

A new *Tetranychus* Dufour (Acari: Tetranychidae) associated with Solanaceae from Turkey

Sultan ÇOBANOĞLU^{1*}, Edward Albert UECKERMANN^{2,3}, Nabi Alper KUMRAL⁴

¹Department of Plant Protection, Faculty of Agriculture, Ankara University, Dışkapı, Ankara, Turkey

²ARC-Plant Protection Research Institute, Queenswood, Pretoria, South Africa

³School of Environmental Sciences and Development, North-West University, Potchefstroom Campus, Potchefstroom, South Africa

⁴Department of Plant Protection, Faculty of Agriculture, Uludağ University, Görükle Campus, Bursa, Turkey

Received: 12.06.2014

Accepted/Published Online: 22.12.2014

Printed: 30.07.2015

Abstract: A new plant-feeding mite species, *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. (Acari: Tetranychidae), is described and illustrated. The samples were collected from various solanaceous plants (Solanaceae) [black nightshade (*Solanum nigrum* L.), bittersweet nightshade (*Solanum dulcamara* L.), eggplant (*Solanum melongena* L.), spiny nightshade (*Solanum rostratum* Dunal), jimsonweed or datura (*Datura stramonium* L.), and tomato (*Lycopersicon esculentum* L.)] in Ankara Province, Turkey. A key to all species of the genus *Tetranychus* Dufour known to occur in Turkey is presented in the paper.

Key words: Acari, Tetranychidae, sp. nov., *Tetranychus solanacearum*, tomato, Ankara

1. Introduction

Spider mites (Acari: Tetranychidae) are the most important family of phytophagous mites. Worldwide, there are 70 genera of tetranychid mites, which contain 1275 species (Hoy, 2011). They have been reported on 3877 different plant species, of which 100 are economically important (Jeppson et al., 1975; Zhang, 2003; Hoy, 2011; Migeon and Dorkeld, 2006–2013).

Migeon and Dorkeld (2006–2013) mentioned 149 *Tetranychus* Dufour species from all over the world. Eighteen species of Tetranychidae were mentioned from Turkey, of which 3 species belong to the genus *Tetranychus* (Migeon and Dorkeld, 2006–2013): *Tetranychus tumidellus* Pritchard & Baker, *Tetranychus turkestanii* (Ugarov & Nikolskii), and *Tetranychus urticae* Koch. Although *Tetranychus desertorum* Banks was reported from *Gossypium hirsutum* L. (Malvaceae) in the Aegean region of Turkey by Düzgüneş (1962), it was not treated in their list. Knowledge of the Turkish tetranychids is based on Düzgüneş (1959), Çobanoğlu (1991–1992), Yüksel and Ulusoy (2000), Özman and Çobanoğlu (2001), Akyazı and Ecevit (2003), Yanar and Ecevit (2005), Bayram and Çobanoğlu (2007), Kasap and Çobanoğlu (2007), and Elma and Alaoğlu (2008).

A new plant-feeding *Tetranychus* Dufour species is described and illustrated in this paper. Specimens were collected from solanaceous plants in Ankara, Turkey.

* Correspondence: coban.sultan@gmail.com

2. Materials and methods

This new species was collected from various Solanaceae plants from the Ayaş experimental farm of the Faculty of Agriculture of Ankara University and from different parts of Ankara (Eymir, Kazan, and Merkez), Turkey.

The leaves were collected randomly from different levels of the plants. Berlese funnels were used to extract the mites from the plant material; the mites were subsequently preserved in 70% ethanol, cleared in lactophenol solution, and mounted in Hoyer's medium (Henderson, 2001). Measurements were made by means of a Zeiss Soft Imaging system. Mites were drawn using an Olympus BX51 microscope equipped with a camera lucida.

The gnathosoma was measured from the base of the chelicerae to the tip of the palptibial claw. All measurements are given in micrometers and presented as the holotype/average followed by the range in parentheses. Terminology for the idiosomal setae follows that of Lindquist (1985). All the collections were made by S Çobanoğlu (Ankara University).

