

A Dispersion survey of the phytoseiid mites on the basis of region topography in agro ecosystem of several provinces of Iran.

Maryam Rezaie¹, Reza Jvannezhad²

¹Zoology Research Department, Iranian Research Institute of Plant Protection, Agricultural Research, Education Organization, Tehran, Iran.

² PhD of Meteorology, Tehran, Iran.

Abstract: Phytoseiid mites are known as the important predators of phytophage mites and small insects. These mites are found in various crops. A faunistic and dispersion survey of phytoseiid mites was carried out from 2010-2013 in more than 10 province orchards, selected from all the western regions of Iran. Different samples were taken from soil, trees, crops and weeds. After clearing the mites in lactophenol fluid, the slides were made and then identified. In this research 23 species from 7 genera of the family phytoseiidae were collected in the western of Iran. 28% of recorded mites were found in Markazi province and the most mites recorded were collected in soil. The highest mite numbers were observed in the altitude range (1500-2000 m). Subfamily Typhlodrominae were found at lower temperature than the subfamily Amblyseiniinae. The phytoseiid mites were found in region with the mean temperature range (12-20°C) and the mean humidity range (34-50%).

Keywords: Phytoseiid mites, province, record, temperature, humidity.

1. Introduction

Mites of the family Phytoseiidae are the most common predators of phytophagous mites on most plant species. Some species are widely studied and used for biological control of mite pests [1]. Many new species continue to be discovered as collection are intensified in certain regions or habitats e.g. in Africa, Asia, Central and South America. Moraes catalog includes almost 2250 species [2]. The widespread interest in the Phytoseiidae Berlese (Acari: Mesostigmata) as biological control agents of Phytophagous mites and thrips is evident from the more than 4000 publication on phytoseiid from 1690-1996 [3]. More than 70 species have been reported as new species or new records for Iran [4]-[32] (Table 1).

Some researchers investigated the distribution of phytoseiid mite in different regions e.g. [33]-[35]. Some researchers investigated about the effect of temperature on distribution of phytoseiid mites [36].

During 2010-2012, in a dispersion survey of phytoseiid mites in 10 provinces, different samples were taken from soil, trees, crops and weeds. The effect of temperature and humidity were studied in this study.

Table 1. the phytoseiid mites were recorded in different regions of Iran.

Phytoseiid mites	Host plants	Distribution	References
<i>Typhlodromus vulgaris</i> (Ehara) <i>Typhlodromus rhenanus</i> (Oudemans) <i>Neoseiulus cucumeris</i> (Oudemans)	Cotton Apple Rice	Gorgan Tehran Shasavar	Khail-Manesh, 1351
<i>Neoseiulus soleiger</i> (Ribaga) <i>Phytoseius corniger</i> Wainstein <i>P. finitimus</i> Ribaga	Apple Fig	Sarrie Varamien	Sepasgossarian, 1356
<i>Typhlodromus persianus</i> McMurtry <i>T. kettanehi</i> Dosse <i>Typhlodromus (Anthoseius) persianus</i> McMurtry	Citrus	Minab Kazeron	McMurtry, 1977

