Occurrence of Predatory Mites of the *Phytoseiidae* Family on Apple-Trees in Integrated and Ecological Orchards

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Abstract

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During the 2005–2007, we identified six species of predatory mites in the integrated and an ecological orchard: *Phytoseius echinus*, *Phytoseius macropilis*, *Euseius finlandicus*, *Typhlodromus pyri*, *Paraseiulus triporus* and *Amblyseius andersoni*. The species *Phytoseius echinus*, *Euseius finlandicus* and *Typhlodromus pyri* occurred in both orchards. *Phytoseius echinus* was dominant especially in the ecological orchard, where its abundance was almost 60% of the overall number of detected mites. The number of all predatory mites differed considerably in the orchards; there was a higher abundance in the ecological orchard. *Euseius finlandicus* abundance was 38.32% in the integrated orchard and almost 17.61% in the ecological orchard. *Typhlodromus pyri* abundance was 17.96% in the integrated orchard and 13.63% in the ecological orchard. *Paraseiulus triporus*, *Amblyseius andersoni* and *Phytoseius macropilis* were less abundant.

Keywords: predatory mites; *Phytoseiidae*; integrated and ecological orchards; apple-tree

Predatory mites of the family *Phytoseiidae* are the most common predators of phytophagous mites from the *Tetranychidae* and *Eriophyidae* families. One of the important mite predators is *Typhlodromus pyri* Scheuten, 1857, a fact proven by a number of recently published studies (e.g. Zacharda 1989; Hluchý *et a*l. 1991; Igram & Nimmo 1993; Fitzgerald *et al*. 1999; Schausberger 1999; Sengonca *et al*. 2003).

Besides *Typhlodromus pyri*, other species from the *Phytoseiidae* family were present in European orchards and vineyards. With the exception of works by Touvinen and Rokx (1991) and Touvinen (1993), however, knowledge on the application of mites in biological protection against phytophagous mites is fragmented and scarce.

In the Czech Republic, Kabíček (2003) found altogether nine species of the *Phytoseiidae* family on apple-trees: *Phytoseius echinus* (Wainstein et Arutunyan, 1970), *Phytoseius macropilis* (Banks, 1909), *Euseius finlandicus* (Oudemans, 1915), *Galendromus longipilus* (Nesbitt, 1951), *Typhlodromus pyri* Scheuten, 1857, *Neoseiulella tiliarum* (Oudemans, 1929), *Paraseiulus triporus* (Chant et Yoshida-Shaul, 1982), *Paraseiulus talbii* (Athias-Henriot, 1960) and *Amblyseius andersoni* (Chant, 1957).

Data on the phytoseiid fauna in Hungary and Croatia have been presented by Ripka (1998). He recorded eight species on the trees in gardens, parks and urban vegetation: *Amblyseius andersoni*, *Amblyseius brihophilus*, *Euseius finlandicus*, *Typhlodromus rhenanus* (Oudemans,

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1905), *Phytoseius echinus*, *Typhloctonus tiliarum* (Oud.), *Typhlodromus bakeri* (Garman, 1948) and *Galendromus longipilus*.

In Slovakia, there has been no research on the abundance of individual species of the *Phytoseiidae* family, which might be used in biological protection against phytophagous mites in orchards and vineyards. Only *Typhlodromus pyri* is recorded, and only based on data gathered outside Slovakia.

The aim of the present work was to evaluate the abundance of predatory mites from the *Phytoseiidae* family on apple-trees in integrated and ecological orchards.

MATERIAL AND METHODS

During the 2005–2007 vegetation seasons, we took samples of leaves from 20 apple-trees in an integrated orchard and from 20 apple-trees in an ecological orchard (each sample contained 10 leaves). Leaves were taken randomly from various parts of the trees, cultivar Topaz. Altogether four samplings were done, resulting in 80 samples from either type of orchard. The sample leaves were transferred to the laboratory and put into a refrigerator to prevent active motion of mites. Later, the leaves were analysed using a stereoscope. Found mites were removed, killed by a mixture of ether, ethyl acetate and chloroform, and were immediately identified using the keys by Kolodochka (1978) and Beglyarov (1981a, b).