A key to all species of the genus *Tetranychus* Dufour known to occur in Turkey is presented. During the construction of the key, *Tetranychus cinnabarinus* Boisd. (Acari: Tetranychidae) and *Tetranychus urticae* Koch were considered as the red and green morphological forms of *T. urticae* as proposed by Auger et al. (2013), respectively.

3. Results and discussion

3.1. Taxonomy

Family Tetranychidae Donnadieu

Genus *Tetranychus* Dufour

Type species: *Tetranychus lintearius* Dufour, 1832

3.2. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. (Figures 1–12)

3.2.1. Diagnosis

The female of this new species has a diamond-shaped pattern of dorsal striae between the setae (*e1*) and (*f1*). Terminal spinneret on palp tarsus stout and twice as long as broad. Tarsus I with only 4 setae proximal to proximal pair of duplex setae. The proximal setae on tarsus I are not in line with the proximal duplex setae. Tibia I in female with 9 setae (+ one solenidion). All empodia without mediadorsal spurs.

Male's aedeagus bending dorsally with very small knob and axis of knob almost parallel with shaft axis.

3.2.2. Female (n = 9) (Figures 1–7)

3.2.2.1. Body

Female yellowish green in color. Body length (excluding the gnathosoma) 349 (291–394); body length (including gnathosoma) 469 (392–598); width 279 (231–296).

3.2.2.2. Dorsum

Body setae long and pilose, each seta extending beyond setal base of next setae behind (Figure 1). Lengths of dorsal setae as follows: *Ve* 83 (60–100); *Sci* 136 (115–150); *Sce* 109 (100–125); *c1* 120 (100–125); *c2* 113 (100–125);

c3 94 (80–100); *d1* 112 (100–125); *d2* 111 (100–125); *e1* 109 (100–125); *e2* 109 (100–125); *f1* 97 (85–100); *f2* 85 (75–100); *h1* 52 (40–70); *h2* 43 (20–50). Female with dorsohysterosomal striae between setae (*e1*) and (*f1*) longitudinal, area between *e1* and *f1* with transverse striation, forming a diamond shape (Figure 1).

3.2.2.3. Venter

Striae anterior to genital flap longitudinal, complete to broken medially. Medioventral striae without lobes. Anogenital region with 1 pair of aggenital setae (*ag*), 2 pairs of genital setae (*g1–2*), 2 pairs of anal setae (*ps1–2*), and 1 pair of paraanal setae (*h3*) (Figure 2).

3.2.2.4. Gnathosoma

The distal part of peritreme hooked (Figure 3).

Terminal spinneret on palp tarsus stout, broad, twice as long (6.6) as wide (3.2) (ratio of length/width of spinneret: 2.1) (Figure 4).

3.2.2.5. Leg chaetotaxy

As follows (I–IV): number of setae and solenidia (in brackets and not included in setal counts) femora 10–6–4–4; genua 5–5–4–4, tibiae 9(1)–7–6–7; tarsi 13(1)+2 dupl.–13(1)+1 dupl.–9(1)–10(1). Tarsus I with only 4 pairs of setae proximal to proximal pair of duplex setae; all empodia without mediadorsal spurs (Figures 5–7).

3.2.3. Male (n = 9) (Figures 8–12)

3.2.3.1. Body

Yellowish to reddish in color. Body length 277 (244–314), including gnathosoma, 356 (327–428). Lengths of dorsal setae as follows: *Ve* 40 (40–53); *Sci* 38 (50–57); *Sce* 77 (78–89); *c1* 61 (61–80); *c2* 61 (61–76); *c3* 81 (81–89); *d1* 59 (62–80); *d2* 55 (60–79); *e1* 52 (60–75); *e2* 55 (58–68); *f1* 55 (44–54); *f2* 49 (42–60); *h1* 24 (20–37); *h2* 30 (21–37).