<i>Kampimodromus aberrans</i> (Oudemans), <i>Paraseiulus erevanicus</i> Wainstein & Arutunjan <i>Typhloseiulus simplex</i> (Chant) <i>Paraseiulus incognitus</i> Wainstein & Arutunjan	Cherry Oak Oak Cherry	Marrand Osکو Osکو Marrand	Daneshvar, 1978
<i>Kampimodromus aberrans</i> (Oudemans), <i>Paraseiulus subsoleiger</i> Wainstein <i>Amblyseius mcmurtryi</i> Muma <i>Euseius finlandicus</i> (Oudemans) <i>Euseius libanesi</i> (Dosse) <i>Phytoseius finitimus</i> Ribaga <i>Typhlodromus (Anthoseius) kazachstanicus</i> Wainstein <i>Typhlodromus (Anthoseius) kerkirae</i> Swirski & Ragusa <i>Typhlodromus (Typhlodromus) athiasae</i> Porath & Swirski <i>Neoseiulus luppovae</i> (Wainstein) <i>Neoseiulus zweofleri</i> (Dosse)	Quince fruit Apple Weed Apple Pome grante Fig Apple Fig Fig Apple Apple	Oromieh Damavand Rashet Gorgan Ghaser shirien Tehran Damvand Rijab Kermanshghab Mindoab Mindoab	Daneshvar, 1980
<i>Phytoseius tropicalis</i> Daneshvar <i>Paraseiulus jirafiticus</i> Daneshvar <i>Typhlodromus (Anthoseius) dalfardicus</i> (Daneshvar) <i>Amblyseius zweofleri</i> Dosse <i>Typhlodromops caspiensis</i> Denmark & Daneshvar <i>Eharius chergui</i> (Athias-Henriot) <i>Neoseiulus kermanicus</i> Daneshvar <i>Neoseiulus oryzaculus</i> Daneshvar <i>Neoseiulus umbraticus</i> (Chant) <i>Proprioseiopsis levis</i> (Wainstein) <i>Typhlodromops rademacheri</i> (Dosse) <i>Kucinellus kuczini</i> (Wainstein) <i>Paraseiulus talbii</i> (Athias-Henriot) <i>Paraseiulus talbii</i> (Athias-Henriot) <i>Paraseiulus subsoleiger</i> Wainstein	Verbascu nm sp Citrus Citrus Citrus Citrus Rice Apple Cotton Alder Fig Apple	Jirfot Jiroft Jiroft Mindab Ramsar Rashet Jiroft Bander gaez Kelardashet Ghalos Golpayegan	Daneshvar 1987
<i>Typhlodromus (Anthoseius) iranensis</i> (Denmark & Daneshvar) <i>Typhlodromus (Anthoseius) rodriguezii</i> (Denmark & Daneshvar) <i>Amblyseius caspiensis</i> (Denmark & Daneshvar) <i>Amblyseius herbicolus</i> (Chant) <i>Typhlodromus (Anthoseius) kettanehi</i> Dosse <i>Typhlodromus (Anthoseius) neyshabouris</i> (Denmark & Daneshvar) <i>Typhlodromus (Anthoseius) torbatajamae</i> (Denmark & Daneshvar) <i>Typhlodromus (Typhlodromus) tubifer</i> Wainstein, <i>Phytoseius ciliatus</i> Wainstein 1982 <i>Proprioseiopsis messor</i> (Wainstein) <i>Amblydromella kettanehi</i> (Dosse) <i>Euseius libanesi</i> (Dosse) <i>Neoseiulus benjamini</i> (Schicha) <i>Euseius libanesi</i> (Dosse) <i>Neoseiulus shambati</i> (El-Badry)	Apple Apple Citrus Citrus Apple Apple Apple Oak fig Apple Apple Apple Apple Oak fig	Trobat jam Sarakhe Ramsar Ramsar Osکو Neshabor Torbata jam Ghalos Ghalos	Daneshvar & Denmark, 1982
<i>Proprioseiopsis messor</i> (Wainstein) <i>Amblydromella kettanehi</i> (Dosse) <i>Euseius libanesi</i> (Dosse) <i>Neoseiulus benjamini</i> (Schicha) <i>Euseius libanesi</i> (Dosse) <i>Neoseiulus shambati</i> (El-Badry)	orchards Fig	Tabriz South region	Fathi pour (1994) Kamali & shishebour (1989) Sadeghie & Kamali (1991)
<i>Typhlodromus perhibus</i> Wainstein & Arutunjan <i>Amblyseius herbicolus</i> (Chant) <i>Paraseiulus soleiger</i> (Ribaga) <i>Transeius caspiensis</i> (Denmark & Daneshvar) <i>Typhlodromus athiasae</i> Porath & Swirskii	Citrus	Mazandaran	Faraji & Kamalie (1993)
<i>Neoseiulus marginatus</i> Wainstein <i>N. bicautus</i> Wainstein <i>Neoseiulus harrowi</i> (Collyer) <i>N. zweofleri</i> Dosse <i>Proprioseiopsis messor</i> (Wainstein)	Grains	Gharmahel	Noorbakhsh & Kamali (1995)

