Persian Journal of Acarology, Vol. 3, No. 1, pp. 27–40.

Article

Phytoseiid mites (Acari: Phytoseiidae) of fruit orchards in cold regions of Razavi Khorasan province (northeast Iran), with redescription of two species

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Abstract

Seven species from five genera of the family Phytoseiidae were collected in northeast Iran. *Typhlodromus* (*Anthoseius*) *neyshabouris* (Denmark & Daneshvar, 1982) were recorded for the second time. This species with the male of *Proprioseiopsis messor* (Wainstein, 1960) are redescribed and illustrated. A key to the adult females of the Razavi Khorasan province of Iran is also provided. *Phytoseius corniger* Wainstein, 1959 had the highest abundance and distribution in this survey.

Key words: Predatory mite fauna, abundance, Mesostigmata, northeast Iran.

Introduction

Razavi Khorasan province is located in northeastern Iran. Mashhad is located in the center and is the capital of the province. Agriculture in Razavi Khorasan province is one of the largest and most important suppliers of agricultural products, with more than 1.06 million hectares under cultivation and horticultural crops play a decisive role in the economy of the province and country (Anonymous 2012). Predatory mites of the family Phytoseiidae are the most important natural enemies of tetranychid and eriophyid mites (Acari: Tetranychidae and Eriophyidae) (Gerson *et al*. 2003; Sabelis 1996). These mites feed on small insects such as whiteflies, thrips and scale insects as well as injurious plant mites. This family is relatively well known in Iran and about 70 species have been reported (Khalil-Manesh 1973; McMurtry 1977; Sepasgosarian 1977; Daneshvar 1980, 1987; Daneshvar & Denmark 1982; Kamali *et al.* 2001; Hajizadeh *et al.* 2002, 2009; Kolodochka *et al.* 2003; Shirdel 2003; Abbasipour *et al.* 2005; Rahmani *et al.* 2006, 2010; Faraji *et al.* 2007a, b, 2008a, b; Hajizadeh 2007; Shirdel *et al.* 2008; Ueckermann *et al*. 2009; Noei *et al.* 2010; Jafari *et al.* 2011; Asali Fayaz & Khanjani 2012, 2013; Asali Fayaz *et al.* 2012, 2013; Hajizadeh & Nazari 2012; Ostovan *et al.* 2012). In this study, a list of phytoseiid species collected from the fruit orchards (including apple, quincunx, pear and cherry) of the cold regions in the Razavi Khorasan province and a key to identification are presented.

Materials and methods

This study was carried out in fruit orchards in Razavi Khorasan province, during 2009 and 2010. Phytoseiid mites were collected by beating or shaking shoots over a white tray or by extracting them from soil samples and fallen fruits using Berlese funnel. The mites were preserved in 70% ethanol and cleared in Nesbitt's fluid and then mounted on microscope slides using Hoyer's medium (Walter & Krantz 2009) for examination under an Olympus BX 41 phase contrast microscope. All specimens were collected by senior author. All measurements are given in micrometers (μm). The classification systems used follows that of Chant & McMurtry (2007). The dorsal and ventral setal nomenclature is that of Rowell *et al.* (1978) and Chant & Yoshida-Shaul (1991). Idiosomal setal patterns are given according to Chant & Yoshida-Shaul (1992). All specimens are deposited in the Acarological Collection at Department of Plant Protection, Faculty of Agriculture, University of Shahed, Tehran, and in Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran.

Results

Amblyseiinae Muma, 1961

***Proprioseiopsis messor* (Wainstein, 1960) (Figs. 1–8)**

Syn.: *Typhlodromus messor* Wainstein, 1960: 668; *Amblyseius (Amblyseius) apheles* van der Merwe, 1968: 121 synonymy according to Ueckermann & Loots (1988); *Amblyseius lindquisti* Schuster & Pritchard, 1963: 246 synonymy according to Abbasova (1972).

Distribution

Algeria, Armenia, Australia, Azerbaijan, France, Gaza Strip, Greece, Israel, Italy, Morocco, New Zealand, South Africa, Spain, Turkmenistan, Ukraine and Iran (Asali Fayaz & Khanjani 2012; Ostovan *et al.* 2012), and new record for the region.

Specimens examined

Two adult females and one male from North Eastern Iran, Razavi Khorasan province, Torghabe–Shandiz, Kang village (36° 19' 08" N, 59° 13' 36" E), 15 June 2009 (n= 2) and 21 May 2009 (n= 1). All from apple trees.