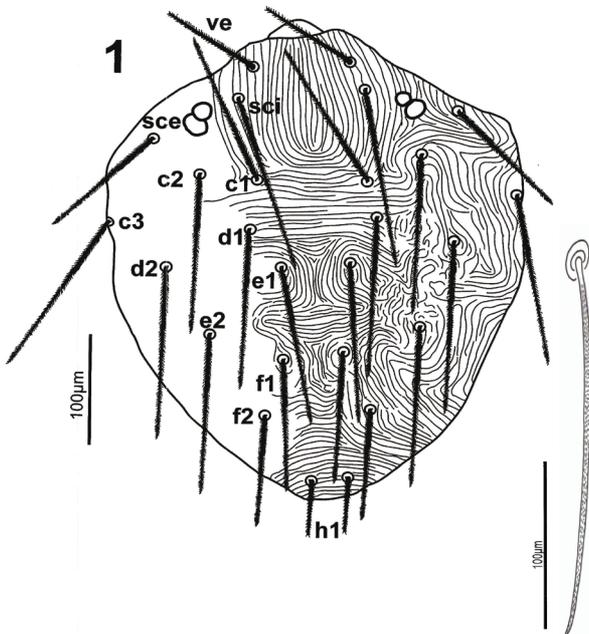


Figure 1. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov., dorsal view of female and dorsal seta.

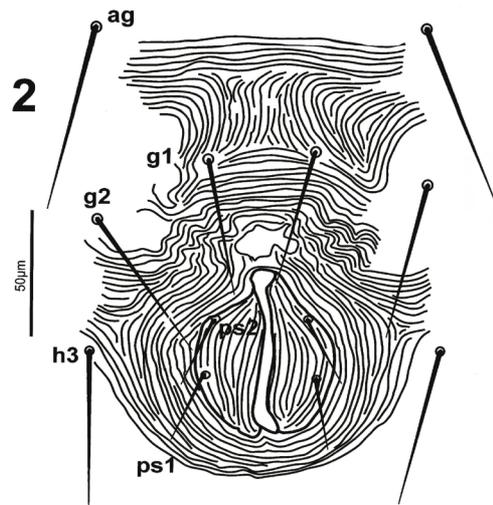
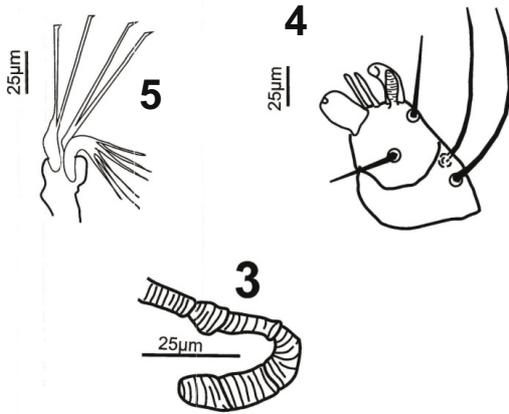


Figure 2. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov., anogenital area of female.



Figures 3–5. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. female: 3. Peritreme; 4. Palp tarsus; 5. Empodium I.

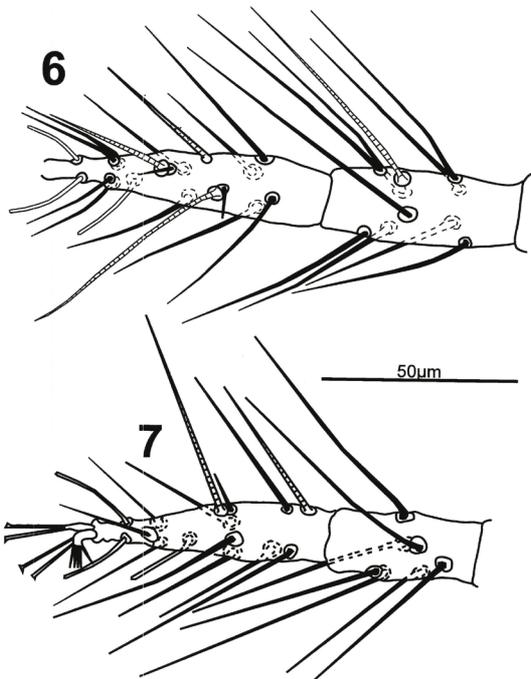


Figure 6. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. female, tibia and tarsus I.