<i>Typhlodromus kettanehi</i> Dosse <i>Neoseiulus barkeri</i> <i>N. marginatus</i>	hive	Lorestan Azarbaijan Sarrie	Mossadegh (1995)
<i>Typhlodromus georgicus</i> Wainstein	needy	Mazandran	Birmanie (1996)
<i>Neoseiulus tarensis</i> (Schicha) <i>Neoseiulus zwoelferi</i> (Dosse) <i>Proprioseiopsis messor</i> (Wainstein)	Legumes	Hamedan	Khanjanie (1996)
<i>Amblyseius ramsaricum</i> Taghavi <i>Amblyseius herbiocolus</i> (Chant) <i>Neoseiulus barkeri</i>	tea	Mazandran	Taghavi et al. (1996)
<i>Neoseiulus sugonijae</i>			Kolokkola et al. (2003)
<i>Paraseiulus talbii</i> (Athias-Henriot) <i>Typhlodromus kettanehi</i> Doss	Pomegra nite	Savhe	Sorosh & Kamalie (2002)
<i>Amblyseius herbiocolus</i> (Chant) <i>Amblyseius caspiensis</i> (Denmark & Daneshvar) <i>Typhlodromipis rademacheri</i> (Dosse)	Berries	Gilan	Ramrodie et al., 2002
<i>Neoseiulus</i> sp	Pastures	Mazandaran	Birmanie & Akbarzadhe (2002)
<i>Neoseiulus zwoelferi</i> Dosse <i>Kuznetellus kuzini</i> Wainstein	walnut	Baft	Ahmadie & Aliakbarie (2002)
<i>Typhloseiulus carmonae</i> (Chant et Yoshida-Shaul)	Orchards	Azarbaijan	Shirdel (2008)
<i>Neoseiulus barkeri</i> Hughes	soil	Tehran	Kamalie et al.(2004)
<i>Typhlodromus (Anthoseius) kettanehi</i> Dosse <i>Phytoseius corniger</i> Wainstein	apple	Azarbijan Tehran Khorasan	Arbabie (2002)
<i>Amblyseius herbiocolus</i> (Chant) <i>Euseius finlandicus</i> (Oudemans) <i>Typhlodromus caudiglanis</i> (Schuster) <i>Typhlodromipis caspiensis</i> Denmark & Daneshvar <i>Euseius ucrainicus</i> Kolodochka <i>Parasiulus triporus</i> (Chant & Yoshida- Shaul) <i>Phytoseius plumifer</i> (Canestrini & Fanzago) <i>Typhlodromus kettanehi</i> (Dosse) <i>Paraseiulus soleiger</i> (Ribago)	orchards	Gilan	Hajzadhe (2002)
<i>Typhlodromus (Anthoseius) recki</i> Wainstein		Gilan	Hajzadhe (2007)
<i>Typhloseiulus pectinatus</i> (Kolodochka) <i>Phytoseius spoofti</i> (Oudemans)	Pine Rice	Gilan	Faraji et al (2007a)
<i>Parasiulus triporus</i> (Chant & Yoshida) <i>Proprioseiopsis dacus</i> (Wainstein)	citrus	Mazandran	Faraji et al (2007b)
<i>Typhlodromipis azerbaijanicus</i> (Abbasova) <i>Amblyseius meridionalis</i> Berlese <i>Neoseiulus multiporus</i> (Wu & Li) <i>Typhlodromus bakeri</i> (Garman)	Soil plum	Mazandran	Faraji et al (2008)
<i>Typhlodromus khosrovensis</i> Arutunjan	apple	esfahan	Ueckermann et al (2009)
<i>Phytoseius juvenis</i> Wainstein <i>Phytoseius plumifer</i> (Canestrini & Fanzago) <i>Euseius amissibilis</i> Meshkov <i>Euseius finlandicus</i> (Oudemans) <i>N. barkeri</i> Hugh <i>Neoseiulus bicaudus</i> (Wainstein) <i>Neoseiulus brevispinus</i> (Kennett) <i>Neoseiulus marginatus</i> (Wainstein) <i>Neoseiulus zwoelferi</i> (Dosse) <i>Typhlodromus (Anthoseius) bagdasarjani</i> Wainstein & Arutunjan <i>Typhlodromus (Anthoseius) bakeri</i> (Garma) <i>Typhlodromus (Anthoseius) kazachstanicus</i> Wainstein <i>Typhlodromus (Anthoseius) recki</i> Wainstein <i>Typhlodromus (Typhlodromus) tubifer</i> Wainstein	Willow Sunflowe r Soil Almond Soil Willow Soil Alfalfa Apple Elves Willow Apple Date willow	Zanjan Zanjan Tabriz Xinoz Zanjan Fadoghlo Zanjan Zanjan Sarab Moghan Zanjan Sarab fadighlo	Rahmanic (2010)
<i>Euseius amissibilis</i> Meshkov <i>Typhlodromus halinae</i> (Wainstein & Kolodochka)			Hajzadeh & Mortazav (2015)