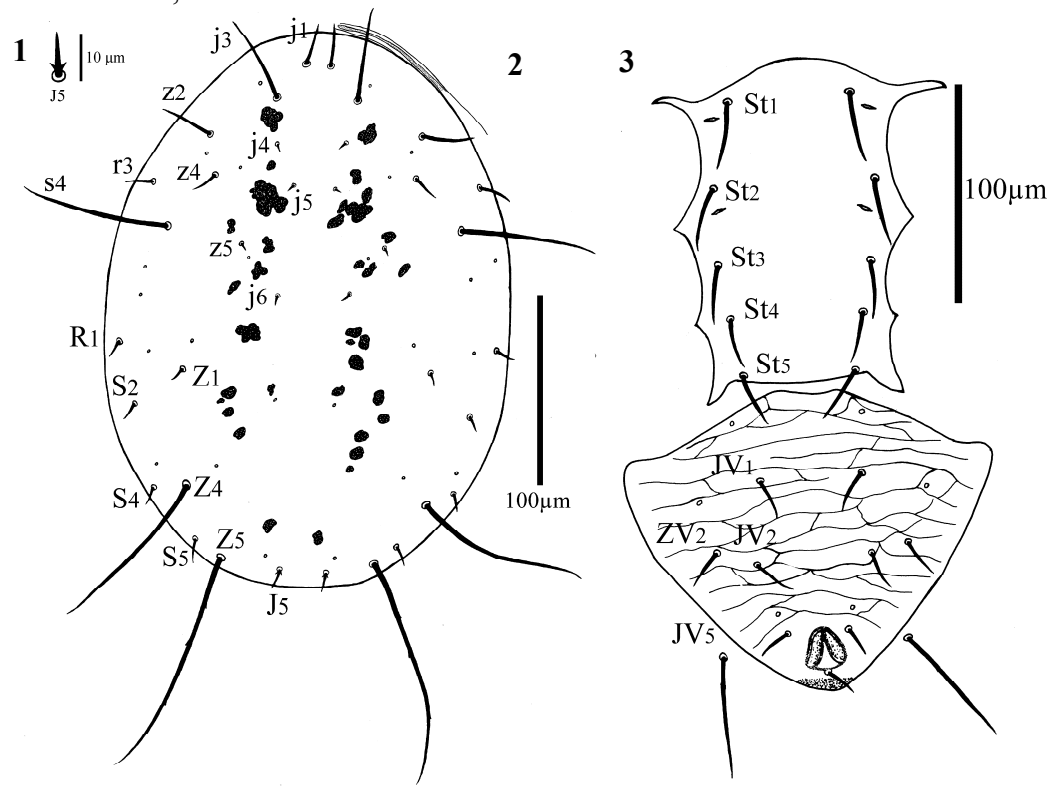
Male (Figs.1–8). One specimen measured.

Dorsum (Fig. 2). Dorsal shield 312 long and 226 at the widest level, smooth with spots (not rugose patches) and pores on dorsal shield. Dorsal setae smooth, except for Z_5, serrate and setae J_5 with two distinctive spines at base (Fig. 1); Setal lengths: j_1 26, j_3 53, j_4 6, j_5 5, j_6 6, J_5 10, z_2 31, z_4 21, z_5 6, Z_1 6, Z_4 103, Z_5 144, s_4 85, S_2 11, S_4 7, S_5 16; r_3 20 and R_1 8 on dorsal shield.

Venter (Fig. 3 & 5). Length of tritosternum (Fig. 5) 78, widened at its base 15. Sternal shield smooth and with two pairs of lyrifissures, length 145, width at widest point 125; with five pairs of setae: St_1 31, St_2 32, St_3 28, St_4 27, St_5 29; ventrianal shield reticulated, with three pairs of pores, length 135, width at widest point 162; with 3 pairs of preanal setae JV_1 25, JV_2 18, ZV_2 26; JV_5 50, Para-anal setae 16 and Post-anal setae 17.

Gnathosoma (Fig. 4). Three pairs of smooth hypostomal setae, Length of setae: h_1 20, h_2 24, h_3 22 and palp coxa with a pair of smooth setae, pc 26. Corniculi 29 horn-like

and stout, internal malae somewhat longer than corniculi. Deutosternal groove with six transverse rows, basal row concave.