Figure 7. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. female, tibia and tarsus II.

3.2.3.2. Gnathosoma

Terminal spinneret of palp tarsus slender, longer (5.5) than broader (2.1), (ratio of length/width of spinneret: 2.6) (Figure 8).

3.2.3.3. Leg chaetotaxy

As follows: femora 10–6–4–4; genua 5–5–4–4; tibiae 9(4)–7–6–7; tarsi 13(3)+2 dupl.–13(1)+1 dupl.–9 or 10(1)–10(1); tarsus I bears 4 tactile setae and 3 solenidia

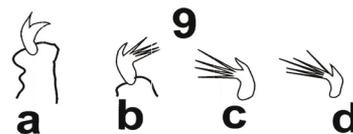
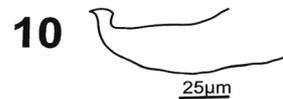
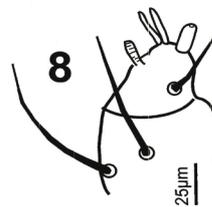
proximal to proximal duplex setae. Empodium I with a mediadorsal spur and proximoventral setae fused to form a spur; empodia II–IV each with 3 pairs of proximoventral hairs and a mediadorsal spur (Figures 9a–9d, 11, and 12).

3.2.3.4. Aedeagus

Knob very small (2.7), about one-fourth of dorsal margin of shaft (11.3), slightly angular anteriorly and pointed posteriorly, axis of knob almost parallel with shaft (Figure 10).

3.3. Remarks

Flechtmann and Knihinicki (2002) divided the genus *Tetranychus* into 9 groups based on the shape of their peritremes, dorsal striation patterns, and position of proximal tactile and/or solenidia in relation to the proximal pair of duplex setae. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. belongs to group 9, the largest group; the peritreme has a hooked shape, and dorsal striation has a diamond-shaped pattern between setae *e1* and *fl*. We have compared the aedeagus of the new species with those of all species in this group, and it resembles the following species with reference to the size (about one-fourth the length of the dorsal margin) and shape of the knob of the aedeagi (without an acute anterior projection, or with minute projection): *T. piercei* McGregor, *T. sawzdargi* Mitrofanov, *T. truncatus* Ehara, *T. umalii* Rimando, and *T. urticae* Koch (Figures 13–17). However, *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. differs from *T. piercei* in that the knob of the aedeagus is weakly sigmoid, with the neck



Figures 8–10. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. male, 8. Palp tarsus; 9a–d. Empodia I–IV; 10. Aedeagus.

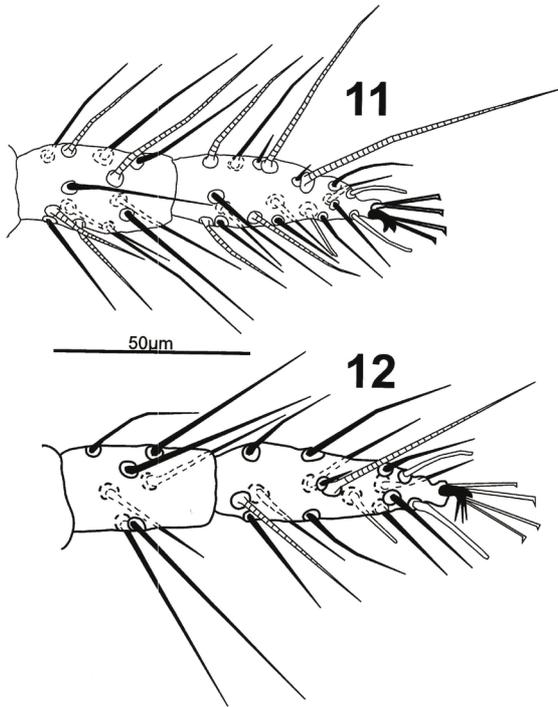


Figure 11. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. male, tibia and tarsus I.

Figure 12. *Tetranychus solanacearum* Çobanoğlu & Ueckermann sp. nov. male, tibia and tarsus II.

