Broad Leaf Trees as Reservoirs for Phytoseiid Mites (*Acari*: *Phytoseiidae*)

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Abstract

Kabíček J. (2003): **Broad leaf trees as reservoirs for phytoseiid mites (***Acari*: *Phytoseiidae***).** Plant Protect. Sci., **39:** 65–69.

The possibility that broad leaf trees can be reservoirs for phytoseiid mites was investigated by determining their occurrence and species diversity on common deciduous tree species. No phytoseiid mites were found on *Betula pendula* and *Populus tremula*. Altogether 280 specimens of phytoseiids belonging to six species (*Neoseiulella aceri, N. tiliarum, Paraseiulus soleiger, Euseius finlandicus, Phytoseius severus, Typhlodromus rhenanus*) were found on *Acer platanoides*, *Fagus sylvatica*, *Quercus robur* and *Salix caprea*. *Ph. severus* was the dominant phytoseiid species on *S. caprea*, while *N. aceri* was most abundant on *A. platanoides*. The greatest abundance and species diversity of phytoseiids were found on *S. caprea* that can thus constitute an excellent reservoir for some phytoseiid mites, particularly *Phytoseius* spp.

Keywords: *Phytoseiidae*; *Acari*; broad leaf trees; species diversity of phytoseiid mites

Phytoseiid mites are one of the many groups of small arthropods that in all parts of the world often live on the foliage and bark of many plants, in humus and other organic litter (Edland & Evans 1998). The majority of phytoseiid species are known as predators of juvenile stages and adults of various other arthropods, particularly tetranychid and eriophyid mites. If living prey is scarce, many phytoseiids use alternative food sources (Overmeer 1985; McMurtry & Croft 1997).

Some species of phytoseiid mites are used in programmes of biological control of acarine and insect pests in agricultural systems (Walter & O'Down 1992; Croft & Barnes 1971; McMurtry & van de Vrie 1973; Hansen 1988; Hoy & Glenister 1991). In natural habitats, some phytoseiids are important in preventing outbreaks of phytophagous mites (Edland & Evans 1998). Many deciduous trees and bushes may serve as reservoirs for phytoseiid mites from where they can migrate into nearby orchards, vineyards or other coenosis (Tuovinen & Rokx 1991; Tuovinen 1994; Strong & Croft 1993). Dispersal of predaceous mites is important to the persistence of many acarine predator-prey systems (Huffaker *et al*. 1963; Nachman 1988). The presence of tall trees offers a good opportunity for rapid phytoseiid aerial migration into orchards (Tuovinen 1994). Some trees and bushes may be important phytoseiid sources in vineyards and apple orchards (Boller *et al*. 1988; Tuovinen 1994).

Little is known about the occurrence of phytoseiid mites on broad leaf trees in the Czech Republic. Some deciduous tree and bush species are common in urban forest and parks and they often are also an important component of the vegetation close to apple orchards and vineyards. The main aim of this preliminary study was to investigate the occurrence and species diversity of phytoseiid mites on some common broad leaf trees. It could help to select tree species that can serve as reservoirs for phytoseiids in methods to preserve natural enemies.

MATERIAL AND METHODS

Phytoseiids were collected from the leaves of deciduous trees common in mixed forests with a closed canopy. Leaf samples were taken from the peripheral trees of a small forest near Vrchoviny (grid mapping code 5662) (Pruner & Míka 1996) in August 2001 when phytoseiids are abundant on leaves. The trees sampled were *Acer platanoides* L., *Betula pendula* Ehrh., *Fagus sylvatica* L., *Populus tremula* L., *Quercus robur* L. and *Salix caprea* L. The species were identified using the key of Dostál (1954).

The standard sample size was five randomly selected leaves (of about the same size and age) per tree from branches 2–3 m above ground; 25 leaves were collected per tree species. The samples in plastic bags were immediately placed into a portable cold-storage chest and brought to the laboratory where they were stored for a short period in the refrigerator at 5°C. Leaves were examinated individually using a stereomicroscope with fibre-optic illumination.