Figures 1–3. *Proprioseiopsis messor* (Wainstein, 1960) (male). 1. Dorsal setae J_5; 2. Dorsal view of idiosoma; 3. Sternal and ventrianal shields.

Palp. Length of palp: 157, ratio of palp-tibia/tarsus length 1.39.

Chelicera (Fig. 6). Fixed digit 30 long with 3 teeth and a setiform pilus dentilis; movable digit 28 long with one tooth.

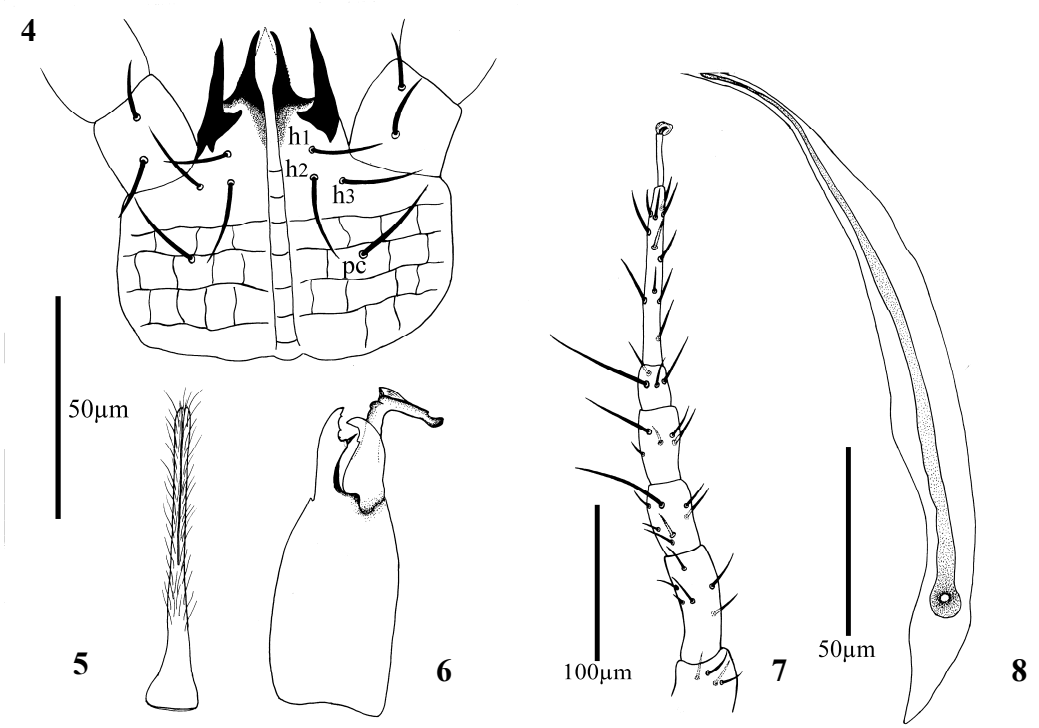
Spermatodactyl. L-shaped with a long foot. The outer margin of the shaft carries a membranous border.

Peritreme (Fig. 8). Extending anterior to setae j_1, 185 long.

Legs (Fig. 7). Length of legs I–IV as follows: leg I 414, leg II 330, leg III 335 and leg IV 424. Leg IV with three macrosetae, on genu 67, tibia 52 and basitarsus 72. Genua I–IV with 10-8-7-7 setae.

Remarks

This redescription of the male is similar to the original description of Amitai & Wysoki (1974). However, it differs from their description in: dorsal setae Z_4 are smooth *vs*. serrated; dorsal setae J_5 with two distinctive spine at the base *vs.* simple; sternal shield with five pairs of setae ($St_{1–5}$) *vs*. four pairs of setae ($St_{1–4}$). Also, setae z_5, s_4, Z_4, Z_5 and macrosetae on leg IV are longer than those of the Israeli specimens. Furthermore the Iranian specimens differ from specimens collected by Schicha (1983) as follows: shape of setae J_5 and setae j_3, z_2, z_4, S_2 and macrosetae on leg IV of the Iranian specimens are longer than those of the Australian specimens.



Figures 4–8. *Proprioseiopsis messor* (Wainstein, 1960) (male). 4. Subcapitulum; 5. Tritosternum; 6. Chelicera & Spermatodactyl; 7. Leg IV; 8. Peritreme and peritremal plate.

