

Beneficial organisms overwintering in fallen leaves in fruit orchards

M. Skalský¹, J. Niedobová¹, J. Ouředníčková¹ and T. Kudláček²

Abstract

*Fruit orchards are agroecosystems with a great potential for an occurrence of the large number of arthropods, beneficial invertebrates included, throughout the year. This is due to a rich spatial arrangement of orchards, which offer a large number of ecological niches to invertebrates. Problematics of predator overwintering in orchards is a little explored area. Therefore, we investigated the number of individuals and predator species at pre-specified size area at the beginning and at the end of winter 2018/2019, where we collected fallen leaves from three types of orchards: cherry, pear and apple orchard. One year results showed us a lot of predator individuals, mainly spiders and ladybirds which overwinter in fallen leaves in orchards. We found 243 individuals of spiders belonging to 11 families and 60 ladybirds in cherry orchard; 113 individuals of spiders belonging to 12 families and 44 ladybirds in pear orchard; 202 individuals of spiders belonging to 11 families and 54 ladybirds in apple orchard. Our investigation shows, that fallen leaves in orchards offer important overwintering sites to wide variety of spiders and ladybirds, mainly seven-spot ladybird (*Coccinella septempunctata*), which could immediately react on the first pests occurred in orchards in the early spring.*

Keywords: spider community, ladybirds, orchards, leaf litter, overwintering

Introduction

Agroecosystems of orchards provide suitable conditions for the supporting and maintenance of functional biodiversity, where those relationships that contribute to pest control are particularly beneficial (Simon et al. 2010). They are the spiders and the ladybirds that can act positively here, as they are food generalists and a large part of their prey are pests (Aslam et al. 2013, Isaia et al. 2010). In the course of the year, the community of spiders differs in individual niches of the orchards. A very interesting period, which is not often examined in terms of invertebrate activity, is the period of vegetation rest. Most species of spiders in Central Europe seek shelters in the fall, where they can survive adverse conditions (Bauchhenss 1995). Spiders can overwinter under the bark of trees (Niedobová et al. 2013) or also in artificial shelters (e. g. rolls or tapes from corrugated cardboard) (Havlová et al. 2017). However, if predators do not find suitable overwintering places in the orchards, they overwinter outside the agroecosystem, which reduces their potential to control pests (Pywell et al. 2005). From the point of view of plant protection against animal pests, it is therefore highly desirable to maintain predator communities (especially spiders and ladybirds) in the orchard environment for as long as possible, even outside the vegetation season. If predators overwinter in the orchard, they can react immediately to pests that are beginning to be active in early spring.

Material and Methods

In winter 2018/2019 fallen leaves were collected from three types of orchards RBIP Holovousy (Czech Republic) - cherry, pear and apple orchard. A total of 14 fallen leaf samples (7 samples from the edge of the orchards and 7 samples from the inside of the

¹ Research and Breeding Institute of Pomology Holovousy Ltd., Holovousy 129, Hořice 508 01, Czech Republic

² Mendel University in Brno, Faculty of Forestry and Wood Technology, Zemědělská 1, 613 00 Brno, Czech Republic

orchard) were taken in each type of orchard, 1 sample was taken from an area of 1 m². A total of 14 m² leaves were collected for each orchard. This procedure was repeated a total of two times, at the beginning of the winter on November 27, 2018 and at the end of the winter on February 19, 2019. Thus, for each type of orchard, a total of 28 m² leaves were collected and analysed. Leaves in plastic bags were transferred to laboratory and kept at 22 °C for evaluation. The spiders and the ladybirds were captured by hand. The spiders were then embedded in plastic tube with 40% ethyl alcohol and determination under a binocular microscope followed.

Results and Discussion

Orchards generally host many more species than, for example, field agroecosystems (Kozár 1992). This is largely due to the fact that the orchards are relatively long-term agrocoenoses (mostly 15-30 years (Nix 2013)) with a strong spatial arrangement that provides organisms with a large number of spatial and food niches. Our annual data (Table 1) shows that a large number of spiders and ladybirds hibernate in fallen leaves. In total, we found 243 individuals of spiders belonging to 11 families and 60 ladybirds in cherry orchard; 113 individuals of spiders belonging to 12 families and 44 ladybirds in pear orchard; 202 individuals of spiders belonging to 11 families and 54 ladybirds in apple orchard. However, orchard management, i.e. individual management measures, can have a significant impact on the abundance of species and individuals of invertebrate organisms that occur in this agroecosystem. Therefore, it should be further explored how the mulching of leaves, which is a common management activity, affects the community of beneficial invertebrates overwintering in leaf litter. Of course, it should be compared following the occurrence of fungal diseases in fallen leaves, especially *Venturia inaequalis*.

Table 1: Summary of predators overwintering in leaf litter in orchards 2018/2019

Predator	Cherry orchard		Pear orchard		Apple orchard	
	November	February	November	February	November	February
Spiders (Family)						
Mimetidae	0	0	0	0	2	0
Linyphiidae	13	13	5	4	4	1
Theridiidae	11	10	4	2	29	14
Dictynidae	4	11	22	10	16	7
Lycosidae	0	4	1	1	4	0
Pisauridae	0	1	1	0	0	0
Phrurolitidae	22	43	13	4	30	12
Anyphaenidae	2	2	0	1	2	0
Gnaphosidae	19	50	15	0	47	6
Hahnidae	0	1	0	0	0	0
Clubionidae	0	0	1	2	0	0
Philodromidae	0	0	3	1	4	0
Thomisidae	5	17	5	3	10	4
Salticidae	6	9	12	3	5	5
Ladybirds						
<i>Coccinella septempunctata</i>	28	28	14	10	35	17
<i>Harmonia axyridis</i>	1	0	6	0	2	0
<i>Adalia bipunctata</i>	1	2	8	6	0	0

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