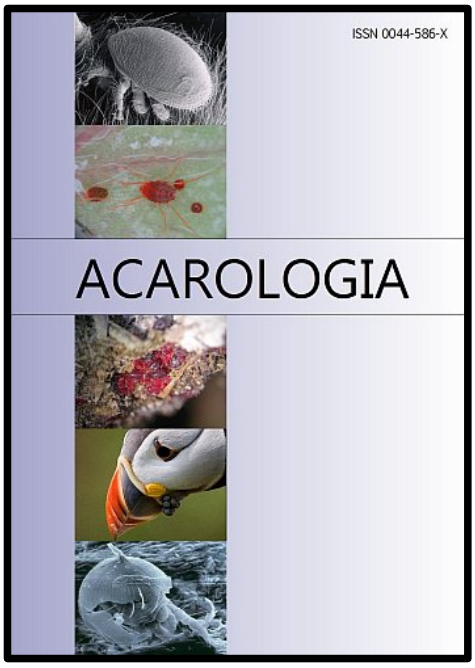

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Phytoseiid mites from the Basilicata region (Southern Italy): species diversity and redescription of *Typhloseiulus arzakanicus* (Arutunjan) with a key of the species of *Typhloseiulus* Chant and McMurtry 1994 (Parasitiformes: Phytoseiidae)

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ABSTRACT — A survey of phytoseiid mites was carried out in the Basilicata region (Southern Italy) between 1976 and 2014 on wild and cultivated plants. A total of 38 species belonging to eleven genera and two subgenera were found on 59 plant species. The most common species was *Euseius finlandicus* (Oudemans) (39%) followed by *Typhlodromus* (*Typhlodromus*) *exhilaratus* Ragusa (32.2%), *Kampimodromus aberrans* (Oudemans) (27.1%), *Typhlodromus* (*Anthoseius*) *cryptus* (Athias-Henriot) (23.7%). *Typhloseiulus arzakanicus* (Arutunjan), found for first time in Italy, is redescribed here, while the male of this species is described for the first time. A dichotomic key of the species belonging to the genus *Typhloseiulus* is also given.

KEYWORDS — Phytoseiidae; Basilicata; Italy; *Typhloseiulus arzakanicus*; redescription; dichotomic key

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INTRODUCTION

Phytoseiid mites are the most important predators of phytophagous mites that are harmful to vascular plants in various natural or agricultural ecosystems. They are considered to be the first exploiters of the foliage habitat (McMurtry, 2010), and their importance as biocontrol agents has been fully demonstrated in the last decades (McMurtry, 1982; Pickett *et al*., 1987; Duso, 1992; Abad-Moyano *et al*., 2010; Schmidt *et al*., 2013). However, limited information is available on phytoseiid fauna associated with uncultivated plants both in agroecosystems and natural ecosystems. It is well known that wild plants give shelter and alternative foods for phytoseiid mites (Duso *et al*., 2010; Tsolakis *et al*., 2016) thus sustaining their populations and this is very important especially when wild plants are in the environs of cultivated ones because they can be a reservoir for these important biocontrol agents (Fauvel and Cotton, 1981; Duso *et al*., 1997, 2010; Tixier *et al*., 1998, 2000).

This work aims at giving new data on the composition and the distribution of phytoseiid species associated with both cultivated and uncultivated plants in the Basilicata region. This is the first report on the Phytoseiidae fauna in this region which

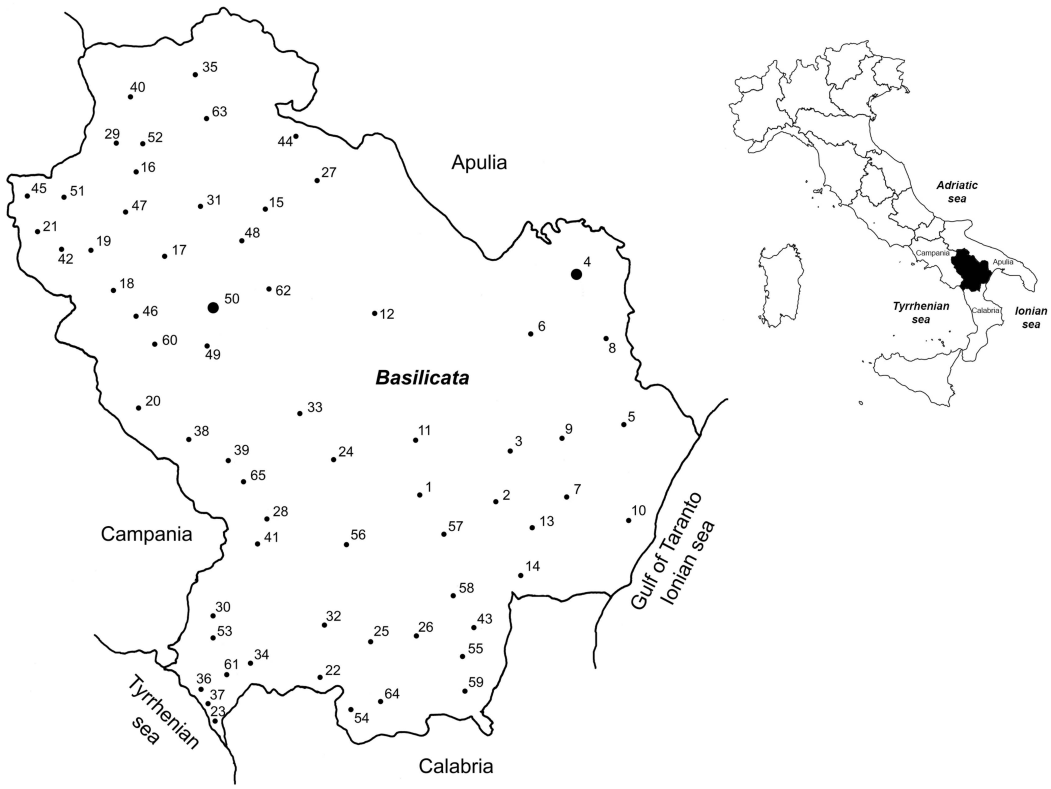

FIGURE 1: Distribution map of collection sites of the Basilicata region. Numbers indicate the localities reported in appendix 1.

is important from an agricultural point of view.