Typhlodrominae Scheuten, 1857

***Typhlodromus (Anthoseius) neyshabouris* (Denmark & Daneshvar, 1982) (Figs. 9–16)**

Distribution

This species has been reported from Iran (Daneshvar & Denmark 1982) and here recorded for the second time from Iran and world.

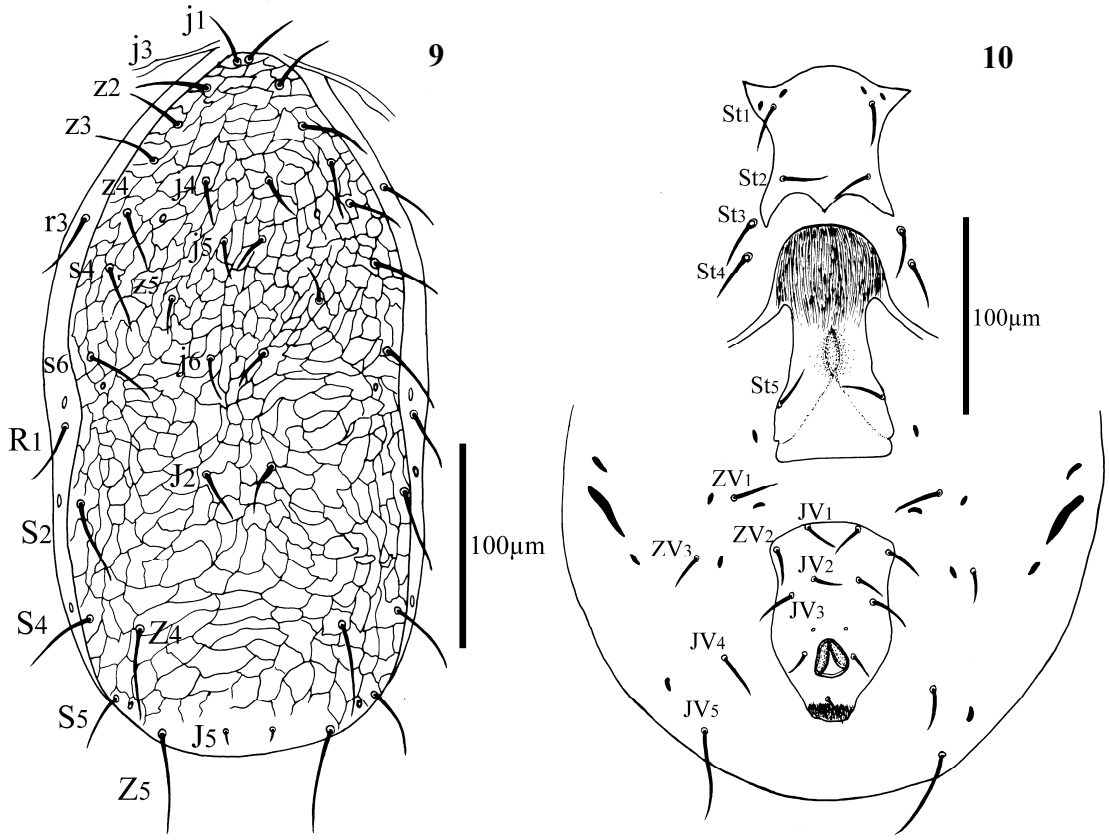
Specimens examined

Three adult females from North Eastern Iran, Razavi Khorasan province: Torghabe-Shandiz, Kang village (36° 19' 08" N, 59° 13' 36" E), 1 Sep. 2009; All from apple trees.

Dorsum (Fig. 9). Dorsal shield reticulated, with 3 pairs of large pores and 3 pairs of small pores. Measurements are as follows: Dorsal shield 365 (355–370) long and 180 (168–190) wide; j_1 22 (20–25), j_3 33 (30–36), j_4 21 (17–22), j_5 20 (18–22), j_6 28 (22–30), J_2 26 (22–33), J_5 5 (4–5); z_2 28 (27–31), z_3 33 (29–36), z_4 34 (30–40), z_5 23 (21–25), Z_4 48 (45–50), Z_5 64 (57–71); s_4 37 (33–41), s_6 41 (39–42), S_2 45 (41–50), S_4 42 (36–46), S_5 33 (29–35); r_3 32 (32–34); R_1 36 (33–40). Seta Z_5 pointed apically.

