ontogenetic changes in organization of dorsal plates from larva to adult and thus that *Agistemus* evolved from the *Zetzellia maori* group of species.

Species of this genus are known to prey on phytophagous mites such as Tetranychidae, Tenuipalpidae and Eriophyidae, and also on eggs of white-flies and scale insects (Hafez *et al.* 1983; Osman & Zaki 1986; Abou-Awad & Elsawi 1993; Momen 2001; Ferla & de Moraes 2003).

The main objective of the present paper was to search for biological control agents for olive eriophyid mites in Manjil vicinity, Guilan province, Iran. A new species, *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei **sp. nov.** was collected from olive leaves and litter during these surveys and is described here.

Materials & methods

Mites were collected from leaves and litter of olive trees, *Olea europaea* L.

(Oleaceae). The collected mites were mounted directly on slides in Hoyer's medium. The slides were dried in an oven, sealed with industrial paint and examined with an Olympus BX51 Differential Interference Contrast (DIC) microscope. Drawings were made by means of a camera lucida. Notations for the gnathosomal and idiosomal setae follows Grandjean (1946, 1939), respectively as adapted for Prostigmata by Kethley (1990). The notations for leg setae follows that proposed by Grandjean (1944). All measurements are presented in micrometer (μm) and the measurements of the holotype are followed by ranges of the paratypes in parentheses.

Family Stigmaeidae Oudemans, 1931

Type genus: *Stigmaeus* Koch, 1836

Genus *Agistemus* Summers, 1960

Type species: *Caligonus terminalis* Quayle, 1912, by original designation.

Genus diagnosis

Chelicerae separate; palptibial claw slightly shorter than palptarsus; prodorsum with a large shield bearing 3 pairs of setae, *vi* absent; dorsal hysterosomal area medially covered with a hexagonal shield, usually with 5 pairs of setae; intercalary shields obvious, divided along midline, with 1 pair of setae. Suranal shield entire, with 2 pairs of setae, *h*₃ absent. Ventral opisthosoma with 1–2 pairs of aggenital setae; genitoanal valves with 1 pair of genital setae and 3 pairs of pseudanal setae (Fan & Zhang 2005).

Agistemus manjilicus Khanjani, Hajizadeh & Zarei sp. nov. (Figs. 1–18)