MATERIALS AND METHODS

Surveys were carried out in different localities of the Basilicata region (Southern Italy) between 1976 and 2014, and collections were done using the branch-shaking method (Tsolakis and Ragusa, 1999). Phytoseiid mites, fallen on a black plastic table were preserved in alcohol 70%, cleared in Nesbitt solution and mounted on slides in Hoyer's medium. A differential interference contrast microscope (DIC) Zeiss Axioplan was used for drawings and measurements. For the dorsal and ventral chaetotaxy the nomenclature used is that proposed by Lindquist and Evans (1965) as adapted by Rowell *et al*. (1978) for the family Phytoseiidae, while for the terminology of adenotaxy and the insemination apparatus we follow, with some changes, Wainstein (1973), Athias-Henriot (1975; 1977) and Beard (2001). The leg chaetotactic formulae are those proposed by Evans and Till (1979). All measurements are given in micrometers (μm). Specimens of all species are kept in the Acari collection of the Laboratory of Agricultural and Applied Acarology "Eliahu Swirski", Department of Agricultural and Forest Sciences, University of Palermo (Italy).

RESULTS

The frequency of phytoseiid species collected in the Basilicata region, their host plants and localities of the surveys are reported in table 1, appendixes 1 and 2 and figure 1. Of the plants surveyed 61% were uncultivated (herbaceous 25%, shrubby 30.6% and arboreal 44.4%) and 39% were cultivated (herbaceous 8.7%, shrubby 4.3% and arboreal 87%) (Appendix 2). Phytoseiid mites showed a different distribution on the surveyed plants. *Euseius finlandicus* (Oudemans, 1915) was the most common species, equally distributed on spontaneous and cultivated plants. Other species, *Typhlodromus* (*Ty-*

TABLE 1: List of phytoseiid species collected on 59 host plants

	Species	A	B	C	D	E
1	*Euseius finlandicus* (Oudemans, 1915)	120	11	12	23	39.0
2	*Typhlodromus* (*Typhlodromus*) *exhilaratus* Ragusa, 1977	52	16	3	19	32.2
3	*Kampimodromus aberrans* (Oudemans, 1930)	135	10	6	16	27.1
4	*Typhlodromus* (*Anthoseius*) *cryptus* Athias-Henriot, 1960 *	52	8	6	14	23.7
5	*Typhlodromus* (*Typhlodromus*) *pyri* Scheuten, 1857	33	8	2	10	16.9
6	*Typhlodromus* (*Anthoseius*) *rhenanoides* Athias-Henriot, 1960	68	7	2	9	15.3
7	*Typhlodromus* (*Anthoseius*) *intercalaris* Livshitz & Kuznetsov, 1972	48	5	2	7	11.9
8	*Euseius stipulatus* (Athias-Henriot, 1960)	22	2	4	6	10.2
9	*Phytoseius finitimus* Ribaga, 1904	35	2	4	6	10.2
10	*Amblyseius andersoni* (Chant, 1957)	12	2	3	5	8.5
11	*Typhlodromus* (*Anthoseius*) *athenas* Swirski & Ragusa, 1976	21	2	2	4	6.8
12	*Typhlodromus* (*Anthoseius*) *recki* Wainstein, 1958	16	2	0	4	6.8
13	*Neoseiulus californicus* (McGregor, 1954)	4	1	2	3	5.1
14	*Phytoseius tropicalis* Daneshvar, 1987	7	2	1	3	5.1
15	*Typhloseiulus simplex* (Chant, 1956)	8	1	2	3	5.1
16	*Kampimodromus langei* Wainstein & Arutunjan, 1973	16	1	1	2	3.4
17	*Neoseiulella crassipilis* (Athias-Henriot & Fauvel, 1981)	6	0	2	2	3.4
18	*Paraseiulus soleiger* (Ribaga, 1904)	2	2	0	2	3.4
19	*Paraseiulus talbii* (Athias-Henriot, 1960)	4	1	1	2	3.4
20	*Phytoseiulus persimilis* Athias-Henriot, 1957	26	0	2	2	3.4
21	*Phytoseius horridus* Ribaga, 1904	5	0	2	2	3.4
22	*Typhlodromus* (*Typhlodromus*) *baccettii* Lombardini, 1960	9	1	1	2	3.4
23	*Euseius gallicus* Kreiter & Tixier, 2010	1	1	0	1	1.7
24	*Neoseiulella aceri* (Collyer, 1957)	3	1	0	1	1.7
25	*Paraseiulus erevanicus* Wainstein & Arutunjan, 1967	1	0	1	1	1.7
26	*Phytoseius plumifer* (Canestrini & Fanzago, 1876)	1	1	0	1	1.7
27	*Typhlodromus* (*Anthoseius*) *creticus* Stathakis & Papadoulis, 2012	6	1	0	1	1.7
28	*Typhlodromus* (*Anthoseius*) *halinae* (Wainstein & Kolodochka, 1974)	2	0	1	1	1.7
29	*Typhlodromus* (*Anthoseius*) *psyllakisi* Swirski & Ragusa, 1976	1	1	0	1	1.7
30	*Typhlodromus* (*Anthoseius*) *spiralis* (Wainstein & Kolodochka, 1974)	2	1	0	1	1.7
31	*Typhlodromus* (*Anthoseius*) *verrucosus* (Wainstein, 1972b) **	1	0	1	1	1.7
32	*Typhlodromus* (*Typhlodromus*) *laurentii* Ragusa & Swirski 1978	1	0	1	1	1.7
33	*Typhlodromus* (*Typhlodromus*) *phialatus* Athias-Henriot, 1960	1	1	0	1	1.7
34	*Typhloseiulus calabriae* (Ragusa & Swirski, 1976)	3	1	0	1	1.7
35	*Typhloseiulus eleonorae* (Ragusa & Swirski, 1981)	12	1	0	1	1.7
36	*Typhloseiulus eliahuswirskii* (Ragusa Di Chiara, 1992)	33	1	0	1	1.7
37	*Typhloseiulus arzakanicus* (Arutunjan, 1972)	3	1	0	1	1.7
38	*Typhloseiulus rodopiensis* Papadoulis & Emmanouel, 1994	2	0	1	1	1.7
	Total	**774**				

A- Total number of specimens collected; B- Uncultivated plants; C- Cultivated plants; D- Total number of host plants; E- Frequency in %

* Evans and Momen (1988) synonymized *T. cryptus* with *T. foenilis* Oudemans 1930, but they did not give any argument for sustaining the synonymy; moreover the original description is quite vague for clarifying this aspect. For this reason, and taking into account the more accurate description by Athias-Henriot (1960), we still consider *T. cryptus* a valid species.