Venter (Fig. 10). Length of tritosternum (Fig. 12) 94 (88–102), widened at its base 13 (13–14), sternal shield smooth and with two pairs of setae (St_1 and St_2) and two pairs of lyrifissures; setae St_3 and St_4 each set on separated platelets. Length of sternal setae as follows: St_1 32 (31–33), St_2 32 (32–33), St_3 31 (30–31), St_4 33 (32-33), St_5 27 (25–28). Genital shield 134 (122–141) long and 75 (65–80) at widest level, spermatheca saccular,

calyx of spermatheca (Fig. 15) 21 (18–24) long, with C-shaped atrium. Ventrianal shield 113 (106–127) long, 72 (68–76) at widest level; with a pair of pores and four of pairs preanal setae, setae JV_1 18 (16–20), JV_2 20 (18–22), JV_3 21 (17–22), JV_4 20 (20–21), JV_5 55 (52–65), ZV_1 23 (21–26), ZV_2 20 (18–21), ZV_3 14 (13–16), both para-anal and post-anal setae 16.



Figures 9–10. *Typhlodromus (A.) neyshabouris* (Denmark & Daneshvar, 1982) (female). 9. Dorsal view of idiosoma; 10. Ventral view of idiosoma.

Gnathosoma (Fig. 11). With three pairs of smooth hypostomal setae. Lengths of setae: h_1 23 (19–25), h_2 20 (16–23), h_3 21 (20–23) and palp coxa with a pair of smooth capitular setae, pc 30 (28-32). Corniculi 23 (22–24), horn-like and stout, corniculi somewhat longer than internal malae.

Palp. Length of palp: 183 (181–185), ratio of palp-tibia/tarsus length 1.41 (1.3–1.46).

Chelicera (Fig. 14). Movable digit 27 (26–28), with a tooth; fixed digit 30 (28–31), with four teeth and a *pilus dentilis*.

Peritreme (Fig. 13). 49 (44–55) long. Apex of peritreme extending close to setae s_4 and s_6, but not to z_2.

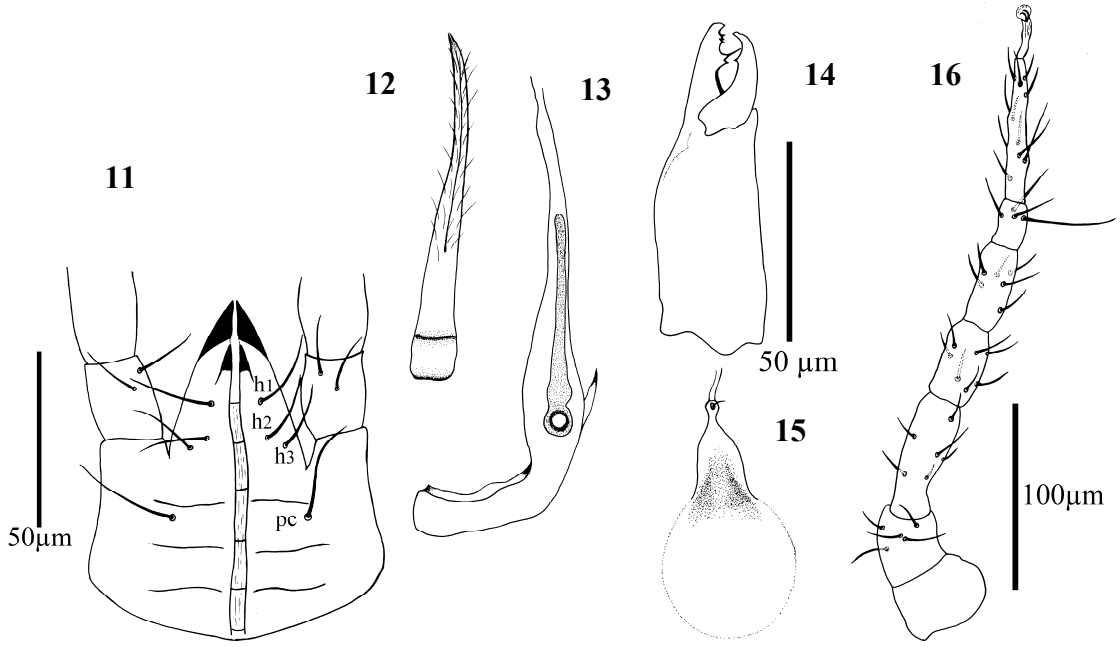
Legs (Fig. 16). Length of legs I–IV as follows: leg I 314 (305–320), leg II 274 (265–289), leg III 293 (282–295) and leg IV 376 (371–384). Basitarsus IV with one macroseta 57 (52–61). Genua I–IV with 10-7-7-7 setae.