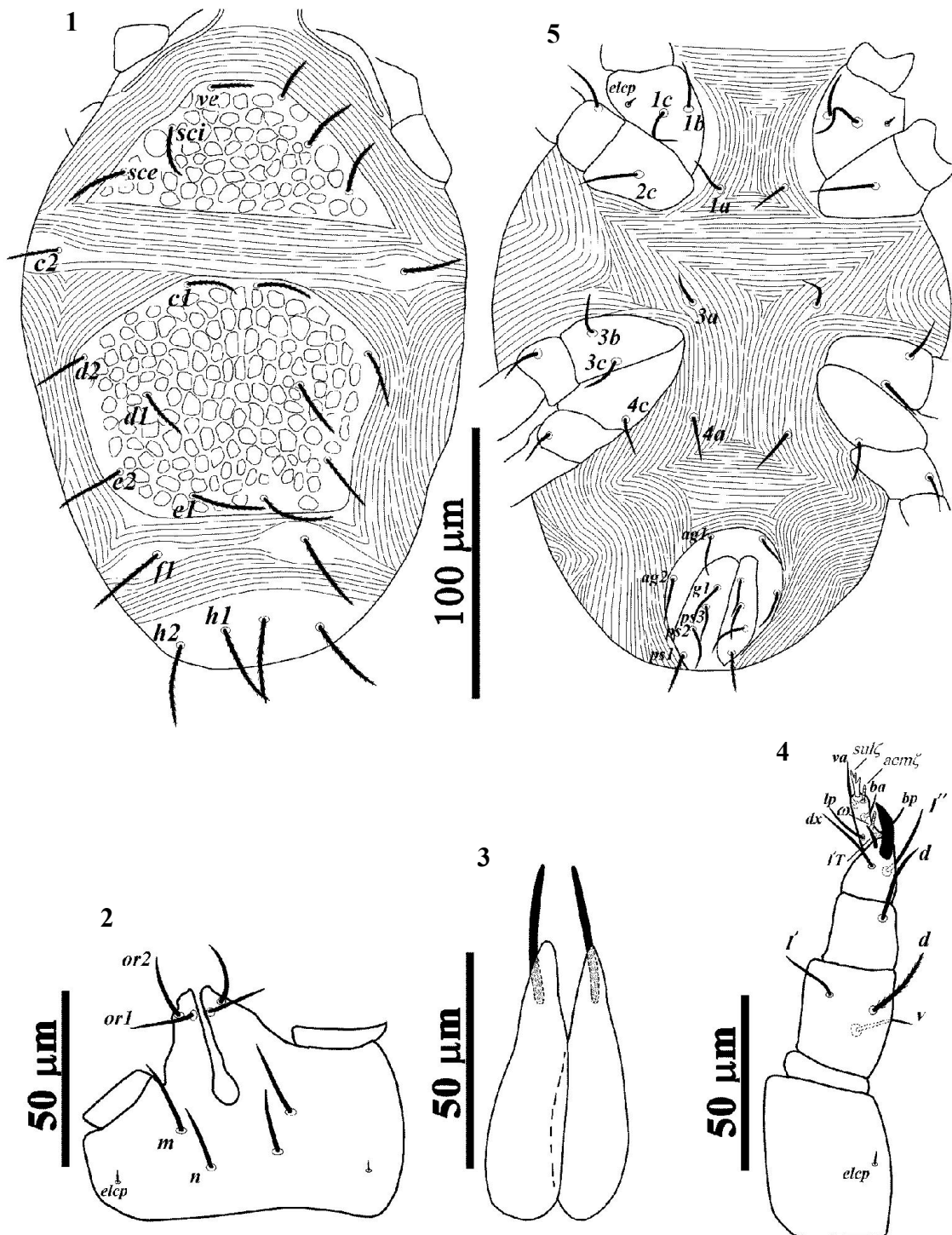
Diagnosis of female

Propodosomal and metapodosomal shields reticulated; *pob* about 1.6 times as large as eye; dorsal idiosomal setae *sci* 1.5 times diameter of *pob*; *ve*: *ve-sci* = 0.9; *c*₁: *c*₁–*c*₁ = 0.8; coxa IV with 1 seta; femur I with 4 setae; genu I with 2 + 1 κ ; tibia IV with 4 setae; tarsus I with 11 + 1 ω ; tarsus IV with 7 setae; tibia IV without $\varphi\rho$; tarsus IV without ω .

Female (n = 5) - Idiosoma broadly oval in dorso-ventral view. Measurements of holotype followed by measurements of paratypes in parentheses: length of body including gnathosoma 370 (380–390), length of body excluding gnathosoma 250 (255–270); width 170 (180–195).