2. Material:

The mites were collected from 10 provinces of Iran (Markazi, Hamedan, Lorestan, Kermansha, Elam, Semnan, Tehran, Alborz, Ghazvin and Qoam). The specimens were taken during spring and summer 2010-2012. The mites were collected by placing plant foliage, litter and soil in a Berlese or by direct examination under a stereomicroscope. Mites were cleaned in lacto phenol solution and mounted in Hoyer's medium on microscope slides. The notations used for dorsal and ventral setations follow those of Rowell *et al.*, 1978 and Chant & Yoshida- Shaul (1992)[37], [38].

Longitude, latitude and altitude were saved during was measured with the hand GPG signal receiver (device GPS Map 60CS). Temperature and humidity were recorded at site.

3. Result and Dissociation

We collected the phytoseiid mites of three subfamilies Amblyseinae, Phytoseiinae and Typhlodrominae. Four tribes *Neoseiuliini*, *Amblyseini*, *Kampimodromiini*, *Euseiini* were recorded for subfamily Amblyseinae. Seven species were recorded for *Neoseiuliini*, two species for *Amblyseini*, a species for *Kampimodromiini*, two species for *Euseiini*. We found a species for subfamily Phytosiinae. We recorded two tribes, tribe *Paraseiuliini* (3 species) and tribe *Typhlodromiini* with eight species in this study (Table 2).

On the base of other studies the highest number of phytoseiid mites recorded at Mazandaran province (20%) and the other provinces the phytoseiid mites numbers were recorded as Gilan

provine (15%), Tehran (8%), the south provinces (9%), Azarbaijan (11%), Kermanshhe (3%), Khorsan (4%), Zanjan (15%), Charmahal (6%), Lorestan (1%), Hamedan (3%), Markezi (2%), Kerman (2%). In this study, the most mite numbers recorded in Markazi provine (28%), Albroz provine (20%), Lorestan provine (20%), Seman provine (11%), Kermansha (11%). The use of pesticides, applied several times during the year before sampling, explains the absence of phytoseiid mites in some regions [39].

Among the host plants, the most number recorded on apple leaves (11%), citrus leaves (10%) and in soil (13%), and on the host record as cotton (1%), rice (1%), fig (7%), oak (4%), pomegranate (4%), berry (4%), walnut (3%). 41% of phytoseiid mites recorded in soil, other host plants recorded as (14%) on pomegranate, 14% on apple, 8% on rose and 8% on grapes. Phytoseiid species showed different development, reproduction and efficiency according to roughness and hairness of plant leaves. Some phytoseiid species developed faster on smooth, glabrous leaves than or rough, hairy ones [40]. In other studies such as, Duso & Pellegrini (2003) investigated the effect of apple cultivars on the distribution of the predatory mite, that large phytoseiid population were recorded on the apple cultivar, despite the low eriophyid occurrence, probably because of its highly pubescent leaf undersurfaces.

Pilesjo *et al* (2005) featured that different topographical parameters can be used to delineate agricultural management zones [41]. Soil characteristics play an important role in crop growth and yield. Soil properties vary with topographic settings. Topographical data in combination with soil information are useful for explaining yield variability on an agricultural field scale [42].

The highest mite number (52%) were observed in higher altitude (1500-2000 m) and 7% were recorded in <2000 m and 13% of phytoseiid mites were observed in lower altitude (<1000 m) and the other mites in this study (26%) were collected in altitude range (1000-1500 m).

The mean temperature that subfamily Amblyseinae were recorded 16.4 °C and the humidity was 41.6 % however the temperature that the other subfamily (Typhlodrominae) were collected was lower (13.8 °C). The phytoseiid mites of subfamily Typhlodrominae need the lower temperature than subfamily Amblyseinae.

The mean temperature that four tribes of Amblyseinae were recorded as *Neosiulini* (16.2°C), *Amblyseini* (17.4°C), *Kampimodromiini* (17.4°C), *Euseiini* (17.4°C) and the mean humidity were recorded 42%, 42%, 41.5%, 41.5% respectively.

The mean temperature and humidity were recorded for two tribes of subfamily Typhlodrominae as follow *paraseiuliini* (13.5 °C), 47% and *Typhlodromiini* 12.3 °C , 46.5%. The phytoseiid mites were found in region with the mean temperature range (12-20°C) and the mean humidity range (34-50%).

