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The predatory mite (Acari, Parasitiformes: Mesostigmata (Gamasina); Acariformes: Prostigmata) community in strawberry agrocenosis

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Abstract

Altogether 37 predatory mite species from 14 families (Parasitiformes and Acariformes) were collected using leaf sampling and pit-fall trapping in strawberry fields (1997 - 2001). Thirty-six were recorded on strawberries for the first time in Latvia. Two species, *Paragarmania mali* (Oud.) (Aceosejidae) and *Eugamasus crassitarsis* (Hal.) (Parasitidae) were new for the fauna of Latvia. The most abundant predatory mite families (species) collected from strawberry leaves were Phytoseiidae (*Amblyseius cucumeris* Oud., *A. aurescens* A.-H., *A. bicaudus* Wainst., *A. herbarius* Wainst.) and Anystidae (*Anystis baccarum* L.); from pit-fall traps – Parasitidae (*Poecilochirus necrophori* Vitz. and *Parasitus lunaris* Berl.), Aceosejidae (*Leioseius semiscissus* Berl.) and Macrochelidae (*Macrocheles glaber* Müll).

Key words: agrocenosis, diversity, predatory mites, strawberry.

Introduction

Predatory mites play an important ecological role in terrestrial ecosystems and they are increasingly being used in management for biocontrol of pest mites, thrips and nematodes (Easterbrook 1992; Wright, Chambers 1994; Croft et al. 1998; Cuthbertson et al. 2003). Many of these mites have a major influence on nutrient cycling, as they are predators on other arthropods (Santos 1985; Karg 1993; Koehler 1999).

In total, investigations of mite fauna in Latvia were made by Grube (1859), who found 28 species, Eglītis (1954) – 50 species, Kuznetsov and Petrov (1984) – 85 species, Lapiņa (1988) – 207 species, and Salmane (2001) – 247 species. There are more than 300 predatory mite species that have been recorded in Latvia currently.

The predatory mite fauna in strawberry agroecosystems has not been investigated previously with the exception of Eglītis (1954) who mentioned *Bdellodes lapidaria* (Kram.) (Bdellidae) on cultivated strawberry, and Kuznetsov and Petrov (1984) who mentioned 6 species: *Amblyseius subsolidus* Begl., *Euseius finlandicus* Oud., *Phytoseius salicis* Wainst. et Arut. (Phytoseiidae), *Lorryia armaghensis* Baker, *L. reticulata* (Oud.) (Tydeidae), and *Anystis baccarum* L. (Anystidae).

The aim of the research was to determine the structure of fauna of insects and mites, abundance and dominance of particular species in Latvian strawberry agroecosystems. The structure, diversity and dominance of the predatory mite fauna is important as the predatory arthropods have an important role in sustainable agriculture.

Materials and methods

Studies of the injurious and beneficial mite (Acari, Parasitiformes, Acariformes) communities in strawberry agrocenosis were carried out during 1997 - 2001 in Latvia. The main material was collected generally from cultivated strawberry fields (about 6 ha) in the Pūre Horticultural Research Station (PHRS; Tukums District, northwest Latvia), but also on privately-owned strawberry fields (Rīga, Dobele and Limbaži Districts). Strawberries were planted in rows with 30-cm distances between plants and 100-cm distances between rows on the PHRS strawberry fields. The PHRS is located on calcareous podzolic sandy loam soil on dolomite bedrock. The private field in the Rīga District was on sandy soils and in the Limbaži District on loamy soils.

The investigations were carried out on fields where chemical treatment was used once per season every two years. Direct observations, collections from leaves, and pit-fall trapping were used. Four to six leaf samples were collected monthly from each field during 1997 - 2000. One leaf sample consisted of 200 leaves (100 folded and 100 unfolded). A method described by Petrova et al. (2000a) was used for sampling, collecting and calculating of mites.

The pit-fall trapping was carried out in 2001. Investigations started in April 9 and ended in October 30. Traps were laid between strawberry plants in rows in triennial strawberry fields at the PHRS. Glass cups (500 cm^3) with a diameter of 70 mm were used for this purpose. For preservation 6 % acetic acid and detergent added were used. Six pit-fall traps were used to catch arthropods living on soil surface. Checking of traps was conducted twice per month. Mites were removed under a stereoscopic microscope and mounted in Berlese medium.