The phytoseiid mites were separated from leaves by using insect pins, and then transferred into lactic acid for clearing. After clearing they were mounted in Swann's medium (Hrbáček 1969) on microscope slides. The mites were identified using the keys of Beglyarov (1981a,b), Chant and Yoshida-Shaul (1982, 1989) and Karg (1993). The nomenclature of phytoseiid species used in this study follows Chant and McMurtry (1994). Non-phytoseiid mites found on the leaves were classified at the family level. The abundance of phytoseiid mites on tree species was evaluated by the analysis of variance (ANOVA), Duncan's multiple range test (Grofík *et al*. 1987).

RESULTS AND DISCUSSION

The abundance and species diversity of phytoseiid mites on selected tree species are presented in Tables 1 and 2. A total of 280 specimens of phytoseiids belonging to six species, *Neoseiulella aceri* (Collyer), *N. tiliarum* (Oudemans), *Paraseiulus soleiger* (Ribaga), *Euseius finlandicus* (Oudemans), *Phytoseius severus* Wainstein et Vartap., *Typhlodromus rhenanus* (Oudemans), was collected. Almost 33.5% of the leaf samples were without *Phytoseiidae*. The absence of phytoseiid mites on individual leaves was found on all tree species (Table 1).

Table 1. The abundance of phytoseiid mites on trees

Tree species	Number of leaves without mites (%)	Mites per leaf
Acer platanoides	20	4.1 a
Betula pendula	100	0.0 b
Fagus sylvatica	28	1.6 b
Populus tremula	100	0.0 b
Quercus robur	48	0.9 b
Salix caprea	8	4.6 a

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

The abundance of phytoseiid mites was significantly higher on *S. caprea* and *A. platanoides* (Duncan's test $P < 0.05$), species that have numerous small morphogenetic structures on the lower surfaces of the leaves. No phytoseiid mites were found on *B. pendula* and *P. tremula* that have glabrous leaves and non-raised veins (Table 1). It is known that the numbers of phytoseiids are positively associated with the density of vein trichomes, the density of bristles in leaf axils, and the presence of leaf domatia (Karban *et al*. 1995). Phylloplane architecture strongly affects the diversity and abundance of foliar mites (Walter 1996; Karban *et al*. 1995; O'Dowd & Willson 1997; Walter & O'Dowd 1992). According to Beard and Walter (2001), aspects of the host plant influence the behaviour and distribution of phytoseiids independently of prey availability and distribution. Various sheltered leaf habitats rather than food availability may limit the numbers of phytoseiid mites on plants (Karban *et al*. 1995; Tuovinen & Rokx 1991). In the present study, most leaves of *P. tremula* and almost 50% of the birch leaves were inhabited by tydeid, eriophyid and acarid mites, which are suitable prey for various phytoseiid mites (Flaherty & Hoy 1971; Hluchý *et al*. 1991; Muma 1971). Thus, food availability can not have limited the occurrence of phytoseiids on the leaves of *P. tremula* and *B. pendula*. Instead, the lack of sheltered leaf habitats (e.g. trichomes on leaf laminae, raised veins with hairs, domatia) on the leaves of these tree species may explain the absence of phytoseiids on them.

Four phytoseiid species were identified and the highest mite density was found on *S. caprea* that

Table 2. The diversity of phytoseiid species on trees

Tree species	*Phytoseiidae* – species (%)
Acer platanoides	*N. aceri* (89.3), *E. finlandicus* (10.7)
Betula pendula	–
Fagus sylvatica	*E. finlandicus* (87.2), *P. soleiger* (12.8)
Populus tremula	–
Quercus robur	*E. finlandicus* (100.0)
Salix caprea	*Ph. severus* (56.0), *T. rhenanus* (28.4), *N. tiliarum* (14.7), *P. soleiger* (0.9)

has microforests of trichomes on the underside of the leaves and raised veins (Table 2). Non-phytoseiid mites (particularly tydeids and acarids) were abundant on all leaves of *S. caprea*. *Phytoseius severus* was the dominant phytoseiid species on *S. caprea* (Table 2). In Finland, *P. macropilis* (Banks) is one of the dominant phytoseiid species on *S. caprea* (Tuovinen & Rokx 1991). The microforests of leaf trichomes are often the preferred habitat of *Phytoseius* species (Walter 1992). *Salix caprea*, with microforests of trichomes on the underside of its leaves, is of interest because it could serve as an excellent reservoir for species of *Phytoseius*.