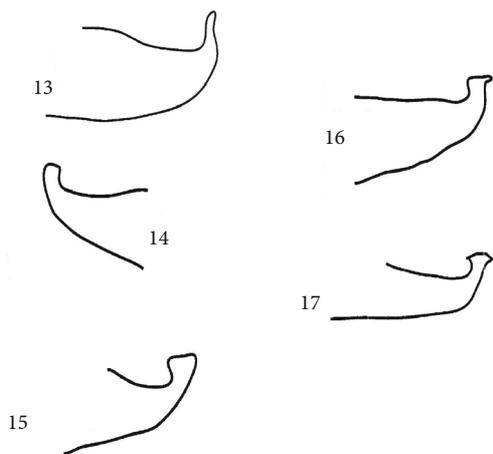


Figure 13. *Tetranychus piercei* McGregor. Aedeagus. From Seeman and Beard (2011).

Figure 14. *Tetranychus sawzdargi* Mitrofanov. Aedeagus. From Mitrofanov et al. (1980).

Figure 15. *Tetranychus truncatus* Ehara. Aedeagus. From Seeman and Beard (2011).

Figure 16. *Tetranychus umalii* Rimando. Aedeagus. From Rimando (1962).

Figure 17. *Tetranychus urticae* Koch. Aedeagus. From Meyer (1987).

tapering to a tip and without a distinct knob in the latter (Seeman and Beard, 2011). Both projections of the knob of the aedeagus of *T. sawzdargi* are hardly visible (Mitrofanov et al., 1980), while the anterior projection of the new species is distinct. The new species is closely related to *T. truncatus* and *T. umalii* in the general appearance of the aedeagi, although the anterior projection of the knob of *T. truncatus* is rounded (Ehara, 1956), while it is angular in *T. umalii* (Rimando, 1962). The dorsal surface of the knob of *T. umalii* is flat and straight, but it is slightly convex in the new species and slightly indented in *T. truncatus*. *T. solanacearum* Çobanoğlu & Ueckermann sp. nov. further differs from both of these species in that the empodia of the legs of the female are without dorsal spurs. *Tetranychus urticae* differs in that the knob of the aedeagus has acute anterior and posterior projections, and the dorsal margin of the knob can be angular or convex; only empodia I and II of the male have spurs (Meyer, 1987). This new species was also compared with *Tetranychus marianae* McGregor (redescription, de Moraes et al., 1987), as it is also associated with solanaceous plants (McGregor, 1950). It further differs from *T. marianae* in that all 4 of the empodia of the male's legs bear distinct dorsal spurs. *Tetranychus marianae* is also orange-red in color and the webbing is extraordinarily dense, while the new species is greenish and the webbing not so dense.

3.4. Material examined

Type material: Holotype: Male from *Solanum rostratum* Dunal (Solanaceae), Eymir (Ankara, Turkey) (39°49.524'N, 32°50.195'E; 975 m a.s.l.), 24.VIII.2010 (Section 132, slide number 31) (collector: S Çobanoğlu).

One paratype male from *Datura stramonium* L., Ayaş-Ankara (40°01.501'N, 32°14.101'E; 680 m a.s.l.), 06.X.2010 (Section 235, slide number 8). One paratype male from *Solanum nigrum*, Ayaş-Ankara, 08.X.2010. One paratype male from *Solanum nigrum*, Ayaş-Ankara, 25.VIII.2010. One paratype male from *Solanum nigrum*, Merkez-Ankara (39°57.375'N, 32°51.527'E; 858 m a.s.l.), 08.XI.2010. One paratype male from *Solanum melongena*, Kazan-Ankara (40°11.174'N, 32°39.504'E; 873 m a.s.l.), 20.VIII.2010; 2 paratype males from *Solanum melongena*, Kazan-Ankara (40°10.533'N, 32°39.469'E; 860 m a.s.l.), 06.VIII.2010. One paratype male from *Solanum melongena*, Ayaş-Ankara, 06.X.2010.