The geographic distribution of the four species in the genus *Phytoseiulus* was surveyed. This genus is known only from tropical and subtropical areas. All four species have been recorded from south America, but none from Asia, *Phytoseiulus macropilis*, the most widely distributed species in the genus, is known from the west coast of Africa to some islands in the southwestern Pacific Ocean. *Phytoseiulus persimilis* is known mainly from Mediterranean climate [43]. In this study the mean temperature and humidity were recorded for this species was 16.8°C and 36% respectively.

Table 2. The phytoseiid mites were recorded in western of Iran and topographic parameters

	Predatory mite	Host plants	distribution	Longitude	Latitude	Altitude	Mean temperature	Relative humidity	
Subfamily: Amblyseini	Tribe: Neoseiuli	<i>Neoseiulus rginatus</i>	Pomegranate Herbal remnants	LoRESTAN provinE Kohdashet, tangesiab Arak provinE Komjan, Ghazvin provinE Ghazvin	33°, 32' N 35°, 50 N 34°, 06 N	47°, 36' E 49°, 49 E 49°, 40E	1196 1367 1741	16.7 14.1 13.9	44 43 47
		<i>Neoseiulus grestis</i>	Apple Pomegranate	Hamedan provinE LoRESTAN provinE, Kohdashet, Tangesiab	34°, 38' N 33°, 32' N	48°, 23' E 47°, 36' E	3112 1196	12.1 16.7	47 44
		<i>Neoseiulus barkeri</i>	Rose Apple Pomegranate	Markazi provinE Mahlat, LoRESTAN provinE, aligodarez, Albores provinE Baraghan	33°, 54' N 35°, 57' N 35°, 49 N	50°, 26' E 50°, 54' E 51°, 00' E	1176 1710 1362	16.8 12.9 15.2	36 43 49
		<i>Neoseiulus sugonjaevi</i>	Pomegranate	LoRESTAN provinE, Kohdashet, Semnan provinE, Semnan	33°, 34' N	47°, 23' E	1420 1520	16.5 17.8	44 40
		<i>Neoseiulus zwoelferi</i>	Apple	Markazi provinE Arak, Chera region	34°, 03' N	49°, 40' E	1823	14.1	43
		<i>Neoseiulus brevispinus</i>	Grape leaves	Markazi provinE Garmsar	35°, 14' N	52°, 20' E	866	19.3	37
		<i>Neoseiulus astutus</i>	Pomegranate	Markazi provinE Garmsar	35°, 14' N	52°, 20' E	866	19.3	37
	<i>Neoseiulus sp</i>	Grape leaves	Elam	33°, 03' N	46°, 42' E	910	21.4	36	
	Tribe: Amblyseini	<i>Transeius herbarius</i>	Soil of orchards Soil of Pomegranate orchards	LoRESTAN provinE	33°, 48' N 35°, 14' N	48°, 49' E 52°, 10' E	1650 941	15.2	42
		<i>Amblyseius mcmurtryi</i>	soil	Hamedan	34°, 32' N	48°, 27' E	1916	12.1	47
		<i>Proprioseiopsis sp</i>	soil	Markazi provinE Mahlat	33, 54' N	50°, 28' E	1740	16.8	36
	Tribe: Typhi	<i>Eharias chergai</i>	Pomegranate orchards Almond orchards	Markazi provinE Savhe Kermansh provinE Ryansar	34°, 49' N 34°, 44' N	50°, 36' E 46°, 37' E	911 1421	19.5 15.4	40 43
		<i>Euseius asmissibilis</i>	Grapes orchards	LoRESTAN provinE Koohdashet	33°, 31' N	47°, 36' E	1206	19.5 15.4	40 43
	Subfamily: Typhlodrominae	Tribe: Typhi	<i>Phytoseiulus permittis</i>	Rose	Markazi provinE Mahlat	33°, 54' N	50°, 27' E	1791	16.8
<i>Phytoseiulus spp</i>			Quince orchards rose	Kermansh Krend Markazi provinE Mahlat	33°, 22' N 33°, 54' N	46°, 53' E 50°, 27' E	1410 1684	16.0 16.8	41 36
Subfamily: Typhlodrominae	Tribe: Paraseiuli	<i>Paraseiulus talbii</i>	Beet root soil	Kermansh provinE Sahneh	34°, 29' N	47°, 31' E	1385	16.0	41
		<i>Paraseiulus triporus</i>	Soil	Albroz provinE Taleghan	36°, 54' N	50°, 41' E	1904	12.3	50
		<i>Kucinellus kuzini</i>	Berry	Albroz provinE Taleghan	36°, 54' N	50°, 41' E	1904	12.3	50
	Tribe: Typhlodromini	<i>Neoseiulella tiliarum</i>	Soil of field	Kermansh provinE Sahneh Albroz provinE Karaj	34°, 28' N 36°, 01' N	47°, 41' E 51°, 09' E	1351 2111	16.0 15.2	41 49
		<i>Typhlodromus iranensis</i>	Soil of orchard	Markazi provinE Hazavhe	34°, 11' N	49°, 31' E	2014	14.1	43
		<i>Typhlodromus bagdasariani</i>	Apple	Markazi provinE Senjan	34°, 03' N	49°, 37' E	1847	14.3	45
		<i>Typhlodromus spp.</i>	Soil of wheat field	LoRESTAN provinE Brojerd	33°, 54' N	48°, 41' E	1783	12.9	43
		<i>Typhlodromus persianus</i>	Grapes	Ghazvin provinE Takestan	36°, 03' N	49°, 41' E	1261	15.8	48
		<i>Typhlodromus geogicus</i>	Soil	Albroz provinE Taleghan	36°, 09' N	50°, 41' E	1835	12.3	50
		<i>Typhlodromus tubifer</i>	apple	Albroz provinE Taleghan	36°, 10' N	50°, 41' E	1940	12.3	50
		<i>Typhloseiulus simplex</i>	weed	Albroz provinE Taleghan	35°, 49' N	51°, 00' E	1810	12.3	50