** Similarly to the above case, Evans and Edland (1998) synonymized *T. verrucosus* with *T. richteri* Karg 1970, without any discussion. Also in this case as the original description of *T. richteri* by Karg, is very poor for defining unequivocally the species status, we decided to follow the original description by Wainstein (1972), and to consider *T. verrucosus* a valid species.

phlodromus) *exhilaratus* Ragusa, 1977, *Kampimodromus aberrans* (Oudemans, 1930), *Typhlodromus* (*Anthoseius*) *cryptus* Athias-Henriot 1960, *Typhlodromus* (*Typhlodromus*) *pyri* Scheuten, 1857, *Typhlodromus* (*Anthoseius*) *rhenanoides* Athias-Henriot, 1960 and *Typhlodromus* (*Anthoseius*) *intercalaris* Livshitz and Kuznetsov, 1972 were found mainly on wild plants with a range varying from 57.1 to 84.2%. On the contrary, *Euseius stipulatus* (Athias-Henriot, 1960), *Phytoseius finitimus* Ribaga, 1904 and *Amblyseius andersoni* (Chant, 1957) were associated mainly with cultivated plants. The remaining species were rarely collected on both wild and cultivated plants. *Quercus* spp. were the forest plants with the richest phytoseiid fauna (20 species), while among the cultivated ones the greatest number of phytoseiids was associated with *Vitis vinifera* (11 species), followed by *Malus* spp. (9 species) (Appendix 2).

Phytoseiid species collected in the Basilicata region belong to eleven genera and two subgenera (Table 1). Among them, one of the most representative was the genus *Typhloseiulus* with 6 nominal taxa. We give here a new description of *Typhloseiulus arzakanicus* (Arutunjan), found for the first time in Italy, as the original one by Arutunjan did not report some important features currently used by taxonomists, and we also describe the male of this species.

Typhloseiulus arzakanicus (Arutunjan, 1972) (Figures 2 and 3)

Seiulus arzakanicus (original designation) — Arutunjan (1972)
Seiulus (*Seiulus*) *arzakanicus* — Beglyarov (1981)
Typhlodromus arzakanicus — Chant & Yoshida-Shaul (1983)
Typhloseiulus arzakanicus — Chant & McMurtry (1994)

Female (n =1)

Dorsum (Figure 2A) — Dorsal shield oval, strongly sclerotized and with evident reticulation throughout, without a distinct waist. Five pairs of minute solenostomes are visible on the dorsal shield: *gd1* posteroantiaxial to *j3*, *gd2* posteroparaxial to *z4*, *gd6* anteroparaxial to *Z1*, *gd8* anteroantiaxial to *Z4* and *gd9* anteroantiaxial to *Z5*. No poroids are visible on the dorsal shield, possibly due to the strong sclerotization of the shield. Some sigilla (muscle marks) are visible on podosoma (Figure 2). Dorsal setae of podosoma shorter than those of the opisthosoma. All setae are thick and inserted on tubercles. Setae j4, j5 and z5 are the shortest and subequal in length. Setae *r3* and *R1* on the interscutal membrane. All setae are smooth, except for Z5 which are lightly serrated. Measurements of dorsal and sublateral setae are as follows in μm; in parentheses measurements of the holotype (Arutunjan, 1972): *j1* 23 (24); *j3* 29 (24); *j4* 16 (15); *j5* 12 (12); *j6* 23 (21); *J2* 30 (25); *J5* 22 (15); *z2* 25 (18); *z3* 29 (30); *z4* 32 (32); *z5* 12 (12); *s4* 35 (36); *s6* 38 (42); *Z1* 35 (33); *Z4* 56 (72); *Z5* 60 (72); *S2* 42 (54); *S4* 61 (76); *S5* 10 (9); *r3* 17; *R1* 12. Angle *Z1-gd6-j6* 134°. Length of dorsal shield (*j1*-end of shield) 382, width at level of setae *s4* 203, width at level of setae *S4* 218.

Ventral idiosoma (Figure 2B) — Sternal shield sclerotized and smooth. Posterior margin slightly concave, anterior arms well visible. Setae *st1*, *st2* inserted on the shield. Setae *st3* and *st4* tylochorous (on platelets); anterior platelets with outward projections. Poroids *iv1* on the shield; poroids *iv2* and *iv3* on the platelets (Figure 2B). Length of sternal shield 46, width (*st1-st1*) 39, width (*st2-st2*) 50. Epigynial shield smooth; anterior margin of epigynium convex projecting laterally into two long arms. Lateral margin with a slight indentation posterior to *st5*. Genital sigilla (1-3 pairs) well visible. Posterior margin of the shield almost straight. Poroids *iv4* on the interscutal membrane posteroantiaxial to *st5*. Genital sigilla of 4th and 5th pair well visible between bases of setae *ZV1*. Sigilla of 6th pair (sgpa) on the interscutal membrane, at level of setae *JV1*. Ventrianal shield (VAS) almost rectangular, sclerotized and irregularly ornamentated; only one pair of setae (JV2), besides circumanal setae are present on VAS. Solenostomes *gv3* and muscle marks are not visible. Length of VAS 101 µm, width at level of *JV2* 59 µm, width at level of paranal setae 68 µm. Ratio length/width VAS at level of *JV2* 1.71. Ratio length/width at level of paranal setae 1.49. Six pairs of setae, *ZV1*, *JV1*, *ZV2*, *ZV3*, *JV4* and *JV5*, on interscutal membrane. Setae *JV5* smooth being the longest of the setae surrounding the VAS (21 µm).

