Scarceness of Phytoseiid Species Co-occurrence (Acari: Phytoseiidae) on Leaflets of *Juglans regia*

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Abstract

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In order to obtain information on the phytoseiid mite taxocoenoses, population density and frequency of occurrence on leaflets of *Juglans regia*, abandoned and uncultivated trees were sampled from July to August 2007. Eight phytoseiid mite species (*Euseius finlandicus*, *Neoseiulella aceri*, *Neoseiulella tiliarum*, *Typhlodromus pyri*, *Typhlodromus cotoneastri, Phytoseius turiacus*, *Amblyseius andersoni*, *Paraseiulus triporus*) were identified. Total phytoseiid population density averaged 1.4 mites per leaflet. The most abundant was *Euseius finlandicus*, and *Neoseiulella aceri* was the second most common species. The predominant presence of only one phytoseiid species per walnut leaflet was noted, but the co-occurrence of two species (mostly *E. finlandicus* with *N. aceri*) was also observed. The simultaneous occurrence of three phytoseiid species on a single leaflet was seldom detected and the cohabitation of more than three species per leaflet was not observed.

Keywords: cohabitation; phytoseiid taxocoenoses; competitive displacement; mite; natural control; walnut-tree

Many phytoseiid mites are known as natural enemies of small arthropods, particularly tetranychid and eriophyid mites. In natural habitats, some phytoseiids play an important role in preventing outbreaks of various phytophagous mites (Edland & Evans 1998). The use of phytoseiid species as effective biological control agents for diverse agriculturally important pests in many crops is common (McMurtry *et al.* 1970; Helle & Sabelis 1985; Gerson *et al.* 2003). Many studies deal with biological characteristics, competition and predation among phytoseiids under defined laboratory conditions or in a very simplified ecosystem (Schausberger & Croft 1999a, b; Kazak *et al.* 2002; Rasmy *et al.* 2004; Villanueva *et al.* 2008). The results of some studies also describe competition between predatory mites under field conditions (Chant 1959; Croft & MacRae 1992). Members of the Phytoseiidae often live on leaves of various plant species. Investigations into the co-occurrence of phytoseiids on leaves of walnut-trees in the field are still missing. In many regions of Bohemia cultivated or mostly uncultivated walnut-trees are common and the knowledge of the phytoseiid mite taxocoenoses on them is scarce. The aims of this study were to investigate the species occurrence, abundance and cohabitation of the phytoseiid species on leaflets of walnut-trees.

MATERIAL AND METHODS

Unsprayed and uncultivated trees of *Juglans regia* L. at one site were surveyed in Central Bohemia near Měňany (49°54'N, 14°05'E). From 15 July to 12 August 2007 the leaf samples (five samples on 15. 7., 22. 7., 29. 7., 5. 8., 12. 8.) were taken from

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25 trees (one sample per tree) which were approximately forty years old. The standard sample size was ten randomly selected leaflets per tree of approximately identical size. All leaflets were taken from branches up to 2–3 m above the ground. A single collected leaflet was immediately placed in a plastic bag and stored in a cold-storage box until examination in the laboratory. Cooled leaflets were surveyed individually using a binocular microscope with fibre-optic illumination. The numbers of active stages of phytoseiid mites per each leaflet were recorded. The entire leaf surface was inspected. Mite densities were expressed as the number of motile stages per leaflet. Phytoseiids were separated from leaflets by using insect pins and mounted in Swann medium on microscope slides. The mites were determined using the keys of Beglyarov (1981a, b), Chant and Yoshida-Shaul (1982). The densities of phytoseiids on leaves were analysed for differences among species using the analysis of variance (ANOVA) and Duncan's multiple range tests (Grofík 1987).

RESULTS AND DISCUSSION

Mites of the family Phytoseiidae occurred on 60.8% of all sampled walnut leaflets. No phytoseiid mites were recorded on the adaxial leaflet area. Eight phytoseiid species, *Euseius finlandicus* (Oudemans, 1915), *Neoseiulella aceri* (Collyer, 1957), *Neoseiulella tiliarum* (Oudemans, 1930), *Typhlodromus pyri* Scheuten, 1857, *Phytoseius turiacus* Wainstein et Kolodochka, 1976, *Amblyseius andersoni* (Chant, 1957), *Paraseiulus triporus* (Chant et Yoshida-Shaul, 1982), *Typhlodromus cotoneastri* Wainstein, 1961, representing a total of 352 specimens, were found on the undersurfaces of the inspected walnut leaflets. The occurrence of *E. finlandicus* and *A. andersoni* on leaves of *Juglans regia* in the Ukraine was also reported by Kolodochka (1978). Papaioannou-Souliotis *et al*. (2000) observed *E. finlandicus* and *T. pyri* on *Juglans regia* in Central Greece. In Finland Tuovinen and Rokx (1991) found *E. finlandicus* on another *Juglans* species.