Dorsum (Fig. 1) - Propodosomal and metapodosomal plates with polyhedral reticulation, intercalary plate and suranal plate are smooth. Eyes 9 (9–10) in diameter; *pob* 15 (13–16) in diameter; All dorsal setae serrated and truncate. Measurement of dorsal setae: *ve* 16 (16–17), *sci* 22 (23–27), *sce* 23 (22–24), *c*₁ 21 (21–23), *c*₂ 24 (23–27), *d*₁ 21 (21–25), *d*₂ 22 (24–26), *e*₁ 29 (31–32), *e*₂ 29 (31–36), *f*₁ 34 (33–37), *h*₁ 35 (36–39), *h*₂ 33 (34–36); distances between dorsal setae: *ve-ve* 28 (25–30), *sci-sci* 53 (55–60), *ve-sci* 21 (22–25), *sci-sce* 24 (22–25), *sce-c*₁ 50 (48–52), *c*₁–*c*₁ 26 (25–27), *c*₂–*c*₂ 135 (133–145), *c*₁–*d*₁ 40 (41–44), *d*₁–*d*₁ 56 (58–60), *d*₁–*d*₂ 28 (25–30), *d*₁–*e*₁ 42 (42–46), *d*₁–*e*₂ 29 (29–32), *d*₂–*e*₂ 41 (40–45), *d*₂–*d*₂ 105 (106–110), *e*₁–*e*₁ 27 (25–29), *e*₂–*e*₂ 83 (82–85), *e*₁–*f*₁ 23 (25–28), *f*₁–*f*₁ 54 (55–58), *f*₁–*h*₁ 34 (32–36), *h*₁–*h*₁ 15 (18), *f*₁–*h*₂ 35 (32–35), *h*₂–*h*₂ 52 (52–54), *h*₁–*h*₂ 19 (16–19); ratio: *ve*: *ve-ve* 0.57 (0.56–0.64), *c*₁: *c*₁–*c*₁ 0.80 (0.84–0.85), *d*₁: *d*₁–*d*₁ 0.37 (0.36–0.38), *e*₁: *e*₁–*e*₁ 1.07 (1.1–1.24), *f*₁: *f*₁–*f*₁ 0.62 (0.6–0.63), *h*₁/*h*₁–*h*₁ 2.33 (2–2.16), *h*₂/*h*₂–*h*₂ 0.63 (0.56–0.66), *h*₁: *h*₂ 1.06 (1.05–

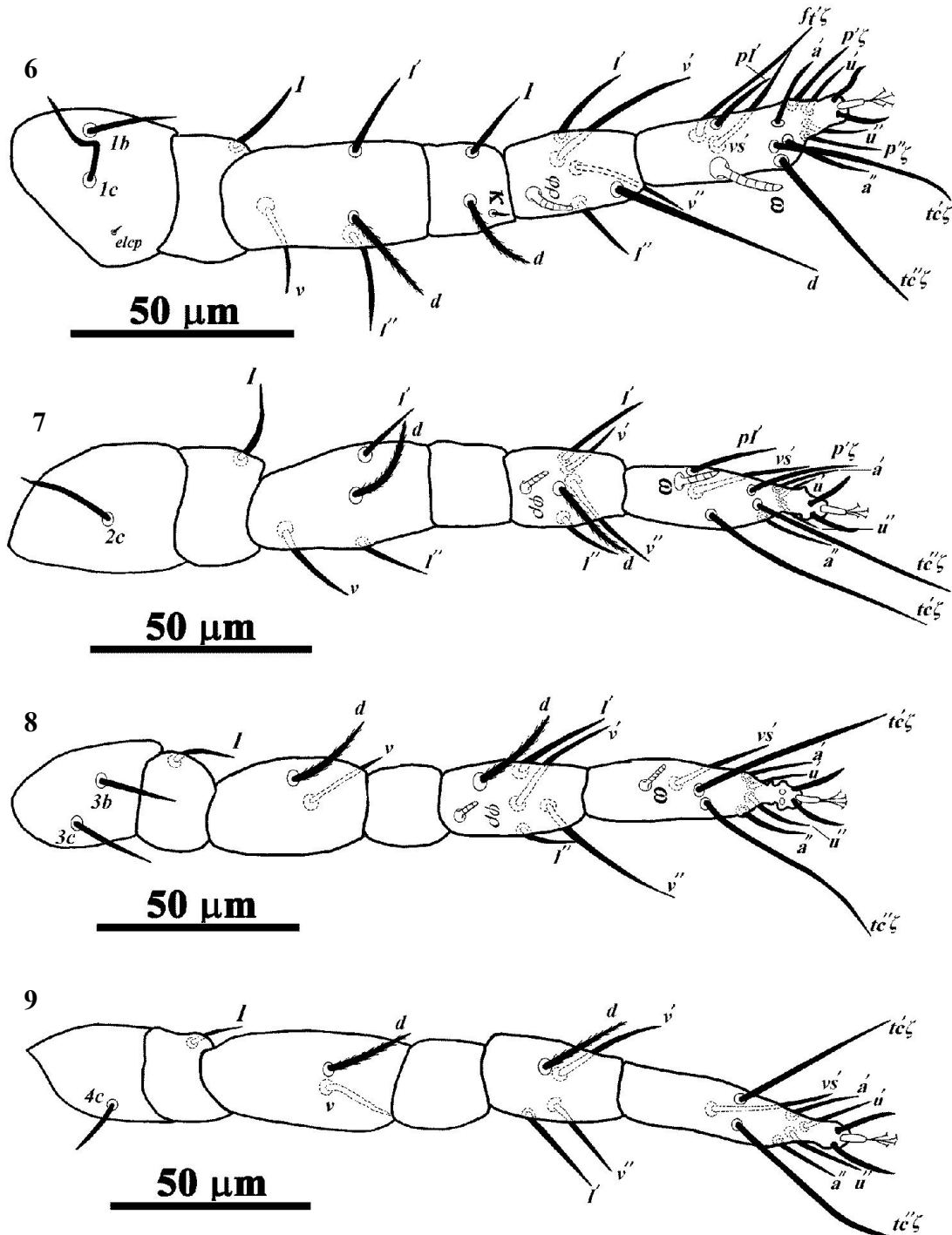
1.08), c_1-c_1 : d_1-d_1 : e_1-e_1 : f_1-f_1 : 0.48 (0.45–0.46): 1.03 (1.03–1.05): 0.5 (0.45–0.5): 1.0.