Results

Predatory mite fauna

The predatory mite fauna of cultivated strawberries consisted of 37 species from 27 genera and 14 families (Table 1): Aceosejidae (6 species), Ameroseiidae (1), Antennoseidae (1), Anystidae (1), Bdellidae (1), Cheyletidae (1), Cunaxidae and Eviphidae (2), Laelaptidae (2), Macrochelidae (1), Parasitidae (6), Phytoseiidae (12), Tydeidae (2), Veigaiaidae (1). The highest species richness was found for Phytoseiidae, Aceosejidae and Parasitidae.

During the 5 years of sampling, we found 32 species of Parasitiformes (86.5 % of the total number of species recorded), and 5 species of Acariformes (13.5 %). The occurrence of mites during the period of investigations is shown in Table 1. Unfortunately not all species were identified, especially for the Cunaxidae and Tydeidae.

Thirty-six predatory mite species were recorded for the first time in strawberry fields in Latvia. Two species *Paragarmania mali* (Oud.) (Aceosejidae) and *Eugamasus crassitarsis* (Hal.) were new for the fauna of Latvia.

Leaf samples

In total, 21 predatory mite species of Parasitiformes from 10 families (Aceosejidae (2), Eviphidae (1), Macrochelidae(1) and Phytoseiidae (12) and Acariformes from 4 families (Anystidae (1), Bdellidae (1), Cheyletidae (1), Tydeidae (2)) were found on strawberry leaves. The number of Parasitiformes and Acariformes mites significantly varied among

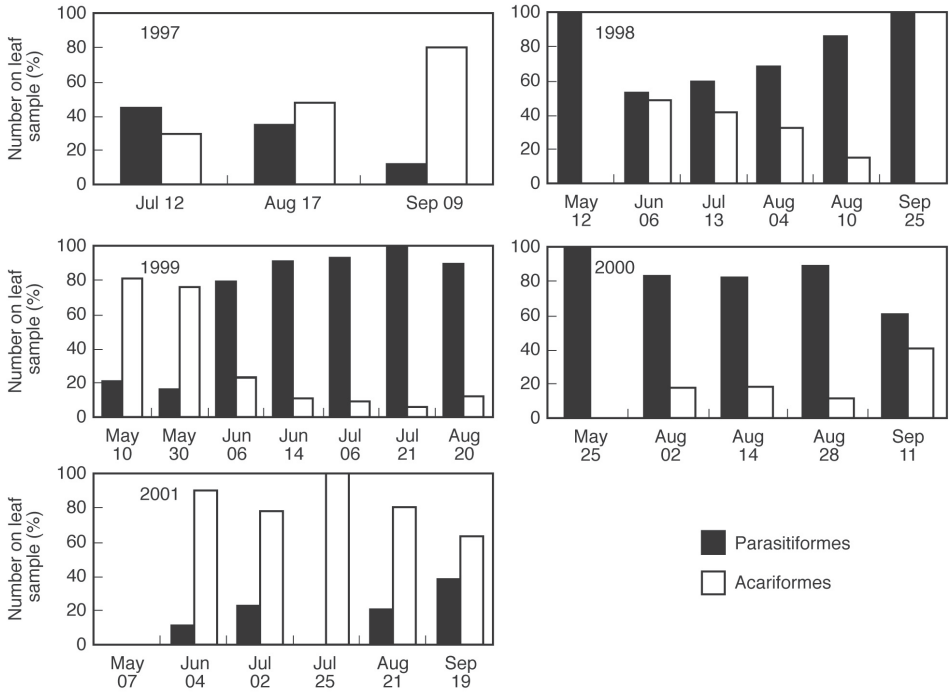

Fig. 1. Comparison of the numbers (%) of predatory mites from families *Parasitiformes* (mainly *Phytoseiidae*) and *Acariformes* (*Anystidae*, *Bdellidae*, *Cheyletidae*, *Cunaxidae*, *Tydeidae*) captured from strawberry leaf samples during the 1997 - 2001.

years (Fig. 1). The abundance of those mites varied on strawberry leaves depending on the age of strawberry plants, population densities of strawberry pests, meteorological conditions and the survival of predatory mites during the winter period. Species of the families Tydeidae, Anystidae, Cunaxidae, and Phytoseiidae were observed on leaves annually. Predatory mites of the remaining families were less frequent.