The population density of phytoseiids averaged 1.4 mites per leaflet. *E. finlandicus* and *N. aceri* were dominant phytoseiid species on the observed walnut leaflets. The frequency of occurrence of *E. finlandicus* was 0.8 mite per leaflet and it was significantly the most frequently occurring (Duncan's test, $P < 0.05$) phytoseiid species on *J. regia* (Table 1). *E. finlandicus* is reported from Europe as a generally common phytoseiid mite mainly inhabiting various deciduous trees and shrubs (Kolodochka 1978; Tuovinen & Rokx 1991). According to Seelmann *et al*. (2007), this species is mostly found on trees with glabrous leaves. The frequency of occurrence of *N. aceri* was 0.5 mite per leaflet. It is known from many broadleaved trees (Karg 1993). The other phytoseiid species were less abundant (Table 1).

Table 1. Species density and frequency of occurrence on leaflets of *Juglans regia*

Phytoseiid mites	Mites per leaflet	Leaflets (%)
Euseius finlandicus	0.804[a]	34.8
Neoseiulella aceri	0.456[b]	27.6
Typhlodromus pyri	0.068[c]	5.2
Neoseiulella tiliarum	0.032[c]	2.8
Amblyseius andersoni	0.020[c]	2.0
Phytoseius turiacus	0.016[c]	1.6
Paraseiulus triporus	0.008[c]	0.4
Typhlodromus cotoneastri	0.004[c]	0.4

Means followed by the same letter are not significantly different ($P < 0.05$) by Duncan's multiple range test

The presence/absence of phytoseiid species on the sampled leaflets of *J. regia* is listed in Table 2. The majority of the examined leaflets (47.2%) were inhabited by a single mite species. Likewise, Kabíček (2008) reported that the presence of a single phytoseiid species per hazelnut leaf was observed most commonly under natural conditions. Only 12.8% of the examined leaflets were found to harbour two different species, the most common combination being *E. finlandicus* and *N. aceri*, detected on 8.4% of the leaflets. By contrast, the single occurrence of *E. finlandicus* and *N. aceri* per individual leaflet was 23.2% and 17.6%,

Table 2. Phytoseiid species per walnut leaflets

Number of species/leaflet	Leaflets (%)
0	39.2
1	47.2
2	12.8
3	0.8
> 3	0.0

Table 3. Simultaneous occurrence of phytoseiid mites on leaflets of *Juglans regia*

Phytoseiid species	Leaflets (%)							
	E. finlandicus	*N. aceri*	*T. pyri*	*N. tiliarum*	*Ph. turiacus*	*P. triporus*	*A. andersoni*	*T. cotoneastri*
E. finlandicus	23.2							
N. aceri	8.4	17.6						
T. pyri	2.0	0.4	2.4					
N. tiliarum	0.0	0.0	0.0	2.4				
Ph. turiacus	0.0	0.0	0.0	0.0	1.2			
P. triporus	0.0	0.0	0.0	0.0	0.0	0.4		
A. andersoni	0.8	1.2	0.0	0.0	0.0	0.0	0.0	
T. cotoneastri	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

respectively. The single occurrence of *T. pyri* per individual leaflet was 2.4%, and its co-occurrence with *E. finlandicus* and *N. aceri* was 2.0% and 0.4%, respectively (Table 3). The simultaneous occurrence of two of the other phytoseiid species on a leaflet was sporadic because of their lower population density.

Competition and interspecific predation among phytoseiids play an important role in the biology and survival of phytoseiid mites (Kabíček 1995; Zhang & Croft 1995; Schausberger 1997; Slone & Croft 2000; Seelmann *et al*. 2007). Population growth and the persistence of some of the phytoseiid species tested in two-species systems showed different levels of competitive displacement in a simplified greenhouse ecosystem (Schausberger 1998). According to Yao and Chant (1989), competition may affect the population levels of natural enemies and may lead to competitive exclusion. Such competitive displacement of some phytoseiids by another phytoseiid species has also been recorded in the field (Croft & MacRae 1992; Duso & Pasqualetto 1993) and it might have been the main cause of the prevalent occurrence of only one phytoseiid species per inspected walnut leaflet.

The co-occurrence of three species of phytoseiid mites (*E. finlandicus, Ph. turiacus, N. tiliarum* and *E. finlandicus, T. pyri, T. cotoneastri*) has been detected on two leaflets only. The co-occurrence of more than three phytoseiid species per inspected leaflet has not been observed. Similarly, the co-occurrence of different phytoseiid mite species on leaves of *Corylus avellana* under natural conditions has seldom been observed (Kabíček 2008). Individual leaves, as distinctly demarcated habitats, allow the realization of opportunistic species interactions among phytoseiid mites. Thus, competitive species interactions negatively affecting the phytoseiid species diversity and the frequency of occurrence of the cohabiting phytoseiid species on individual walnut leaflets could be the main reason for the scarceness of phytoseiid species co-occurrence on the examined leaflets of *Juglans regia*. So it could be speculated that the natural control of potential prey mediated by phytoseiid predators per individual leaf might have been realized predominantly by only one or by a highly limited number of phytoseiid species in field conditions.

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