Allotype female from *Solanum melongena*, Ayaş-Ankara, 30.VII.2010. Paratype females as follows: 2 females from *Solanum nigrum*, Kazan-Ankara (40°11.011'N, 32°40.107'E; 860 m a.s.l.), 08.X.2010 (Section 230, slide numbers 161, 162); 3 females from *Solanum dulcamara*, Merkez-Ankara, 11.X.2010 (Section 287, slide numbers 1, 2, 3); 1 female from *Solanum nigrum*, Ayaş-Ankara, 22.IX.2010; 1 female from *Lycopersicon esculentum*, Ayaş-Ankara, 15.IX.2010; 1 female from *S. melongena*,

Kazan–Ankara (40°11.174'N, 32°39.504'E; 873 m a.s.l.), 06.VIII.2010 (slide number 174).

3.5. Depository

The holotype male, allotype female, and 7 male and 7 female paratypes are deposited in the mite collection of the Acarology Laboratory, Department of Plant Protection, Ankara University, Turkey (S Çobanoğlu). One male and one female paratype are deposited in the mite collection of Biosystematics, ARC–Plant Protection Research Institute, Queenswood, Pretoria, South Africa (male, Ayaş Çiftlik, *Solanum nigrum*, 08.10.2010, and female, Kazan, *Solanum nigrum*, 08.10.2010 (230/161)).

3.6. Etymology

The name of the species, *solanacearum*, refers to the host plant family, Solanaceae.

3.7. Key to the *Tetranychus* species of Turkey

1. Female: Tarsus I with proximal setae in line with proximal duplex setae; aedeagus with anterior and posterior projections pointed, latter a large sharp hook pointed downwards, axis of knob parallel or at slight angle to that of main shaft.....*T. desertorum* Banks
 - Female: Tarsus I with proximal pair of duplex setae anterior to proximal setae.....2
2. Male: Knob of aedeagus small with one or both projections acute3
 - Male: Knob of aedeagus large, with obtusely angulate dorsum, anterior projection broad and narrowly rounded, posterior projection small and acute*T. turkestanii* Ugarov & Nikolski

3. Female: Striae on opisthosoma entirely transverse; empodia each with a mediodorsal spur about half as long as proximoventral setae. Male: Aedeagus with both projections acute.....*T. tumidellus* Pritchard & Baker
 - Female: Striae on opisthosoma not entirely transverse, longitudinal between either *el* and or *fl*; empodia without mediodorsal spurs. Male: Aedeagus with one or both projections acute.....4
4. Anterior and posterior projections of male aedeagus are acute, empodia I and II with dorsal spurs*T. urticae* Koch
 - Anterior projection of male aedeagus slightly angular and posterior margin acute, empodia I–IV each with a dorsal spur.....*T. solanacearum* Çobanoğlu & Ueckermann sp. nov.

Acknowledgments

The authors wish to thank the TÜBİTAK TOVAG (Grant No.: 108O363) and European Union Foundation FP7 IRSES (Grant No.: 269133) projects for funding this project. This work was also partly based upon research supported by the National Research Foundation (NRF), South Africa. Any opinion, findings, and conclusions or recommendations expressed in the study material are those of the authors; therefore, the NRF does not accept any liability in regard thereto. The authors also wish to thank Prof Carlos Flechtmann and Dr Gilberto de Moraes (São Paulo University, Universidade de São Paulo–ESALQ, Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, Piracicaba, São Paulo, Brazil) for constructive suggestions.