Figures 1–5. *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei **sp. nov.** (Female) - 1. Dorsal view of idiosoma; 2. Gnathosoma; 3. Chelicera; 4. Palp; 5. Ventral view of idiosoma.

Gnathosoma (Figs. 2–4) - Subcapitulum (Fig. 2) with two pairs of setae (m , n) and two pairs of sub terminal adoral setae (or_1 , or_2); m 19 (19–22), n 15 (13–16), or_1 13 (13–15), or_2 12 (12–14); distances: $m-m$ 26 (26–27), $n-n$ 20 (18–20), $m-n$ 6 (6–8), or_1-

m 30 (31–33), or_2-m 29 (21–22), or_1-or_1 4 (5), or_2-or_2 12 (12–13), or_1-or_2 4 (3–4) (Fig. 2). Chelicerae free 72 (70–78), movable digit 44 (42–48) (Fig. 3). Palp six segmented, palp tarsus with four simple setae, one solenidion and one tridentate plus one simple eupathidium; palp tibia with two setae, one accessory claw and one robust claw; palp genu with one long seta; palp femur with three setae, seta d serrated and more robust; trochanter without setae; coxa with one spiniform setae (Fig. 4).



Figures 6–9. *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei sp. nov. (Female) - 6. Leg I; 7. Leg II; 8. Leg III; 9. Leg IV.

Venter (Fig. 5) - Ventral surface ornamented with well-spaced striations; three pairs of setae between coxae, first at level of coxa II (*1a*), second anterior to coxa III (*3a*), and third at level of coxa IV (*4a*). Length of ventral setae *1a* 16 (14–16), *1b* 18 (18–21), *1c* 19 (20–22), *2c* 22 (23–35), *3a* 13 (13–16), *3b* 14 (13–16), *3c* 14 (15–17), *4a* 16 (13–15) and *4c* 14 (14–17). Anogenital region with a horseshoe-shaped shield surrounding genital opening anteriorly, with two pairs of aggenital setae (*ag1–2*); ano-genital region with four pairs of setae (*g1*, *ps1*, *ps2*, and *ps3*), *ps1* robust and slightly serrated (Fig. 5). Measurements of setae: *ag1* 17 (16–19), *ag2* 21 (20–25), *g* 21 (21–23), *ps1* 20 (18–20), *ps2* 17 (17–20), *ps3* 15 (16–18). Distances: *ag1–ag1* 25 (20–25), *ag2–ag2* 40 (41–46), *ag1–ag2* 30 (26–32); *g–g* 9 (10–14), *g–ps1* 9 (9–10), *ps1–ps1* 19 (20–22), *ps2–ps2* 22 (25–28), *ps3–ps3* 17 (15–20), *ps1–ps2* 9 (10), *ps2–ps3* 10 (8–10).