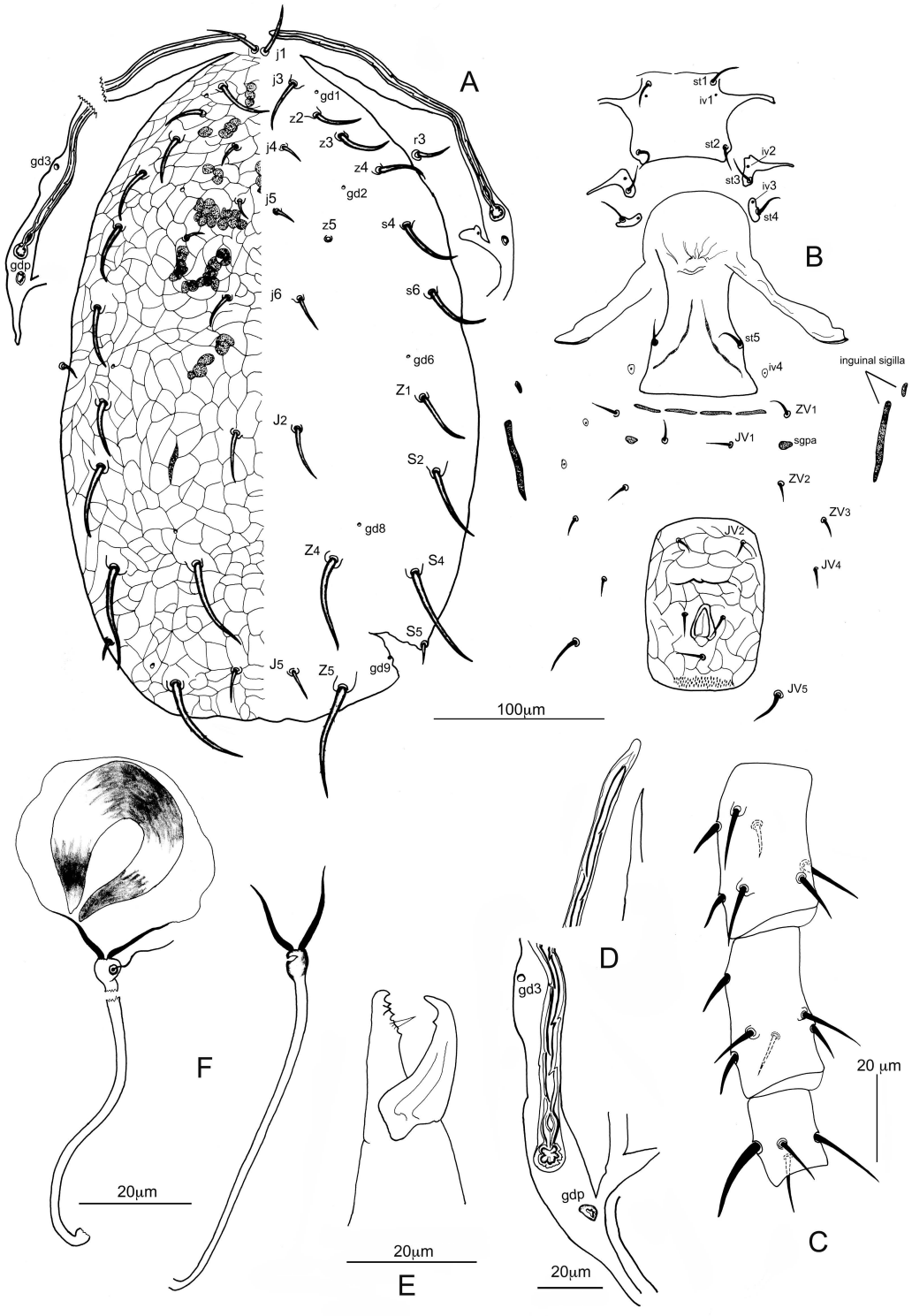

FIGURE 2: *Typhloseiulus arzakanicus* Arutunjan. Female: A – dorsal shield; B – ventral view; C – genu, tibia and tarsus of leg IV; D – apical and basal part of peritrematal shield; E – chelicera; F – Insemination apparatus.

Anterior inguinal sigilla (metapodal platelets), 7 µm long; posterior inguinal sigilla 45 µm long and 6µm thick (Figure 2B).

Insemination apparatus (Figure 2F) — Receptaculum[1] visible, slightly enlarged. Major duct cylindrical, narrow, lightly sclerotized, 57 μm long. Atrium bulbous, well differentiated, free and separate from the calyx by a constriction. Embolus[2] well visible. Minor duct thin, clearly visible. Calyx campanulate, thick-walled all over, without basal neck, 12 μm long. Membranous vesicle well visible.

Legs (Figure 2C) — Seven setae are present on genu of leg II (1 1/1 2/0 2) and leg IV (0 2/1 2/1 1). One macroseta (18 – 20 µm) (sensu Beard 2001) is present on basitarsus of leg IV (17 in the holotype).

Chelicerae (Figure 2E) — Fixed digit with four teeth plus the apical tooth (three in the holotype); *pilus dentilis* evident. Movable digit with one tooth plus the apical one. 23µm long.

Peritreme (Figure 2D) — Apex of peritreme extends to bases of setae *j1*. Solenostome *gd3* well visible on peritrematal shield at level of setae *z4*. Solenostome *gdp* crescentic, posterior to the opening of the stigma. The shape of peritreme presents the characteristic indentation found in other species of the genus (Figure 2D).

Male (Figure 3)

Dorsum (Figure 3A) — Dorsal shield oval, strongly reticulated as female. Five pairs of minute solenostomes are present on dorsal shield: *gd1* posteroantiaxial to *j3*; *gd2* anteroparaxial to *z4*; *gd6* anteroparaxial to *Z1*; *gd8* anteroantiaxial to *Z4* and *gd9* anteroparaxial to *S5*. Only poroids *idm1*, *is1*, *idm3* and *idm4* are visible on the dorsal shield. Dorsal setae thick, shorter than those of the female, smooth, inserted on tubercles. Setae of prosoma subequal in length than those of the opisthosoma. Setae r3 and R1 on dorsal shield. Peritrematal shield is fused with dorsal one at level of setae *z3*. Measurements of dorsal setae in µm means (min-max): *j1* 20 (19 – 20); *j3* 20 (20 – 21); *j4* 13 (12 – 14); *j5* 11; *j6* 14 (13 – 15); *J2* 18 (17 – 19); *J5* 14 (13 – 14); *z2* 17 (15 – 18); *z3* 20 (19 – 21); *z4* 21 (19 – 22); *z5* 9 (9 – 10); *s4* 22 (21 – 24); *s6* 20 (19 – 22); *Z1* 18 (17 – 19); *Z4* 28 (26 – 29); *Z5* 31 (29 – 33); *S2* 21 (20 – 22); *S4* 24 (22-25); *S5* 9 (8 – 10); *r3* 15 (14 – 15); *R1* 10 (9 – 11). Angle *Z1-gd6-j6* 53°. Length of dorsal shield (*j1*-end of shield) 290 (285 – 295), width at level of setae *s4* 174, width at level of setae *S4* 159 (154 – 164).

Ventral idiosoma (Figure 3B) — Sternogenital shield smooth. Cingulum[3] absent. Ventrianal shield (VAS) almost completely ornamentated, triangular, length 108 µm (104 – 112), width at level of *JV2* 140 µm (137 – 142), width at level of paranal setae 76 µm (72 – 79). Setae JV5 11 µm long (10 – 11), smooth and tapered. Genital sigilla of 6th pair (sgpa) not visible. Solenostome gv3 not visible.

Legs — Seven setae are present on genu of leg II (1 1/1 2/0 2) and leg IV (0 2/1 2/1 1). One macroseta (15 – 17 µm) (sensu Beard 2001) is present on basitarsus of leg IV.