References

- Akyazı F, Ecevit O (2003). Ordu, Samsun ve Giresun illeri fındık bahçelerinde görülen akar türlerinin belirlenmesi. J Fac Agric OMU 18: 39–45 (in Turkish).
- Auger P, Migeon A, Ueckermann EA, Tiedt L, Navajas M (2013). Evidence for synonymy between *Tetranychus urticae* and *Tetranychus cinnabarinus* (Acari, Prostigmata, Tetranychidae): review and new data. Acarologia 53: 383–415.
- Bayram Ş, Çobanoğlu S (2007). Mite fauna (Acari: Prostigmata, Mesostigmata, Astigmata) of coniferous plants in Turkey. Turk J Entomol 31: 279–290.
- Çobanoğlu S (1991–1992). An annotated list of mites on hazel of Turkey. Israel J Entomol 25–26: 35–40.
- de Moraes GJ, McMurtry JA, Baker EW (1987). Redescription and distribution of the spider mites *Tetranychus evansi* and *T. marianae*. Acarologia 28: 333–343.
- Düzgüneş Z (1959). *Tetranychus tumidellus* “Yer-fıstığı akarı”. Bitki Koruma Bülteni 1: 10–14 (in Turkish with English summary).
- Düzgüneş Z (1962). Pamuk akarları (kırmızı örümcekler). Türkiye Ziraatına Zararlı Olan Böcekler ve Mücadelesi 6: 70–77 (in Turkish).
- Ehara S (1956). Tetranychoid mites of mulberry in Japan. J Fac Sci Hokkaido Univ (Ser VI) Zool 12: 499–510.
- Elma FN, Alaoğlu Ö (2008). The harmful mite species and their natural enemies on trees and shrubs in recreation areas of Konya province. Turk J Entomol 32: 115–129 (in Turkish with English summary).
- Flechtmann CHW, Knihinicki DK (2002). New species and new record of *Tetranychus* Dufour from Australia, with a key to the major groups in this genus based on females (Acari: Prostigmata: Tetranychidae). Aust J Entomol 41: 118–127.
- Henderson, RC (2001) Technique for positional slide-mounting of Acari. Syst Appl Acarol Special Publications 7: 1–4.
- Hoy AM (2011). Agricultural Acarology: Introduction to Integrated Mite Management. Boca Raton, FL, USA: CRC Press.

- Jeppson LR, Keifer HH, Baker EW (1975). *Mites Injurious To Economic Plants*. Berkeley, CA, USA: University of California Press.
- Kasap I, Çobanoğlu S (2007). Mite (Acari) fauna in apple orchards around the Van Lake basin of Turkey. *Turk J Entomol* 31: 97–109.
- Lindquist EE (1985). External anatomy. In: Helle W, Sabelis MW, editors. *Spider Mites: Their Biology, Natural Enemies, and Control*. Vol. 1A. Amsterdam, the Netherlands: Elsevier, pp. 3–28.
- McGregor EA (1950). *Mites of the family Tetranychidae*. *Am Midl Nat* 44: 257–420.
- Meyer, MKPS (1987). African Tetranychidae (Acari: Prostigmata), with reference to the world genera. *Entomology Memoir*, Department of Agriculture and Water Supply, Republic of South Africa 69: 1–175.
- Migeon A, Dorkeld D (2006–2013). *Spider Mites Web: A Comprehensive Database for the Tetranychidae*. Montpellier, France: INRA. Available online at <http://www.montpellier.inra.fr/CBGP/spmweb>.
- Mitrofanov VI, Strunkova ZI, Livshits IZ (1980). New species of the Tetranychoida (Acariformes). *Zool Zh* 10: 1571–1575.
- Özman SK, Çobanoğlu S (2001). Current status of hazelnut mites in Turkey. *Acta Hort* 556: 479–487.
- Rimando L C. (1962). The tetranychoid mites of the Philippines. *Univ Philippines Col Agric Techn Bul* 11: 1–52.
- Seeman OD, Beard JJ (2011). Identification of exotic pest and Australian native and naturalised species of *Tetranychus* (Acari: Tetranychidae): *Zootaxa* 2961: 1–72.
- Yanar D, Ecevit O (2005). Plant injurious and predatory mite species in apple (*Malus communis* L.) orchards in Tokat province. *J Fac Agric OMU* 20: 18–23 (in Turkish with English summary).
- Yüksel B, Ulusoy H (2000). Harmfulness and control of *Oligonychus ununguis* Jacobi in conifer forest in eastern Black Sea region of Turkey. *Orman Mühendisliği Dergisi* 36: 28–31 (in Turkish with English summary).
- Zhang ZQ (2003). *Mites of Greenhouses: Identification, Biology, and Control*. Cambridge, MA, USA: CABI Publishing.