Legs (Figs. 6–9) - Length of leg I 187 (190–198); leg II 178 (180–186); leg III 188 (183–195), leg IV 199 (200–206). Setal formulae of leg segments as follows (specialized setae not included in setal number): coxae 2+*elcp*-1-2-1; trochanters 1-1-1-1; femora 4-4-2-2; genua 2+1 κ -0-0-0; tibiae 5 +1 $\varphi\rho$ -5 +1 $\varphi\rho$ -5+1 $\varphi\rho$ -4; tarsi 11+1 ω -9+1 ω -7+1 ω -7. Length of solenidia: I ω 12 (10–12), II ω 9 (9–10), III ω 7 (5–7). I $\varphi\rho$ 9 (9–10), II $\varphi\rho$ 5 (6), III $\varphi\rho$ 3 (3–4); I κ 4 (3–4). Coxa I with one *elcp* seta 3 (3) (Figs. 6–9).

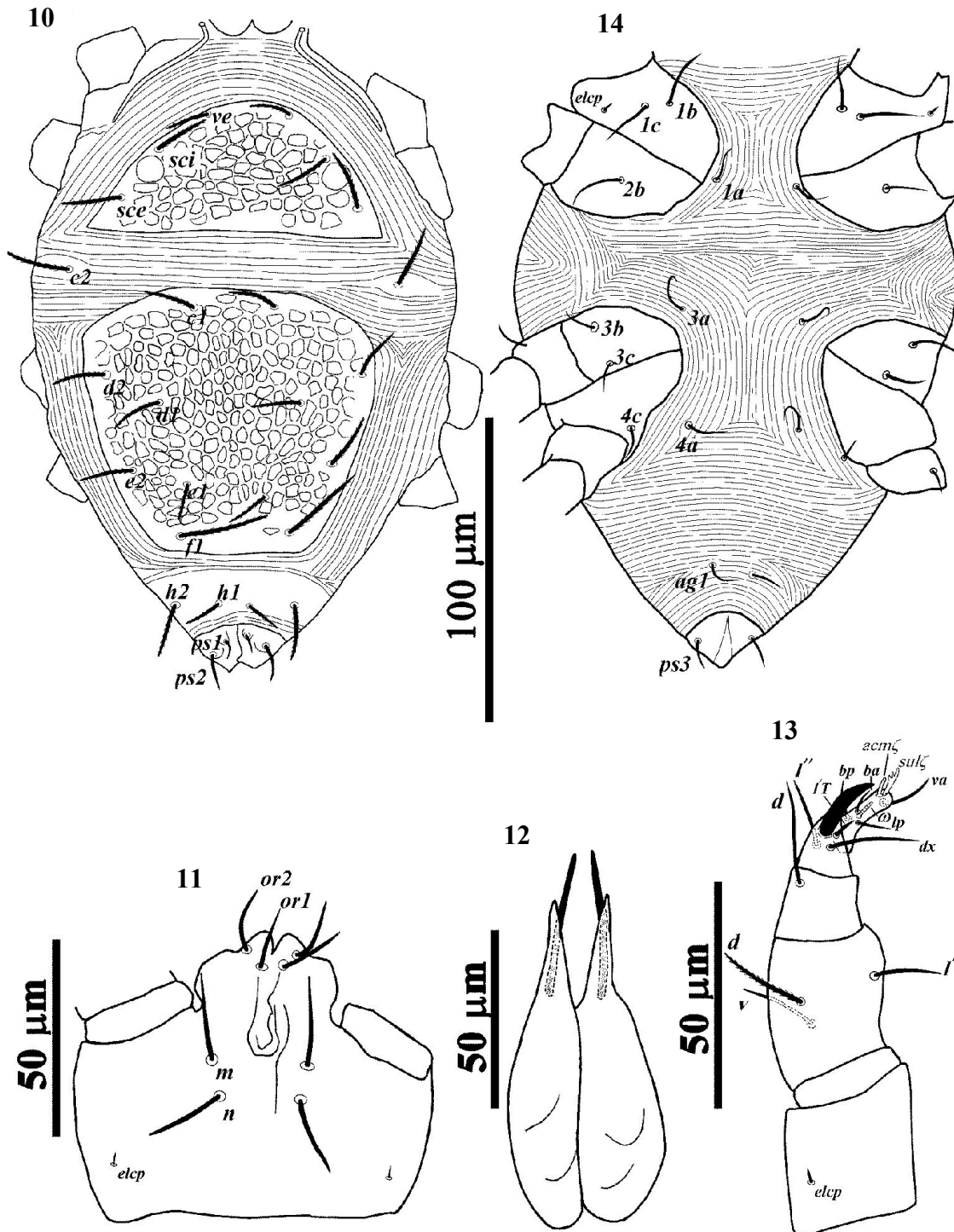
Male (n = 1) - Length of body including gnathosoma 325, length of body excluding gnathosoma 215; width 155.