Male: Unknown.

Remarks

The characteristics of the specimens collected are very similar to those of the original

description of Denmark & Daneshvar (1982). However, it differs from them in: fixed digit of chelicera with four teeth plus a *pilus dentilis* vs. three teeth plus a *pilus dentilis* in the original description. Also, length and width of dorsal shield and all setae of these specimens are longer than those of the original description.



Figures 11–16. *Typhlodromus (A.) neyshabouris* (Denmark & Daneshvar, 1982). 11. Gnathosoma; 12. Tritosternum; 13. Peritreme; 14. Chelicera; 15. Spermatheca; 16. Leg IV.

***Typhlodromus (A.) bagdasarjani* (Wainstein & Artunjan, 1967)**
Typhlodromus bagdasarjani Wainstein & Arutunjan, 1967: 1765; de Moraes *et al.* 2004: 311; *Typhlodromus* (*Anthoseius*) *kettanehi* Dosse, 1967: 32.

Distribution
Armenia, Azerbaijan, Iran, Lebanon, Turkey and Turkmenistan (Rahmani *et al.* 2010).

Specimens examined
Razavi Khorasan province: Laeen village, Kalat Naderi (37° 07' 45" N, 59° 29' 56" E), 19 Oct. 2009 (n= 1); Kang village, Torghabe–Shandiz (36° 19' 08" N, 59° 13' 36" E), 2 Sep. 2009, (n= 5); Torogh, Mashhad (36° 12' 37" N, 59° 39' 36" E), 2 Sep. 2009 (n= 3) and 16 Oct. 2009 (n= 2); Mashhad (36° 18' 28" N, 59° 31' 36" E), 15 Sep. 2009 (n= 22) and 13 Oct. 2009 (n= 5); All collected on apple, peach, quince and cherry trees.

Phytoseiinae Berlese, 1916

***Phytoseius corniger* Wainstein, 1959**

Distribution
Azarbaijan, Iran, Turkey and Turkmenistan (Hajizadeh 2007).

Specimens examined

Razavi Khorasan province: Laeen village, Kalat Naderi (37° 07' 45" N, 59° 29' 56" E), 13 Oct. 2009 (n= 56), 5 Nov. 2009 (n= 28), 2 Sep. 2009 (n= 49); Kang village, Torghabe–Shandiz (36° 19' 08" N, 59° 13' 36" E), 11 Sep. 2009 (n= 4); Torogh, Mashhad (36° 12' 37" N, 59° 39' 36" E), 1 Oct. 2009 (n= 35) 15 Sep. 2009 (n= 19); Mashhad, (36° 18' 28" N, 59° 31' 36" E), 24 May 2009 (n= 6), 20 June 2009 (n= 4), 22 Aug. 2009 (n= 10), 1 Sep. 2009 (n= 75), 8 Sep. 2009 (n= 58), 15 Sep. 2009 (n= 47), 19 Sep. 2009 (n= 142), 27 Sep. 2009 (n= 123), 7 Oct. 2009 (n= 102), 13 Oct. 2009 (n= 71), 25 Oct. 2009 (n= 96), 31 Oct. 2009 (n= 82), 6 Nov. 2009 (n= 45), 14 Nov. 2009 (n= 18), 12 Dec. 2009 (n= 12), 30 Apr. 2010 (n= 9), 6 May 2010 (n= 14); All on apple, peach and cherry trees.

Amblyseiinae Muma, 1961

***Neoseiulus barkeri* Hughes, 1948**

Neoseiulus barkeri Hughes, 1948: 141; *Amblyseius mckenziei* Schuster & Pritchard, 1963: 268; *Amblyseius* (*Amblyseius*) *usitatus* (van der Merwe, 1965): 71; *Amblyseius oahuensis* Prasad, 1968: 1518; *Amblyseius picketti* Specht, 1968: 681; *Amblyseius mycophilus* Karg, 1970: 290; *Amblyseius masiaka* Blommers & Chazeau, 1974: 308; *Neoseiulus kermanicus* Daneshvar, 1987: 14; Faraji *et al.* 2007a: 233.