Chelicerae (Figure 3C) — Fixed digit with two teeth plus the apical one; *pilus dentilis* small but well visible. Movable digit with one bifid tooth in addition to apical tooth, 20 µm long (18 – 22). Spermatodactyl almost straight like a bird's beak. Heel (*antiramus*) absent. Foot conical, finishing in a toe (*processus apicalis*) slightly rounded. Lateral projection not visible. A membranous *velum* slightly visible. Shaft (*truncus*) is thick; channel well visible along shaft and foot, 32 µm long (30 – 35).

Peritreme (Figure 3A) — Apex of peritreme between bases of setae *j1* and *j3*. Peritrematal shield joint the dorsal one at level of setae z3. Solenostome gd3 on peritrematal shield.

Distribution — *T. arzakanicus* is reported from Armenia (Arutunjan, 1972), from Italy (present study) and from Serbia (Stojnić *et al.*, 2014).

Remarks — The unique specimen collected on *Quercus* sp. is very close to *T. arzakanicus*. It differs from the latter species as some dorsal setae are shorter (*Z4*, *Z5*, *S2* and *S4*) and some others are longer (*j3*, *J2* and *z2*); moreover, five solenostomes are well visible on the dorsal shield, while they are not reported by Arutunjan (1972). The authors tried to get the type material of this species kept in the Scientific Center for Zoology and Hydroecology National Academy of Science of Republic of Armenia, but they never got the material. According to K.P. Dilbaryan, head of the above mentioned scientific

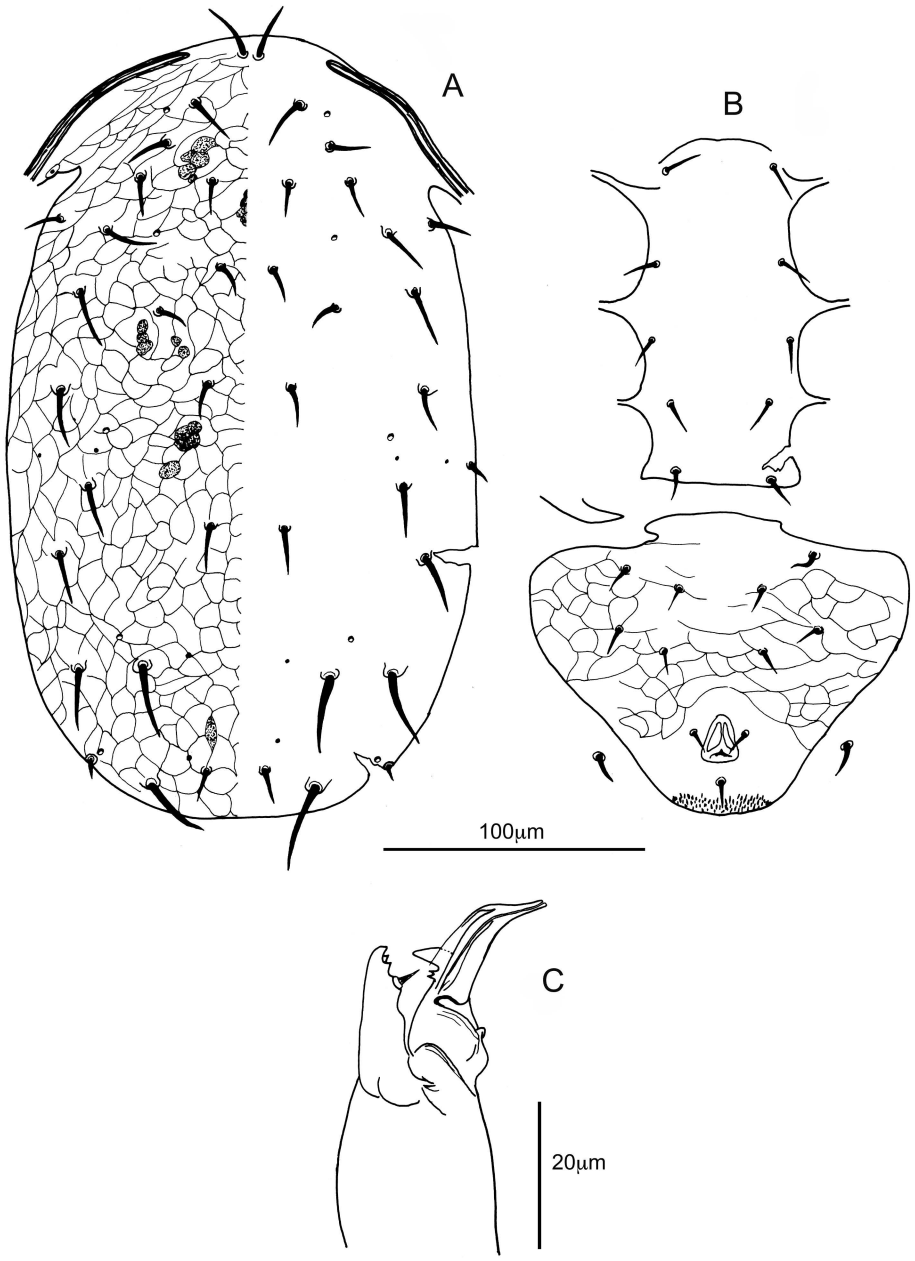

FIGURE 3: *Typhloseiulus arzakanicus* Arutunjan. Allotype: A – dorsal shield; B – ventral shields; C – Chelicera.

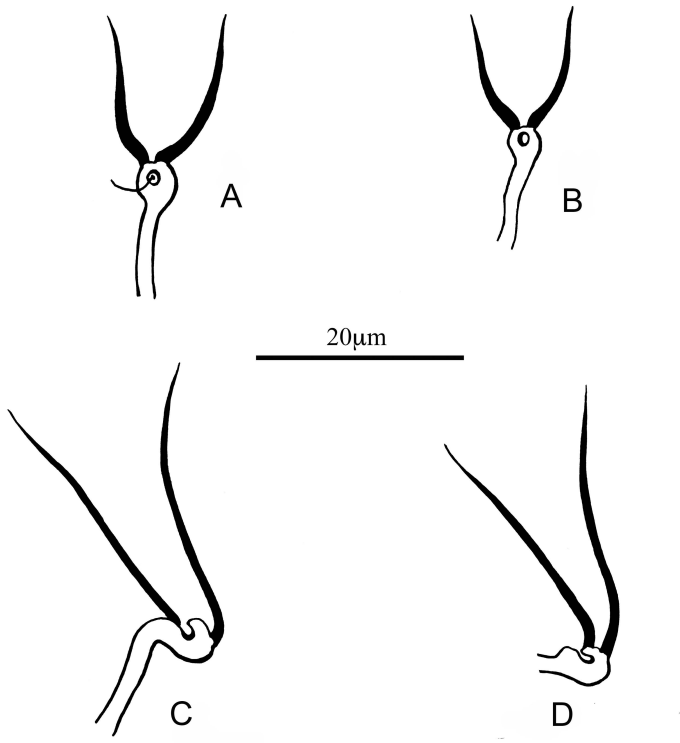

FIGURE 4: Insemination apparatuses of eleonorae species group and simplex species group: A and B – *T. eleonorae*; C and D – *T. simplex*.

center, the registration book of the Arutunjan's collection is missing, and it is almost impossible to locate the slides of the type material, as well as the absence of written identification on the preserved slides (Dilbaryan pers. com).