More than 1982 species in 90 genera was included in an analysis of the biogeography of the phytoseiidae. Seven biogeographic regions were taken into account: Nearctic, Neotropical, Ethiopian, west Palaearctic, East Palaearctic, Oriental, Australasian. The number of species was particularly high in the neotropical, oriental and west Palaearctic regions. These regions also present the highest level of species endemism. The number of genera was quite similar in all regions except for Neotropics, which also a high level of endemism [44].

Chant (2009) [45] reported twenty- three species in 4 genera (*Neseiulus* Huges, *Amblyseius* Berlese, *Chelaseius* Muma & Demark and *Proprioseiopsis* Muma from northern tundra, in Aluska, Canada, Greenland Iceland, Russia & Norway. In another study, no significant relationships were found between total acari dispersal and any weather variables [46].

References

- [1] U. Gerson, R. L. Smiley, R. Ochoa, 'Mites (Acari) for Pest Control'. 539 p., Blackwell Science Ltd., UK. 2003.
- [2] G. J. Moraes, J. A. McMurtry, H.A. Denmark, C.B. Campos, 'A revised catalog of family Phytoseiidae', *Zootaxa*, 434: 1-494. 2004.
- [3] T. Kostianen, M.A. Hoy, 'Egg-harvesting allows large scale rearing of *Amblyseius finlandicus* (Acari: Phytoseiidae) in the laboratory'. *Exp. Appl. Acarol.* 18: 155-165, 1994.
- [4] B. Khalil-Manesh, Phytophagous mites fauna of Iran. *Entomol. Phytopathol. Appl.* 35, 30-38, 1973. (in Persian)
- [5] J.A. Mc Murtry, 'Description and biology of *Typhlodromus persianus* n. sp. from Iran, with notes on *T. kettanehi* (Acari: Mesostigmata: Phytoseiidae)'. *Ann. Entomol. Soc. Amer.*, 70(4): 563-568. 1977.
- [6] H. Sepasgosarian, 'The 20 years research of Acarology in Iran'. *J. Engin. Soc. Iran*, 56, 40-50, 1977.
- [7] H. Daneshvar, 'Some predator mites from northern and western Iran'. *Entomol. Phytopathol. Appl.* 48: 15-17, 87-96. 1980.
- [8] H. Daneshvar, 'Some predatory mites from Iran, with descriptions of one new genus and six new species (Acari: Phytoseiidae, Ascidae)'. *Entomol. Phytopathol. Appl.* 54(1-2), 13-37, 1987.
- [9] H. Daneshvar, H. A. Demark, Phytoseiid of Iran (Acarina: Phytoseiidae). *Internat. J. Acarol.* 8(3): 3-22. 1982.
- [10] J. Hajizadeh, R. Hosseini, A. J. Mcmurtry, Phytoseiid mites (Acari :Phytoseiidae) associated with Eriophyid mite (Acari:Eriophyidae) in Guilan province of Iran. *Inter. J. Acarol.* 28(4): 373-378. 2002.
- [11] J. Hajizadeh, 'Introducing a part of the phytoseiids (Acari: Phytoseiidae) fauna of Guilan province, part I: subfamily Typhlodrominae Scheuten'. *Agricultural Research*, 6, 48-63 2006.
- [12] L. A. Kolodochka, H. Hajiqannbar, J. MacMurtry, 'Adescription of unknown male and redescription of female of the rare phytoseiid mite *Neoseiulus sugonjaevi* (Wainstein & Abbasova, 1974) (Parasitiformes: Phytosweiidae) from Iran'. *Acarina.* 11(2): 321- 233, 2003.
- [13] K. Kamali, H. Ostovan, A. Atamehr, 'A catalog of mites and ticks (Acari) of Iran'. Islamic Azad University Scientific Publication Center, 192 pp. 2001.
- [14] F. Faraji, M. Shiroodbakhshi, H. Ostovan, J.A. McMurtry 'Redescription of the female of *Paraseiulus triporus* and *Proprioseiopsis dacus* (Acari: Phytoseiidae) based on