Two phytoseiid species were identified on the less-hairy leaves of *A. platanoides* and *F. sylvatica*, with trichomes particularly on basal parts of prominent raised veins and domatia created by tufts of hairs in the vein axils on the underside of the leaves. While *N. aceri* was the predominant phytoseiid species on *A. platanoides*, *E. finlandicus* was more abundant on *F. sylvatica* (Table 2). Only one phytoseiid species (*E. finlandicus*) was found on *Q. robur* which has a raised main vein on the underside of the smooth leaves. Non-phytoseiid mites (particularly tetranychids and tydeids) occurred in different densities on many leaves of *A. platanoides* and *F. sylvatica*, but only sporadically on leaves of *Q. robur*.

While *N. aceri* occurred only on *A. platanoides*, *E. finlandicus* was collected on three tree species. Kabíček and Koubková (1998) found *E. finlandicus* on 19 deciduous tree and shrub species in a city park. This mite species has been recorded on numerous trees and bushes in Finland (Tuovinen 1993), and occurs mostly in temperate zones also on deciduous fruit trees (Croft *et al*. 1997; Tuovinen & Rokx 1991). It is the generalist mite predator that mostly feeds on pollen (McMurtry & Croft 1997). Blackwood *et al*. (2001) reported that *E. finlandicus* preferred larvae of *Tetranychus urticae* Koch in prey-stage preference tests. The occurrence of *E. finlandicus* on a broad spectrum of trees and shrubs indicates that in Bohemia it is a generally common mite of the family *Phytoseiidae* and has a low host plant specificity. By contrast, the occurrence of *N. aceri* only on *A. platanoides* indicates a strong host plant specificity. These results correspond with those recorded by Tuovinen (1993), although *N. aceri* had also been found on some other trees and bushes (de Moraes *et al*. 1986; Beglyarov 1981a; Chant & Yoshida-Shaul 1989). Aerial dispersal may have been the cause of occurrence of *N. aceri* on some other trees and bushes and may also influence the occurrence of phytoseiids on a host plant.

Long-range displacement by air currents permits phytoseiids to spread and escape from unfavourable conditions, and colonize new habitats (Jung & Croft 2001; Tuovinen & Rokx 1991). Aerial dispersal is a passive method of transport (Sabelis & Dicke 1985). Thus, the accidental occurrence of phytoseiid mites with strong host plant specificity on other plant species is possible. More experiments will have to be conducted to evaluate interactions between phytoseiids and host plants.

The results of this study show that abundance and species diversity of phytoseiid mites may strongly differ between various broadleaf tree species in mixed woodland at the same locality. Various leaf microhabitats and host plant specificity influenced the species diversity and the numbers of phytoseiids on the investigated tree species. While *Acer platanoides* may serve as a reservoir, in particular for *N. aceri*, *Salix caprea* might be an excellent reservoir for more phytoseiid species, particularly for species of *Phytoseius*. *Salix caprea* could therefore be used in methods of conservation of natural enemies – one of the three general approaches to biological control of pests.

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Souhrn

Kabíček J. (2003): **Listnaté stromy jako rezervoáry pro roztoče čeledi** *Phytoseiidae* **(***Acari*: *Phytoseiidae***).** Plant Protect. Sci., **39:** 65–69.

Možnost využití listnatých stromů jako rezervoárů pro roztoče čeledi *Phytoseiidae* byla sledována u *Acer platanoides*, *Betula pendula*, *Fagus sylvatica*, *Populus tremula*, *Quercus robur* a *Salix caprea*. Bylo nalezeno šest druhů roztočů čeledi *Phytoseiidae* (*Neoseiulella aceri*, *N. tiliarum*, *Paraseiulus soleiger*, *Euseius finlandicus*, *Phytoseius severus*, *Typhlodromus rhenanus*), celkem 280 kusů. Vhodným rezervoárem dravých roztočů, zejména z rodu *Phytoseius*, může být *Salix caprea* s nejvyšším počtem nalezených jedinců a druhů roztočů čeledi *Phytoseiidae*.

Klíčová slova: *Phytoseiidae*; *Acari*; listnaté stromy; druhová diversita roztočů čeledi *Phytoseiidae*

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