Phytoseiidae were the most abundant family, and had the highest number of species (12). All of them were found for the first time on strawberry leaves in Latvia. *Amblyseius barkeri* (Hug.) was recorded as a new species for the fauna of Latvia (Petrova et al. 2000c). The most frequent were *Amblyseius cucumeris* Oud., *A. herbarius* (Wainst.), *A. aurescens* A.-H., and *A. bicaudus* Wainst. The abundance of phytoseiid species varied among years and months. *A. cucumeris* was most abundant species in 1997, *A. aurescens* in 1998, and *A. bicaudus* in 1999. *A. cucumeris* and *A. aurescens* was most abundant species in 2000 (in equal proportions), *A. marginatus* (Wainst.) in 2001. In May (1998 - 1999) the most abundant were *A. herbarius* and *A cucumeris*, in June (1998 - 1999) – *A. aurescens*, and *A. cucumeris*, in July (1997 - 1999) – *A cucumeris* and *A. agrestis* (Karg), in August (1997 - 2000) – *Typhlodromus rademacheri* Dosse and *A. agrestis*.

Proctolaelaps bickleyi (Bram) (Aceosejidae), *Paragarmania mali* (Oud.) (Aceosejidae), *Alliphis siculus* Oud. (Eviphidae), *Macrocheles glaber* (Müll.) (Eviphidae), and *Poecilochirus necrophori* Vitzt. (Parasitidae) were recorded as less abundant species on strawberry leaves.

Acariformes mites were represented by Anystidae (1), Bdellidae (1) Tydeidae (2), and Cheyletidae (1). The dominant species was *Anystis baccarum* L. (Anystidae.). It was observed on strawberry foliage annually and the most abundantly in May and June. Tydeidae and Cunaxidae were observed annually on folded and unfolded strawberry leaves among phytophagous mite (*Tetranychus urticae* Koch, *Phytonemus pallidus* Banks) colonies. *Bdellodes longirostris* (Herm.) (Bdellidae) and *Cheletomorpha lepidopterorum* (Schaw) (Cheyletidae) were less abundant.

The predatory mite fauna of the small strawberry fields was represented by six species: *Amblyseius aurescens*, *A. cucumeris*, *A. herbarius*, *A. reductus* Wainst., *T. rademacheri* Dosse (Phytoseiidae), and *A. baccarum* (Anystidae). As rule, these agroecosystems had the least pest mite infestation and predatory mite occurrence (Table 2).

All species of Parasitiformes and Acariformes, with exception of *A. baccarum*, recorded on strawberry foliage were found on strawberries for the first time in Latvia.

Pit-fall traps

In total, 24 mite species were found during the period of pit-fall trapping (Table 1). The highest species diversity was found for Parasitidae (6) (Table 3). Of the Parasitiformes, the family Parasitidae had the highest number of species and the highest number of individuals, and was the most abundant in 2001. Parasitidae mites were found during the whole investigation period of 2001 with an increase in October. *Poecilochirus necrophori* Vitz. and *Parasitus lunaris* Berl. (Parasitidae) were the most abundant in 2001. *Eugamasus crassitarsis* (Hal.) was recorded for the first time in Latvia.

The second most diverse family was Aceosejidae (5 species). *Leioseius semiscissus* (Berl.) was the most abundant species. Aceosejidae were recorded in April, May, and June, but in April and May they were the most abundant.

The family Phytoseiidae took the third position in species richness – four species with dominance of *A. zwoelferi* and *A. aurescens*. The family Phytoseiidae was the most abundant in June.

Table 1. List of the predatory mites collected in strawberry agroecosystems in 1997 - 2001. *, collected from leaves; **, collected from pit-fall traps

Family, Species	1997*	1998*	1999*	2000*	2001*	2001**
Parasitiformes						
Aceosejidae						
Cheiroseius necorniger (Oud., 1903)						×
Leioseius bicolor (Berl., 1918)						×
Leioseius minutus (Hal., 1915)						×
Leioseius semiscissus (Berl., 1892)						×
Paragarmania mali (Oud.)		×				×
Proctolaelaps bickleyi (Bram, 1956)			×			
Ameroseiidae						
Epicriopsis horridus (Kram., 1876)						×
Antennoseiidae						
Antennoseius sp.						×

(continued)