Integrated orchard – Fructop Ostratice (district Partizánske): established in 1992, size approx. 250 ha; 170 m altitude, 48°37' (N) latitude 18°26' (E) longitude, mean annual temperature 9.92°C, annual rainfall 575.04 mm. The nutrients for the orchard came from organic and industrial fertilisers; for weed, disease and pest management during the vegetation period, various kinds of pesticides against weeds (containing MCPA agents), fungi (mancozeb, folpet and triadimenol) and pests (fenitrothion, triazamate, deltamethrin and dimethoate) were applied.

Ecological orchard – Orchard Livia Nitra-Kolíňany (district Nitra): established in 1997, size 50 ha; 173 m altitude, 48°18' (N) latitude 18°05' (E) longitude, mean annual temperature 9.70°C, annual rainfall 580.00 mm. Only organic fertilisers were used in the orchard; no pesticides were used, pest control was based on mechanical means (including glue tapes, yellow and white glue plates).

The results were evaluated statistically using the Tukey test at $P = 0.05$ (Anděl 1978).

RESULTS

The numbers of predatory mites collected on apple-tree leaves in the integrated (IN) and ecological (EK) orchard during the 2005–2007 seasons are presented in Table 1.

During the three seasons we collected 519 individuals of predatory mites. In this number, we identified six species of predatory mites from

Table 1. Abundance of predatory mites of the *Phytoseiidae* family in integrated and ecological apple orchards

Predatory mites (species)	Year						Total	
	2005		2006		2007			
	IN	EK	IN	EK	IN	EK	IN	EK
Phytoseius echinus	22^{Ac*}	98^{Bc}	10^{Aa}	40^{Bc}	21^{Ab}	65^{Bb}	53^{Ab}	203^{Bc}
Euseius finlandicus	18^{Ab}	26^{Bb}	24^{Ab}	15^{Ab}	22^{Ab}	21^{Aa}	64^{Ac}	62^{Ab}
Typhlodromus pyri	10^{Aa}	8^{Aa}	14^{Ac}	20^{Ba}	6^{Aa}	20^{Ba}	30^{Aa}	48^{Ba}
Paraseiulus triporus	4	2	–	6	2	6	6	14
Amblyseius andersoni	2	2	3	8	–	5	5	15
Phytoseius macropilis	6	1	3	–	–	9	9	10
Total	62^{A}	137^{B}	54^{A}	89^{B}	51^{A}	126^{B}	167^{A}	352^{B}

The differences are highlighted with capital letters between the two agricultural systems (in rows) and with small letters across the species (in columns)

IN – integrated orchard; EK – ecological orchard

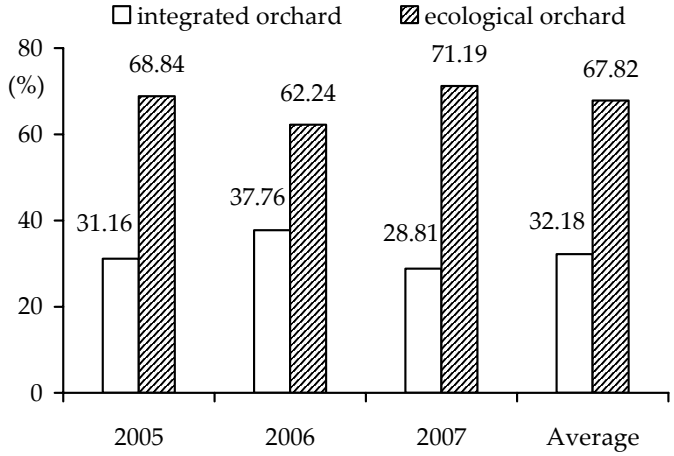

Figure 1. Abundance (% of total) of predatory mites of the *Phytoseiidae* family in integrated and ecological apple orchards