Dorsum (Fig. 10) - All dorsal setae serrated; measurement of dorsal setae: *ve* 19, *sci* 23, *sce* 23, *c1* 20, *c2* 23, *d1* 18, *d2* 22, *e1* 13, *e2* 23, *f1* 35, *h1* 14, *h2* 24; distances between dorsal setae: *ve–ve* 29, *ve–sci* 29, *sce–c1* 47, *c1–c1* 28, *c2–c2* 117, *c1–d1* 36, *d1–d1* 50, *d1–d2* 20, *d1–e1* 36, *d1–e2* 23, *d2–e2* 24, *d2–d2* 88, *e1–e1* 26, *e2–e2* 68, *e1–f1* 19, *f1–f1* 36, *f1–h1* 28, *h1–h1* 10, *f1–h2* 24, *h2–h2* 40, *h1–h2* 14; ratio: *ve: ve–ve* 0.65, *c1: c1–c1* 0.71, *d1: d1–d1* 0.36, *e1: e1–e1* 0.50, *f1: f1–f1* 0.97, *h1/h1–h1* 1.40, *h2/h2–h2* 0.60, *h1: h2* 0.58, *c1–c1: d1–d1: e1–e1: f1–f1: 0.77: 1.38: 0.72: 1.0*.

Gnathosoma (Figs. 11–13) - Subcapitulum (Fig. 11) with two pairs of setae (*m*, *n*) and two pairs of subterminal adoral setae (*or1*, *or2*); *m* 22, *n* 16, *or1* 12, *or2* 12; distances: *m–m* 25, *n–n* 19, *m–n* 10, *or1–m* 27, *or2–m* 29; *or1–or1* 6, *or2–or2* 15, *or1–or2* 5 (Fig. 11). Palp six segmented, palp tarsus with four simple setae, one solenidion and one tridentate plus one simple eupathidion; palp tibia with two setae, one accessory claw and one robust claw; palp genu with one long seta; palp femur with three setae, seta *d* serrated and more robust; trochanter without setae; coxa with one spiniform seta (Fig. 13).

Venter (Fig. 14) - Ventral surface ornamented with well-spaced striations; three pairs of slender setae between coxae, first at level of coxa II (*1a*), second anterior to coxa III (*3a*), and third at level of coxa IV (*4a*). Length of ventral setae *1a* 13, *1b* 20, *1c* 22, *2c* 20, *3a* 14, *3b* 16, *3c* 15, *4a* 13, and *4c* 12. Terminal anogenital region with four pairs of setae (*ag1*, *ps1*, *ps2*, *ps3*) (Fig. 14). Measurements of setae: *ag1* 13, *ps1* 7, *ps2* 11, *ps3* 12. Distances: *ag1–ag1* 13, *ps1–ps1* 8, *ps1–ps2* 7, *ps2–ps2* 20, *ps3–ps3* 19, *ps2–ps3* 15.