Family, Species	1997*	1998*	1999*	2000*	2001*	2001**
Eviphidae						
Alliphis siculus (Oud., 1905)					×	×
Iphidosoma fimetarium (Mull., 1859)						×
Laelaptidae						
Laelaps agilis (C.L. Koch, 1836)						×
Hypoaspis lusisi (Lapina, 1976)						×
Macrochelidae						
Macrocheles glaber (Mull., 1860)					×	×
Parasitidae						
Eugamasus crassitarsis (Hal.)						×
Gamasodes spiniger (Trāg., 1910)						×
Parasitus lunaris (Berl., 1906)						×
Pergamasus vagabundus (Karg, 1968)						×
Pergamasus crassipes (L., 1758)						×
Poecilochirus necrophori (Vitzt., 1930)					×	×
Phytoseiidae						
Amblyseius agrestis (Karg, 1960)	×	×	×	×		
Amblyseius aurescens (A.-H., 1961)	×	×	×	×	×	×
Amblyseius barkeri (Hug., 1948)		×	×	×		
Amblyseius bicaudus (Wainst., 1962)	×	×	×	×		
Amblyseius cucumeris (Oud.,1933)	×	×	×	×	×	
Amblyseius herbarius (Wainst., 1960)	×	×	×	×	×	
Amblyseius marginatus (Wainst., 1961)					×	×
Amblyseius reductus (Wainst., 1962)	×					
Amblyseius zwoelferi (Dosse, 1957)	×	×			×	×
Anthoseius sp.					×	
Proprioseiopsis okanagensis (Chant, 1957)		×	×			
Typhlodromips rademacheri (Dosse, 1958)	×	×				
Veigaiaidae						
Gamasolaelaps excisus (C.L. Koch, 1879)						×
Acariformes						
Anystidae						
Anystis baccarum (L., 1758)	×	×	×	×	×	×
Bdellidae						
Bdellodes longirostris (Herm., 1804)			×			
Cheyletidae						
Cheletomorpha lepidopterorum (Schaw,1794)		×			×	×
Tydeidae	×	×	×	×	×	×
Tydeus californicus (Banks, 1904)		×				
Tydeus kochi (Oud., 1928)		×				
Cunaxidae		×	×	×	×	×

Table 2. Pest mite and predatory mite infestation and population density in the small strawberry fields

Location	Season	Area	Pest	Infestation (%) pest / predat.	Population density (No. ind. leaf^{-1}) pest / predat.
Rīga District	July 1997	0.02 ha	*T. urticae*	0	0
			P. pallidus	4.2 / 2.0	0.2 / 0.1
Limbaži District	July 1998	0.02 ha	*T. urticae*	6.8 / 3.1	2.4 / 0.1
			P. pallidus	12.5 / 4.4	9.7 / 0.3
Dobele District	July 1999	0.5 ha	*T. urticae*	15.2 / 2.7	1.3 / 0.1
			P. pallidus	0	0

The other families – Ameroseiidae, Antennoseiidae, Eviphidae, Laelaptidae, Macrochelidae, Veigaiaidae – were represented by one species.

Acariformes mites found in pit-fall traps were represented by two species: *A. baccarum* (Anystidae) and *Ch. lepidopterorum* (Cheyletidae). *A. baccarum* was the dominant species. *Ch. lepidopterorum* was found in July.

In total, 23 species of predatory mites from pit-fall traps were recorded for the first time in strawberry agroecosystems in Latvia.

Discussion

The present sampling in Latvian cultivated strawberry fields recorded 32 species of Parasitiformes and five species of Acariformes. Predatory Gamasina mites (Parasitiformes) are known from a wide range of habitats, mainly as free living and mobile predators, and they are often used as bioindicators (Karg 1993; Koehler 1999). The mite species recorded by the authors in strawberry fields are common inhabitants of Latvian agroecosystems (Kuznetsov, Petrov 1984; Lapina 1988; Petrova et al. 2000a,b; Salmane 2001). They are important predators of Nematoda, Acari, Collembola and insect larvae (Karg 1993; Koehler 1999), and they can influence the population growth of the other soil organisms. The predatory mites of Phytoseiidae, Anystidae, Bdellidae, Cheyletidae, Cunaxidae, Tydeidae (Parasitiformes, Acariformes) living on plants may efficiently control small arthropods like mites and thrips (Livschits, Mitrofanov 1975; Karg 1993; Koehler 1999). The Phytoseiidae mites are the most studied group, as they are effective and specialised predators on numerous plant pests (Salmane, Petrova 2002).