Despite the above mentioned differences between our specimen and the holotype, we consider it as *T. arzakanicus* with waiting of more specimens and the possibility to observe the type material, in order to support the description of a new species.

Genus *Typhloseiulus* (Chant and McMurtry, 1994)

Chant and Yoshida-Shaul (1983) created the *simplex* species group in the genus *Typhlodromus*. Some years later, Chant and McMurtry (1994) raised the *simplex* species group to the rank of genus, describing the new genus *Typhloseiulus*; at present 10 nominal species are known for this genus.

All *Typhloseiulus* species described up to now are of palearctic region: England, Portugal, Italy, Greece, Moldova, Armenia and Iran. The species of this genus have the same idiosomal setal pattern, 12-A:9B/JV-3:ZV and the same dorsal and ventral *habitus*: dorsal setae thick and thorn-like inserted on tubercles, often serrated and a strongly sclerotized and reticulated dorsal shield. Another characteristic of these species is the indented peritreme almost allover the marginal surface (Fig. 4a, b).

However, they differ by the shape of the calyx of the insemination apparatus. Accordingly, we decide to establish two new species groups:

A. eleonorae species group with the calyx of the insemination apparatus short, thick-walled and campanulate (Figure 4A, B): *T. eleonorae* and *T. arzakanicus*.

B. simplex species group with the calyx of the insemination apparatus elongate, flute shaped and flaring towards the distal part (Figure C, D): *T. simplex*, *T. subsimplex*, *T. calabriae*, *T. peculiaris*, *T. carmonae*, *T. erymanthii*, *T. eliahuswirskii* and *T. rodopiensis*.

Dichotomic key to the species of the genus *Typhloseiulus*: Adult females

I. Insemination apparatus as defined in A: eleonorae species group

1. Genu II with 7 setae. Setae j6 less than 30 μm and longer than setae S5 at least 2 times. All dorsal setae are smooth, except setae Z5 which are lightly serrated ..... *T. arzakanicus*
— Genu II with 8 setae. Setae j6 more than 40 μm and subequal to setae S5. Most of the dorsal setae are big, thick (6-8 μm in width) and strongly serrated ..... *T. eleonorae*

II. Insemination apparatus as defined in B: simplex species group

1. Genu II with 8 setae 2
— Genu II with 9 setae ..... *T. rodopiensis*

2. Setae j6 short (less than 30 μm) 3
— Setae j6 longer than 30 μm 7

3. Setae J2 subequal to setae S5 ..... *T. calabriae*
— Setae J2 longer than setae S5 4

4. Setae j6 about half length of setae S5 ..... *T. subsimplex*
— Setae j6 subequal or longer than setae S5 5

5. Setae J2 four (or more) times longer than setae j6 ..... *T. peculiaris*
— Setae J2 about double in length than setae j6 6

6. Setae J2 three or more times longer than setae S5 ..... *T. simplex*
— Setae J2 about two times longer than setae S5 ..... *T. erymanthii*

7. Setae J2 about 2 times longer than setae j5 ..... *T. carmonae*
— Setae J2 more than four times longer than setae j5 ..... *T. eliahuswirskii*

Notes

[1] *Receptaculum* – the proximal segment of the major duct after the opening between the 3rd and the 4th pair of coxae and may be simple or differentiate; in the latter case it is defined receptaculum (Athias-Henriot, 1977).

[2] *Embolus* – the dimple present in the atrium on which the minor duct is inserted (Athias-Henriot, 1977).

[3] *Cingulum* – in some species the end of the male's peritrematal shield is attached to the anterior part of ventrianal shield through a narrow bridge of sclerotized tegument; this strip is defined cingulum.

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APPENDIX 1: Coordinates and altitudes of surveyed localities

No.	Date	Province	Localities	Elevation m.a.s.l.	Latitude (North)	Longitude (East)
1	24 Jun 98	Matera	Aliano	460	40°19′N	16°14′E
2	27 Aug 07	Matera	Caprarico	123	40°18'N	16°24'E
3	21 Aug 07	Matera	Craco	301	40°22'N	16°26'E
4	18 Aug 76, 27 Jul 14	Matera	Matera	201	40°39'N	16°37'E
5	13 Feb 89	Matera	Metaponto	6	40°22'N	16°48'E
6	19 Aug 07	Matera	Miglionico	331	40°34'N	16°30'E
7	26 Aug 07	Matera	Montalbano Jonico	199	40°17'N	16°34'E
8	28 Jul 14	Matera	Montescaglioso	178	40°33'N	16°39'E
9	21 Aug 07	Matera	Pisticci	260	40°23'N	16°33'E
10	13 May 88	Matera	Scanzano Jonico	10	40°14'N	16°41'E
11	21 Aug 07	Matera	Stigliano	827	40°24'N	16°13'E
12	24 Aug 07	Matera	Tricarico	682	40°36'N	16°08'E
13	26 Aug 07	Matera	Tursi	263	40°14'N	16°27'E
14	26 Aug 07	Matera	Valsinni	183	40°10'N	16°26'E
15	23 Aug 07	Potenza	Acerenza	694	40°47'N	15°56'E
16	23 Aug 07	Potenza	Atella	524	40°52'N	15°39'E
17	24 Aug 07	Potenza	Avigliano	753	40°43'N	15°42'E
18	24 Aug 07	Potenza	Baragiano	497	40°40'N	15°35'E
19	24 Aug 07	Potenza	Bella	567	40°45'N	15°32'E
20	25 Aug 07	Potenza	Brienza	794	40°28'N	15°37'E
21	24 Aug 07	Potenza	Castelgrande	971	40°47'N	15°25'E
22	28 Aug 07	Potenza	Castelluccio Inferiore	501	40°00'N	15°58'E
23	26 Jun 98, 24 Aug 07	Potenza	Castrocucco	15	39°56'N	15°45E
24	21 Aug 07	Potenza	Corleto Perticara	654	40°22'N	16°02'E
25	26 Aug 07	Potenza	Episcopia	426	40°05'N	16°07'E
26	26 Aug 07	Potenza	Francavilla in Sinni	383	40°05N	16°16'E
27	23 Jul 07	Potenza	Genzano di Lucania	496	40°50'N	16°01E
28	25 Aug 07	Potenza	Grumentum	574	40°16'N	15°53'E
29	21 Jul 07	Potenza	Laghi di Monticchio	419	40°55'N	15°36'E
30	26 Aug 07	Potenza	Lagonegro	554	40°07'N	15°45'E
31	23 Aug 07	Potenza	Lagopesole	732	40°48'N	15°44'E
32	26 Aug 07	Potenza	Latronico	707	40°05'N	16°00E
33	21 Aug 07	Potenza	Laurenzana	733	40°27'N	15°58'E
34	28 Aug 07	Potenza	Lauria	710	40°03'N	15°50'E
35	27 Aug 07	Potenza	Lavello	312	41°02'N	15°47'E
36	25 Jun 98, 27 Aug 07	Potenza	Maratea	386	39°59'N	15°43'E
37	27 Aug 07	Potenza	Marina di Maratea	227	39°57'N	15°44'E
38	25 Aug 07	Potenza	Marsico Nuovo	762	40°25′N	15°44′E
39	25 Aug 07	Potenza	Marsicovetere	826	40°22′N	15°50′E
40	21 Aug 07	Potenza	Melfi	516	40°59'N	15°39'E
41	25 Jul 07	Potenza	Moliterno	927	40°14'N	15°52'E
42	24 Aug 07	Potenza	Murolucano	452	40°45'N	15°29'E
43	26 Aug 07	Potenza	Noepoli	526	40°05'N	16°19'E
44	23 Aug 07	Potenza	Palazzo S. Gervasio	474	40°55'N	15°59'E
45	24 Aug 07	Potenza	Pescopagano	873	40°50'N	15°23'E
46	24 Aug 07	Potenza	Picerno	679	40°38′N	15°38′E
47	24 Aug 07	Potenza	Pierno	947	40°47'N	15°36'E
48	23 Aug 07	Potenza	Pietragalla	665	40°44'N	15°53'E
49	22 Aug 07	Potenza	Pignola	850	40°34'N	15°47'E