Legs (Figs. 15–18) - Length of leg I 180; leg II 176; leg III 169, leg IV 188. Setal formulae of leg segments as follows (specialized setae not included in setal number): coxae 2+*elcp*-1-2-1; trochanters 1-1-1-1; femora 4-4-2-2; genua 2+1 κ -0-0-0; tibiae 5 +1 $\varphi\rho$ -5 +1 $\varphi\rho$ -5+1 $\varphi\rho$ -4; tarsi 11+2 ω -9+2 ω -7+1 ω . Length of solenidia: I ω_1 14, I ω_2 8, II ω_1 12, II ω_2 10, III ω 5, IV ω 5. I $\varphi\rho$ 7, II $\varphi\rho$ 5, III $\varphi\rho$ 3; I κ 3. Coxa I with one *elcp* seta 3 (Figs. 15–18).

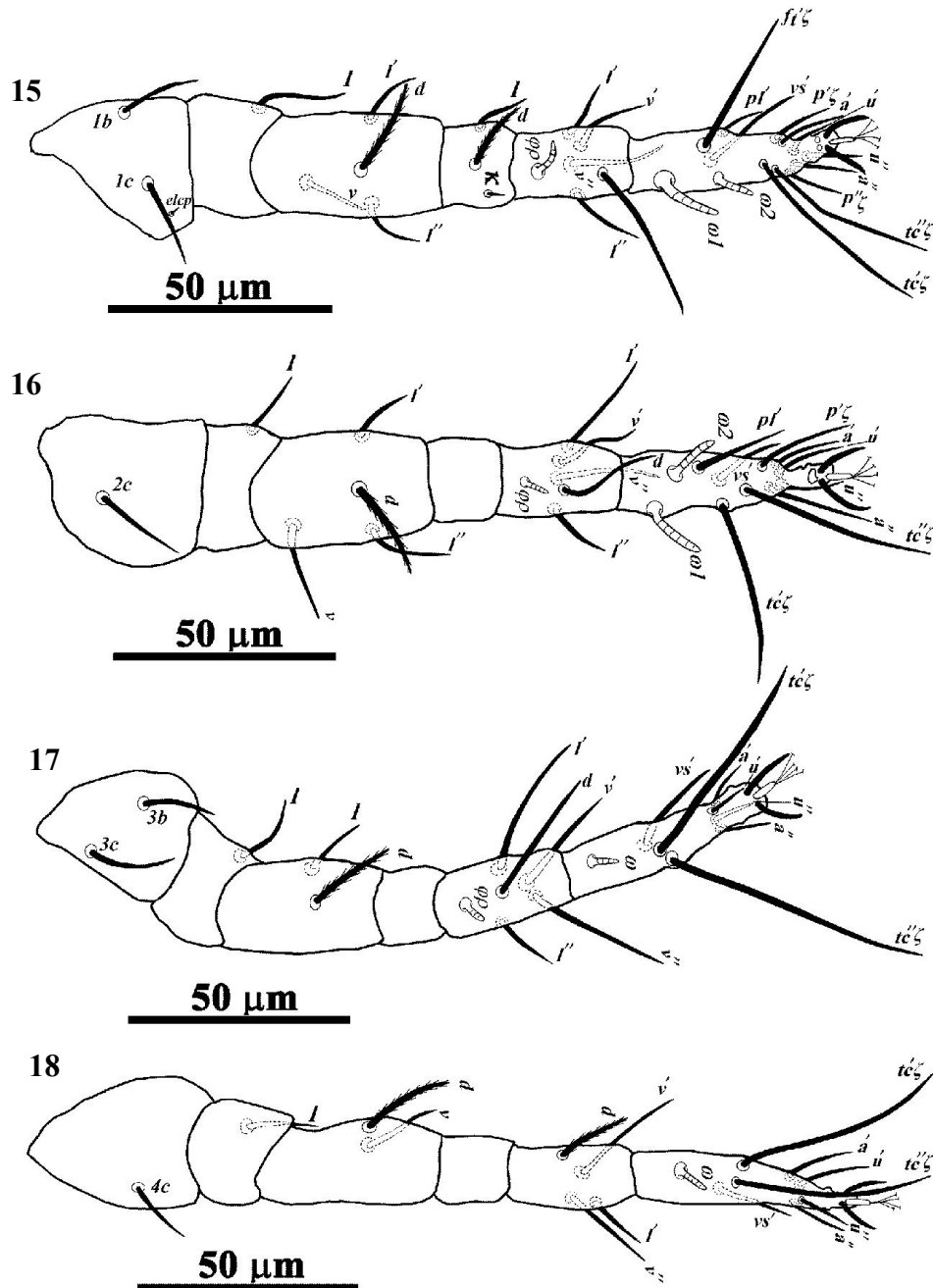


Figures 10–14. *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei **sp. nov.** (Male) - 10. Dorsal view of idiosoma; 11. Gnathosoma; 12. Chelicera; 13. Palp; 14. Ventral view of idiosoma.

Remarks

The new species closely resembles *A. collyerae* González-Rodríguez, 1963 in having almost the same leg chaetotaxy and dorsal ornamentations. However, differences are as follows: 1. Most of the dorsal setae are much shorter than those of *A. collyerae* as in the original description and in Fan & Zhang (2005); 2. *ve* is half the length of the *ve*

in *A. collyerae*; 3. Setae *sci* 1.5 times longer than diameter of *pob*; *ve*: $ve-sci = 0.9-1.08$; setae *ve* 16–17, *sci* 22–27, *sce* 22–24, *c*₁ 21–23, *c*₂ 23–27, *d*₁ 21–25, *d*₂ 22–26, *e*₁ 29–32, *e*₂ 29–36; length of leg I 190–198; leg II 180–186; leg III 183–195, leg IV 200–206 in new species instead of seta *sci* 2.8 times longer than diameter of *pob*; *sci*: $sci-sce = 1.2-1.5$; setae *ve* 20–28, *sci* 34–48, *sce* 31–43; *c*₁ 29–40, *c*₂ 31–47, *d*₁ 34 (27–43), *d*₂ 29–43, *e*₁ 