The Phytoseiidae community and dominance structure of species associated with cultivated strawberries varies among countries. In Russia, of 12 species, the dominant were *A. herbarius*, *A. reductus* Wainst., and *A. zwölferi* Dosse (Meshkov 1996). In Finland, among 12 species, dominant were *Anthoseius rhenanus* Oud. and *Amblyseius tenuis* (West.) (Tuovinen 1995). In South Sweden, 5 phytoseiid species (Steeghs et al. 1993) have been recorded. In Latvian strawberry fields, the phytoseiid fauna consisted of 15 species with dominance of *A. aurescens*, *A. bicaudus*, *A. cucumeris*, and *A. herbarius*.

According to the results of the authors and data from the literature, the Latvian predatory mite fauna of cultivated strawberry agroecosystems consists of 43 species

Table 3. The number of predatory mite species and specimens from families *Parasitiformes* and *Acariformes* collected in pit-fall traps in strawberry fields in 2001

Family	Number of species	Number of specimens	Specimens (%)
Parasitiformes			
Aceosejidae	5	14	6.0
Ameroseiidae	1	1	0.4
Antennoseiidae	1	1	0.4
Eviphidae	2	3	1.3
Laelaptidae	2	2	0.9
Macrochelidae	1	34	14.9
Eviphidae	2	3	1.3
Laelaptidae	2	2	0.9
Parasitidae	5	99	43.4
Phytoseiidae	4	16	7.0
Veigaiaidae	1	3	1.3
Acariformes			
Anystidae	1	54	23.7
Cheyletidae	1	1	0.4

from 27 genera and 14 families (Aceosejidae, Ameroseiidae, Antennoseidae, Anystidae, Bdellidae, Cheyletidae, Cunaxidae, Eviphidae, Laelaptidae, Macrochelidae, Parasitidae, Phytoseiidae, Tydeidae, and Veigaiaidae).

Thirty-six species of the predatory mites were recorded for the first time in strawberry agroecosystems. Two predatory mite species were new for the fauna of Latvia: *P. mali* (Aceosejidae) and *E. crassitarsis* (Parasitidae).

Phytoseiidae and Anystidae were the most abundant families. The dominant Phytoseiidae species were *A. cucumeris*, *A. aurescens*, *A. herbarius* and *A. bicaudus*; the dominant Anystidae species was *A. baccarum*.

In the material collected from the pit-fall traps the most abundant families were Parasitidae (43.4 %) and Anystidae (23.7 % from total). Four Gamasina species – *Poecilochirus necrophori* Vitz. (37.5 %), and *Parasitus lunaris* Berl. (23.5 %) (Parasitidae), *Macrocheles glaber* Müll. (11.4 %) (Macrochelidae) and *Leioseius semiscissus* Berl. (5.4 % from total) (Aceosejidae) – were the most abundant species.

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Plēsīgo ērču (Acari, Parasitiformes: Mesostigmata (Gamasina); Acariformes: Prostigmata) fauna zemeņu stādījumos

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Kopsavilkums

Plēsīgo ērču (Acari, Parasitiformes, Acariformes) pētījumi (1997 - 2001) tika veikti kultivēto zemeņu agrocenozēs Latvijā. Materiālu ievāca ar zemeņu lapām un augsnes lamatām. Pavisam konstatētas 37 plēsīgo ērču sugas, no tām 36 sugas zemeņu stādījumos atrastas pirmo reizi Latvijā. Divas Gamasina (Parasitiformes) sugas *Paragarmania mali* (Oud.) un *Eugamasus crassitarsis* (Hal.) (Parasitidae) ir jaunas sugas Latvijas faunā. Visvairāk ērču uz zemeņu lapām tika atrasts no sekojošām dzimtām (sugām): Phytoseiidae (*Amblyseius cucumeris* Oud., *A. aurescens* A.-H., *A. herbarius* Wainst., *A. bicaudus* Wainst.) un Anystidae (*Anystis baccarum* L.). Ar augsnes lamatām ievāktajos paraugos visvairāk ērču tika atrasts no dzimtām Parasitidae (*Poecilochirus necrophori* Vitz., *Parasitus lunaris* Berl.), Aceosejidae (*Leioseius semiscissus* Berl.) un Macrochelidae (*Macrocheles glaber* Müll).