APPENDIX 1: Continued.

No.	Date	Province	Localities	Elevation m.a.s.l.	Latitude (North)	Longitude (East)
50	25 Aug 07	Potenza	Potenza	710	40°38'N	15°48'E
51	24 Aug 07	Potenza	Rapone	811	40°50'N	15°30'E
52	23 Aug 07	Potenza	Rionero in Vulture	619	40°55'N	15°40'E
53	27 Aug 07	Potenza	Rivello	385	40°04'N	15°45'E
54	28 Aug 07	Potenza	Rotonda	446	39°57'N	16°02'E
55	26 Aug 07	Potenza	San Costantino Albanese	617	40°02'N	16°18'E
56	25 Aug 07	Potenza	San Martino d' Agri	647	40°14'N	16°03'E
57	26 Aug 07	Potenza	Sant'Arcangelo	224	40°15'N	16°16E
58	26 Aug 07	Potenza	Senise	418	40°08'N	16°17'E
59	26 Aug 07	Potenza	Terranova di Pollino	914	39°58'N	16°17'E
60	25 Aug 07	Potenza	Tito	722	40°34'N	15°40'E
61	27 Aug 07	Potenza	Trecchina	414	40°01'N	15°46'E
62	24 Aug 07	Potenza	Vaglio di Basilicata	985	40°40'N	15°55'E
63	22 Aug 07	Potenza	Venosa	392	40°57'N	15°49'E
64	28 Aug 07	Potenza	Viggianello	490	39°58'N	16°05'E
65	24 Aug 07	Potenza	Villa d'Agri	600	40°21'N	15°49'E

APPENDIX 2: List of host plants with the associated phytoseiid species. Numbers refer to the localities reported in appendix 1.

Host plants		Phytoseiidae	Surveyed localities
Family	**Species**		
Aceraceae	*Acer* sp.	*E. finlandicus*	21, 41
		K. aberrans	36
		N. aceri	46
		P. plumifer	41
		T. (*A.*) *cryptus*	33, 41
		T. (*A.*) *intercalaris*	29
		T. (*T.*) *pyri*	29
		T. calabriae	36, 49
Anacardiaceae	*Pistacia lentiscus* L.	*E. stipulatus*	23
		T. (*A.*) *rhenanoides*	23
		T. (*T.*) *exhilaratus*	36
	Pistacia terebinthus L.	*E. finlandicus*	23
Asteraceae	*Cynara cardunculus* L.	*N. californicus*	36
	Dittrichia viscosa (L.) Greuter	*T.* (*A.*) *recki*	7, 9, 23
		T. (*T.*) *exhilaratus*	35, 36
Betulaceae	*Corylus avellana* L.	*A. andersoni*	64
		K. aberrans	32, 46, 64
		K. langei	60
		T. (*A.*) *intercalaris*	46
Boraginaceae	*Echium* sp.	*T.* (*T.*) *exhilaratus*	36
Buxaceae	*Buxus sempervirens* L.	*T.* (*T.*) *baccettii*	38
Cupressaceae	*Cupressus sempervirens* L. var. horizontalis	*T.* (*A.*) *rhenanoides*	4
	Cupressus sempervirens L. var. pyramidalis	*T.* (*A.*) *cryptus*	36
		T. (*A.*) *rhenanoides*	36, 39
	Thuja sp.	*T.* (*A.*) *rhenanoides*	22
Dennstaedtiaceae	*Pteridium aquilinum* (L.) Kuhn	*T.* (*T.*) *pyri*	54
Ericaceae	*Erica* sp.	*T.* (*A.*) *rhenanoides*	36
		T. (*T.*) *exhilaratus*	36
Euphorbiaceae	*Ricinus communis* L.	*E. finlandicus*	23
Fabaceae	*Spartium junceum* L.	*T.* (*T.*) *exhilaratus*	36
	Spartium sp.	*K. aberrans*	53
		T. (*A.*) *spiralis*	18
		T. (*T.*) *exhilaratus*	53
	Ceratonia siliqua L.	*E. finlandicus*	36, 37
		E. stipulatus	37
		T. (*T.*) *exhilaratus*	37
Fagaceae	*Castanea sativa* Miller	*E. finlandicus*	21, 41, 47, 61
	Fagus sylvatica L.	*A. andersoni*	30
		E. finlandicus	21, 30
		T. (*A.*) *intercalaris*	60
		T. (*T.*) *exhilaratus*	30
	Quercus cerris L.	*K. aberrans*	28
	Quercus ilex L.	*K. aberrans*	36
		T. (*A.*) *intercalaris*	36
		T. (*A.*) *rhenanoides*	36, 45
	Quercus sp.	*K. aberrans*	11, 13, 14, 18, 26, 36, 51, 53, 54, 56
		E. gallicus	8

APPENDIX 2: Continued.