- material collected from citrus in northern Iran'. *Syst. Appl. Acarol.* 12: 199–204, 2007.
- [15] F. Faraji, H. Sakenin- Chelav, K. Kamali, J.A. McMurtry, 'Four new species record of Phytoseiidae (Acari: Mesostigmata) for Iran, and description of variability in the spermatheca of *Typhlodromus barkeri*'. *Sys. App. Acarol.* 13: 123- 132, 2008.
- [16] D. Shirdel, K. Kamali, F. Faraji, 'Redescription of *Typhloseiulus carmonae* (Chant and Yoshida-Shaul) (Mesostigmata: Phytoseiidae) new species for Iran'. *Acarina*, 16 (1), 51–56, 2008.
- [17] H. Rahmani, K. Kamali, F. Faraji, 'Predatory mite fauna of Phytoseiidae of northwest Iran (Acari: Mesostigmata) Turk'. *J. Zool.* 34: 497-508, 2010.
- [18] Y. Fathipour. 'Investigated fun of soil mites in Tabriz orchards', M.S. thesis, Trabiati Modares University, 214pp. 1995.
- [19] K. Kamali, P. Shieshebour, 'The fun of fig mites in the western south of Iran', in Proceedings of the 9 th Iranian Plant Protection Congress, Pp: 75, 1991.
- [20] H. Sadeghie, K. Kamalie, 'The fun of suger beet in Khosetan' in Proceedings of the 10 th Iranian Plant Protection Congress, Pp: 89. 1989.
- [21] F. Fraji, K. Kamalie, 'The fun of citrus in Mazandaran'. in Proceedings of the 11 th Iranian Plant Protection Congress. Pp: 200, 1991.
- [22] H. Noorbakhesh, K. Kamalie, 'The fun of pest and predatory mites in Charmahal'. In Proceedings of the 12 th Iranian Plant Protection Congress, Pp: 310, 1993.
- [23] M.S. Mosadegh, 'Some phytoseiid species in hive of *Apis mellifera* in Iran'. In Proceedings of the 12 th Iranian Plant Protection Congress, Pp: 320, 1995.
- [24] A. Birmani, 'The fune of needy and biology of *Oligonychus unaagais* in Klardasht'. Shaid Charman University, 158pp, 1996.
- [25] M. Khanjani, 'Fune of mite of Fabacea and efficiency of some predatory mite on *Tetranychus turkestanii* in Hamedan'. Phd thesis. Trabiati Modares University. 330pp. 1996.
- [26] A. Taghavi, K. Kamali, A. Saragard, 'Fune of mite in western of Mazandran'. Proceedings of the 13 th Iranian Plant Protection Congress. 100pp. 1998.
- [27] M. Sorosh, K. Kamali, 'Fune of pomegranate orchard in Savhe'. In Proceedings of the 15 th Iranian Plant Protection Congress, 244pp, 2002.
- [28] S. Ramravie, J. Hajizadhe, M. Arbabi, 'The predatory mites in berry orchards in Gilan'. Proceedings of the 15 th Iranian Plant Protection Congress 253pp. 2002.
- [29] H. Birmani, H. Akbrzadhe, 'The mites of *Grospihla aretioides* in western of Mazandran In Proceedings of the 15 th Iranian Plant Protection Congress, PP: 246. 2002.
- [30] M. Arbabi, 'The final report of predatory mites of the European red mite in apple orchard in Tehran, Khorasan and Azarbaijan' 16pp, 2002.
- [31] E.A. Ueckermann, M. Jalaeina, A. Saboori, H. 'Seyedoleslami, Re- description of *Typhlodromus khosrovensis* Arutunjan, first record for Iran (Acari: Phytoseiidae)'. *Acarologia*, 49(1): 23- 27, 2009.