Distribution

This species is known from Algeria, Australia, Brazil, China, England, Finland, France, Germany, Ghana, Greece, Guinea, Hawaii, India, Iran, Italy, Japan, Jordan, Madagascar, Mozambique, Nigeria, Palestine, Russia, Spain, South Africa, South Korea, Sweden, Taiwan, The Netherlands, Turkey, Ukraine, USA, Yemen (Rahmani *et al.* 2010), Canary Islands, Cape Verde, Georgia, Norway, Reunion Island and West Bank (Asali Fayaz & Khanjani 2012) and this is a new record for this region.

Specimens examined

Razavi Khorasan province: Torghabe–Shandiz (36° 18' 37" N, 59° 22' 25" E), 6 Aug. 2009 (n= 1); on apple trees.

***Euseius amissibilis* Meshkov, 1991**

Euseius amissibilis Meshkov 1991: 138.

Distribution

This species has been reported from Azarbaijan, Iran, Turkey, Turkmenistan (Hajizadeh 2007) and Tajikistan (Rahmani *et al.* 2010) and this is also a new record for this region.

Specimens examined

Razavi Khorasan province: Laeen village, Kalat Naderi (37° 07' 45" N, 59° 29' 56" E), 31 Aug. 2009 (n= 1); 19 Oct. 2009 (n= 44), 29 Oct. 2009 (n= 95), 2 Nov. 2009 (n= 55), 12 Nov. 2009, (n= 64), 20 Nov. 2009 (n= 67); all on apple, peach and cherry trees.

***Neoseiulus marginatus* (Wainstein, 1961)**

Typhlodromus marginatus Wainstein, 1961: 158; *N. polyporus* (Wainstein, 1962): 143.

Distribution

This species has been reported from Algeria, Armenia, Azerbaijan, Georgia, Greece, France, Moldova, Russia, Turkmenistan, Ukraine (de Moraes *et al.* 2004), Hungary, Kazakhstan and Kenya (Asali Fayaz & Khanjani 2012) and a new record for this region.

Specimens examined

Razavi Khorasan province: Mashhad (36° 18' 28" N, 59° 31' 36" E), 14 Nov. 2009 (n=1) and 10 Oct. 2009 (n=2); all on apple trees.

Key to the Phytoseiidae of Razavi Khorasan province (northeast Iran) (female)

1. Seta z_3 and s_6 absent (Amblyseiinae Muma) 6
– Either or both setae z_3 and s_6 present 2
2. Setae Z_1, S_2, S_4 and S_5 absent (Phytoseiinae Berlese, *Phytoseius* Ribaga) ……..…… *P. corniger* Wainstein
– At least one of setae Z_1, S_2, S_4 and S_5 present (Typhlodrominae Chant & McMurtry) 3
3. Ventrianal shield with three pairs of preanal setae ……..……..... ……..……*Typhlodromus (Anthoseius) rodriguizi* (Denmark & Daneshvar)
– Ventrianal shield with four pairs of preanal setae……..……4
4. Dorsal shield with 5 pairs of large pores; movable digit of chelicerae without teeth .....*T. bagdasarjani* Wainstein & Arutunjan
– Dorsal shield with 3 pairs of large pores; movable digit of chelicerae with one tooth 5
5. Ventrianal shield with a pair of pores.....*T. (A.) neyshabouris* (Denmark & Daneshvar)
– Ventrianal shield without any pores.....*T. (A.) torbatejamae* (Denmark & Daneshvar)
6. Seta JV_1 inserted well behind anterior margin of ventrianal shield and preanal setae arranged in an almost transverse row; cheliceral digits short and stout (*Euseius* Wainstein) ……..... *Euseius amissibilis* Meshkov
– Seta JV_1 inserted near margin of ventrianal shield and preanal setae not arranged in a transverse row across the shield, cheliceral digits elongate.....7
7. Macrosetae present only on leg IV or absent and J_2 present (*Neoseiulus* Hughes) 8
– Macrosetae present at least on genua III, as well as on leg IV and J_2 absent..... ……..……..*Proprioseiopsis messor* (Wainstein)
8. Spermatheca with a stalk between atrium and calyx.....*N. marginatus* (Wainstein)
– Spermatheca without a stalk between atrium and calyx……..……...*N. bakeri* Hughes