36–50, *e*₂ 36–50; length of leg I 161–169; leg II 142–157; leg III 143–155, leg IV 156–168 in Fan & Zhang (2005); 4. Tarsus IV with 7 setae vs. 8 setae in description of González-Rodríguez (1963); 5. Setae *gl* and *ag*₂ much shorter than those of the two descriptions because they are subequal to the other anogenital setae, while in the other two descriptions they are clearly longer.



Figures 15–18. *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei sp. nov. (Male)
- 15. Leg I; 16. Leg II; 17. Leg III; 18. Leg IV.

Type material

The holotype female, four paratype females and one male were collected from olive leaves and litter of olive trees, *Olea europaea* L. (Oleaceae) in Manjil vicinity, Guilan province, north Iran. (49° 45' N, 36° 45' E, a.s.l. 600 m), 21 July 2013, by Hamed Zarei. The holotype female, two paratype females and one male are deposited in the Collection of the Acarology Laboratory, University of Bu–Ali Sina, Hamedan, Iran. Two paratype females are deposited in the Collection of the Acarology Laboratory, University of Guilan, Rasht, Iran.

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گونه جدیدی از جنس *Agistemus* (Acari: Stigmaeidae) به عنوان عامل شکارگر
کنه‌های اریوفید از باغ‌های زیتون استان گیلان، ایران

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چکیده

گونه جدید *Agistemus manjilicus* Khanjani, Hajizadeh & Zarei **sp. nov.** از برگ و بقایای برگ‌های درختان زیتون، (*Olea europaea* L. (Oleaceae)، اطراف منجیل، استان گیلان، ایران توصیف و ترسیم شد.
واژگان کلیدی: کنه شکارگر، طعمه، Raphignathoidea، کنه گیاهخوار، کنترل بیولوژیک.

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