the *Phytoseiidae* family: *Phytoseius echinus*, *Euseius finlandicus*, *Typhlodromus pyri*, *Paraseiulus triporus*, *Amblyseius andersoni* and *Phytoseius macropilis*. Of these species, *Phytoseius echinus* was dominant especially in the ecological orchard, where its abundance was almost 60% of the overall number of detected mites. Also, *Euseius finlandicus* and *Typhlodromus pyri* had high frequencies of occurrence, whereas *Paraseiulus triporus*, *Amblyseius andersoni* and *Phytoseius macropilis* were less abundant.

The number of predatory mites was considerably different in the orchards; there was a higher abundance in the ecological orchard. Percent abundance of the annual totals is presented in Figure 1. During the 2005 season, we identified 62 individuals (31.16%) of predatory mites in the integrated orchard and 137 individuals (68.84%) of predatory mites in the ecological orchard, i.e. 75 mites more than in the integrated orchard. During the 2006 season, we identified 54 individuals (37.76%) in the integrated orchard and 89 individuals (62.24%) in the ecological orchard, i.e. 35 mites more than in the integrated orchard. During the 2007 season, we identified 51 individuals (28.81%) of predatory mites in the integrated orchard and 126 individuals (71.19%) of predatory mites in the ecological orchard, i.e. 75 mites more than in the integrated orchard. In the 2005–2007 seasons combined, 167 individuals (32.18%) of predatory mites were found in the integrated orchard and 352 individuals (67.82%) in the ecological orchard, i.e. 167 more mites than in the integrated orchard.

Considerable differences in the number of predatory mites among the mite species and between the two types of orchards were verified by statistical evaluation.

DISCUSSION

The species of predatory mites identified in our experiments are mentioned by many authors. In some studies the dominance of species is similar to our results, but in some it is different. According to other studies, the structure of populations of mites is larger than we found in our experiments. Kabíček (2003) discovered altogether nine species of predatory mites on the apple-tree leaves of two orchards, three species were identified in both orchards – *Phytoseius echinus*, *Euseius finlandicus* and *Typhlodromus pyri*, of which *Phytoseius echinus* was dominant like in our experiments. He detected three mite species – *Galendromus longipilus*, *Neoseiulella tiliarum* and *Paraseiulus talbii* – which were not identified in our experiments. Ripka (1998) considered *Amblyseius andersoni* to be dominant alongside with *Typhlodromus pyri* and *Euseius finlandicus*, which were quite abundant also in our experiments.

Several studies deal with the abundance of predatory mites in integrated and ecological orchards, as well as with the effect of applied pesticides on the population of predatory mites in an orchard. Fitzgerald and Solomon (2002) identified *Typhlodromus pyri* to be the most abundant species in the integrated orchard, followed by *Phytoseius macropilis* and *Euseius finlandicus*. These three species were also the most abundant ones in the ecological orchard. *Phytoseius macropilis* was discovered in limited numbers in our experiments. Niemczyk *et al.* (2002) found a high toxicity of Trebon 10 SC, Aztec 140 EW and Pirimor 100 PC for predatory mites, while Pirimor 25 WG was semi-selective. Fitzgerald *et al.* (1999) discovered several resistant strains of *Typhlodromus pyri* after

the application of organo-phosphoric zoocides in the integrated orchard. The authors suppose that resistance of certain strains was probably due to a change in the active centre of the final enzyme acetyl cholinesterase.

Some fungicides had toxic effects on the populations of predatory mites. Igram and Nimmo (1993) discovered toxic effects of applied fungicides that contain the active ingredients mancozeb, metiram, sulfur, thiram, zineb and ziram.

The quoted studies confirm the results of our experiments: application of pesticides has a negative effect on the abundance of predatory mites in the integrated orchard compared to the abundance in the ecological one.

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