Host plants		Phytoseiidae	Surveyed localities
Family	**Species**		
Fagaceae	*Quercus* sp.	*E. stipulatus*	4
		K. langei	28, 43, 48, 62
		P. talbii	8
		P. finitimus	4
		T. (*A.*) *athenas*	1
		T. (*A.*) *creticus*	8
		T. (*A.*) *cryptus*	4, 48
		T. (*A.*) *intercalaris*	8, 22, 28, 29, 31, 51, 61
		T. (*A.*) *psyllakisi*	4
		T. (*A.*) *recki*	8
		T. (*A.*) *rhenanoides*	8
		T. (*T.*) *exhilaratus*	4, 62
		T. (*T.*) *phialatus*	4
		T. (*T.*) *pyri*	8
		T. eleonorae	8
		T. eliahuswirskii	4
		T. arzakanicus	4
		T. simplex	8, 22
Juglandaceae	*Juglans regia* L.	*A. andersoni*	25
		E. finlandicus	29, 50, 52, 53, 65
		E. stipulatus	25
		T. (*A.*) *halinae*	64
Lamiaceae	*Lavandula officinalis* L.	*K. aberrans*	38
	Rosmarinus officinalis L.	*T.* (*T.*) *exhilaratus*	22, 62
		T. (*T.*) *pyri*	54
Moraceae	*Morus alba* L.	*E. finlandicus*	25, 42
	Ficus carica L.	*E. finlandicus*	23
		K. aberrans	1, 25, 36, 48, 57
		P. finitimus	3, 23, 36, 57
		P. horridus	42
		T. (*A.*) *cryptus*	36
Myrtaceae	*Feijoa sellowiana* Berg	*T.* (*T.*) *exhilaratus*	36
Oleaceae	*Olea europaea* L.	*P. talbii*	36
		P. persimilis	23
		T. (*A.*) *athenas*	4, 14, 24, 40, 57
		T. (*A.*) *rhenanoides*	36
		T. (*T.*) *baccettii*	53, 54
Pinaceae	*Cedrus atlantica* (Endl.)	*E. finlandicus*	19, 33
		T. (*A.*) *cryptus*	19, 33
		T. (*T.*) *exhilaratus*	44
Pinaceae	*Pinus* sp.	*P. soleiger*	11
		T. (*A.*) *athenas*	13
		T. (*A.*) *cryptus*	16
		T. (*T.*) *exhilaratus*	16
Platanaceae	*Platanus hybrida* Brot.	*K. aberrans*	17
Poaceae	*Cynodon dactylon* (L.)	*T.* (*T.*) *exhilaratus*	36
		A. andersoni	30

APPENDIX 2: Continued.

Host plants		Phytoseiidae	Surveyed localities
Family	**Species**		
Poaceae	*Ampelodesmos mauritanicus* (Poir.) Dur. & Schinz	*N. californicus*	36
		T. (A.) cryptus	36
Rosaceae	*Crataegus* sp.	*T. (A.) cryptus*	54
		T. (A.) intercalaris	48
		T. (T.) pyri	49
	Fragaria sp.	*P. persimilis*	5
	Malus pumila Miller	*A. andersoni*	28, 64
		N. californicus	28
		E. finlandicus	31
		K. aberrans	20, 22, 46, 64
		P. erevanicus	31
		P. horridus	46
		T. (A.) verrucosus	64
	Malus x domestica Borkh	*K. aberrans*	55
		T. simplex	55
	Prunus dulcis (Mill.) D.A. Webb	*E. finlandicus*	11
		T. (T.) laurentii	59
		T. (T.) pyri	11
	Prunus armeniaca L.	*E. finlandicus*	16
		T. (A.) cryptus	16
	Prunus avium L.	*E. finlandicus*	54
		P. finitimus	32
	Prunus domestica L.	*E. finlandicus*	16
		K. aberrans	11
		T. (A.) cryptus	16
	Prunus laurocerasus L.	*T. (T.) exhilaratus*	15
	Prunus pissardii (Carriére)	*E. finlandicus*	50
	Prunus sp.	*T. (A.) cryptus*	36
	Pyrus communis L.	*T. (A.) cryptus*	46
	Pyrus pyraster (L.) Burgsd.	*N. crassipilis*	39, 57
		T. (A.) athenas	43
		T. (A.) cryptus	36
		T. (A.) intercalaris	33
		T. (T.) exhilaratus	39
		T. simplex	43
	Rosa canina L.	*E. finlandicus*	17
		P. soleiger	17
		T. (T.) pyri	48
	Rubus fruticosus L.	*E. finlandicus*	12, 31, 61
		K. aberrans	12, 63
		P. finitimus	52
		P. tropicalis	27, 55
		T. (A.) cryptus	22, 36
		T. (A.) recki	27, 52
		T. (T.) exhilaratus	53
		T. (T.) pyri	12, 22, 34, 36, 45
	Persica vulgaris Miller	*E. finlandicus*	17
Rutaceae	*Citrus aurantium* L.	*E. stipulatus*	7

APPENDIX 2: Continued.

Host plants			Surveyed
Family	**Species**	**Phytoseiidae**	**localities**
Rutaceae	*Citrus sinensis* (L.) Osbeck	*P. finitimus*	2
Sapindaceae	*Aesculus hippocastanum* L.	*K. aberrans*	17, 38
Simaroubaceae	*Ailanthus altissima* (Mill.)	*T.* (*T.*) *exhilaratus*	36
Tiliaceae	*Tilia* sp.	*E. finlandicus*	65
Ulmaceae	*Ulmus* sp.	*E. finlandicus*	41, 54
		K. aberrans	3, 6
		P. talbii	54
		P. tropicalis	3
Urticaceae	*Parietaria officinalis* L.	*T.* (*T.*) *pyri*	36
Vitaceae	*Vitis vinifera* L.	*E. finlandicus*	3
		E. stipulatus	53
		K. aberrans	3, 6, 11, 27, 39, 40, 42, 46, 58
		N. crassipilis	39
		P. finitimus	4, 22, 39, 52, 58
		P. tropicalis	2
		T. (*A.*) *recki*	46
		T. (*A.*) *rhenanoides*	22
		T. (*T.*) *exhilaratus*	10
		T. (*T.*) *pyri*	58
		T. rodopiensis	4
	Parthenocissus sp.	*E. finlandicus*	50