- [32] J. Hajizadeh, S. Mortazavi, 'The genus *Euseius* wainstein (Acari: Phytoseiidae) in Iran, with a revised key to Iranian phytoseiid mites', *International Journal of Acarology*, 41(1): 53-66. 2015.
- [33] P.A. Croft, P. Shearer, G.J. Fields, H.W. Riedl, 'Distribution of *Metaseiulus occidentalis* (Nesbitt) and *Typhlodromus pyri* Scheuten (Parasitiformes: Phytoseiidae)'. *The Canadian Entomologist*, 122(1): 5-14, 1990.
- [34] D.L. McGroartry, B.A. Croft, 'Sampling the density and distribution of *Amblyseius fallacies* (Acarina: Phytoseiidae) in the ground cover of Michigan apple orchards'. *The Canadian Entomologist*, 110(8): 785-794, 1978.
- [35] P.D. Pratt, L.N. Monetti, B.A. Croft, 'Within and between-plant dispersal and distribution of *Neoseiulus californicus* and *N. fallacies* (Acari: Phytoseiidae) in simuted bean and apple plant system', 27(1): 148-153, 1998.
- [36] D.A. Chant, 'Species of phytoseiid mites from northern tundra vegatation (Acari: Phytoseiidae)'. *International Journal of Acarology*, 23(3): 199-221, 2009.
- [37] H.J. Rowell, D.A. Chant, R.I.C. Hansell, 'The determination of setal homologies and setal patterns on the dorsal shield in the family Phytoseiidae (Acarina : Mesostigmata)'. *The Canadian Entomologist*, 110: 859-876, 1978.
- [38] D.A. Chant, E. Yoshid –Shaul, 'Adult idiosomal setal pattern in the family Phytoseiidae (Acari: Gamasina)'. *Internat. J. Acarol.* 18(3): 177-193, 1992.
- [39] S. Kreiter, M.S. Tixier, P. Auger, K. Lebdi- Grissa, 'Phytoseiid mites (Acari: Phytoseiidae) of southern Tunisia'. *Acarologia*, 46 (1): 5-13, 2006.
- [40] I. Steinite, G. Ievinsh, 'Possible role of trichomes in resistance of strawberry cultivars against spider mites'. *Acta Univ. Lat.* 662: 56– 65, 2003.
- [41] C. Duso, M. Pellegrini, 'Distribution of the predatory mite. *Typhlodromus pyri* (Acari: Phytoseiidae) on different apple cultivars'. *Biocontrol Science and Technology*. 49(13): 671-681, 2003.
- [42] P. Pilesjo, L. Thylen, A. Persson, 'Topographical data for delineation of agricultural management. In. Proc 5 th European Conf. Precision Agriculture Stafford, UK. 2005.
- [43] F. Takahashi, D.A. Chant, 'Phylogenetic relationships in the genus *Phytoseiulus* Evans (Acari: Phytoseiidae). I. Geographic distriubation'. *International Journal of Acarology*, 19(1): 15-22, 1993.
- [44] M.S. Tixier, S. Kreiter, G.J. De Moraes, 'Biogeographic distribution of the Phytoseiidae (Acari: Mesostigmata)'. *Biological Journal of the Linnean Society*, 93(4):845-856, 2008.
- [45] T. Mugnussen, 'Aerial dispersal of invertebrates on Svalbard and the influence of weather'. Master thesis in ecology. Department of Biology University in OSLO. 50pp. 2010.

Author Profile

Maryam Rezaie¹ Agricultural Zoology Research Department, Iranian Research Institute of Plant Protection (IRIPP), Agricultural Research, Education Organization Tehran, Iran.

Reza Javannezhad² PhD of Meteorology, Tehran, Iran.