Discussion

In the study, seven species from five genera of the family Phytoseiidae were reported from Razavi Khorasan province (northeast Iran). *Typhlodromus* (*Anthoseius*) *neyshabouris* (Denmark & Daneshvar, 1982) were recorded for the second time in Iran and the male of *Proprioseiopsis messor* (Wainstein, 1960) are redescribed. *Phytoseius corniger* Wainstein, 1959 was the most abundant species among the seven species collected in fruit orchards in the cold regions of Razavi Khorasan province (northeast Iran) (Fig. 17). The species was collected from all sampled regions and has a good distribution in the studied area. Therefore, it is important to protect or conserve the

predator in the environment especially by reducing pesticide application in pest management program.

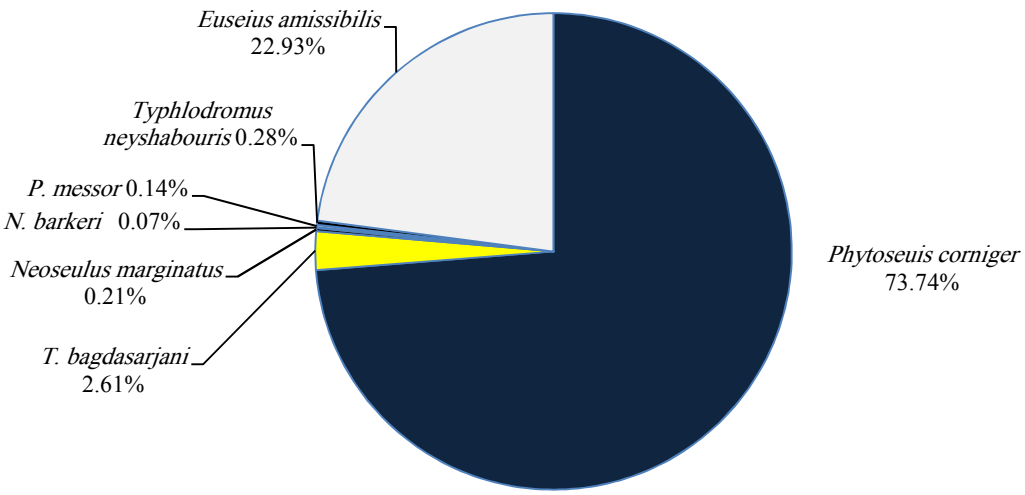


Figure 17. Relative abundance of phytoseiid predatory mites in fruit orchards of the cold regions of Razavi Khorasan province (northeast Iran) during surveys in 2009 and 2010.

Acknowledgements

The authors wish to express their gratitude to Prof. Dr. Alireza Saboori (Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran) for his advice, guidance, interest and motivation, and Dr. Farid Faraji (MITOX Consultants, Amsterdam, The Netherlands) for his kind help in the identification of the specimens. This project is a part of the M. Sc. thesis of the senior author and was financially supported by the Shahed University, which is greatly appreciated.

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Received: 11 October 2013
Accepted: 18 November 2013
Published: 15 January 2014

کنه‌های فیتوزئید (Acari: Phytoseiidae) باغ‌های میوه سردسیری استان خراسان رضوی (شمال شرق ایران) همرا با باز توصیف دو گونه

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چکیده

هفت گونه از پنج جنس از خانوادهٔ Phytoseiidae از شمال شرق ایران جمع‌آوری شد. گونهٔ *Typhlodromus* (*Anthoseius*) *neyshabouris* (Denmark & Daneshvar, 1982) برای دومین بار

گزارش می‌شود. این گونه به همراه نمونهٔ نر گونهٔ *Proprioseiopsis messor* (Wainstein, 1960) بازتوصیف و ترسیم شدند. کلیدی برای کنه‌های ماده استان خراسان رضوی ایران نیز تهیه شده است. گونهٔ *Phytoseius corniger* Wainstein, 1959 بیشترین فراوانی و پراکندگی را در این پژوهش داشت.

واژگان کلیدی: فون کنه‌های شکارگر، فراوانی، میان‌استیگمایان، شمال شرق ایران.

تاریخ دریافت: ۱۳۹۲/۷/۱۹
تاریخ پذیرش: ۱۳۹۲/۸/۲۷
تاریخ چاپ: ۱۳۹۲/۱۰/۲۵