

Survey of pests and beneficial fauna in organic small fruits plantations

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Abstract

A survey for the recognition of harmful and beneficial fauna present in organic plantations of Japanese rose (*Rosa rugosa*) and raspberry was carried out. Monitoring was performed by random sampling of leaves and fruits once a month and by using pheromone traps for raspberry cane midge (*Resseliella theobaldi*) and for tortrix moths (*Archips rosana* and *Adoxophyes orana*). In raspberry plantations limited infestations of aphids and thrips were noted, also restricted to few plantations. Tortrix moths were also very limited in number of individuals, while quite abundant were larvae of *Notocelia uddmanniana*. When considering the mites, the two-spotted spider mite was found in all 6 plantations examined, while raspberry leaf and bud mite (*Phyllocoptes gracilis*), vector of the raspberry leaf spot virus, was detected only in 2 out of 6 plantations. A quite diverse population of beneficial fauna was observed in these plantations. Phytoseiidae were found in 2 plantations and Tydeidae in 5. Predators such as Anthocoridae, green lacewings (*Chrysopidae*) ladybirds and Cecidomyiidae were quite common. Laboratory breeding of *Notocelia uddmanniana* larvae allowed to obtain 7 different species of parasitoids belonging to 4 families (*Bethylidae*, *Eulophidae*, *Ichneumonidae* and *Pteromalidae*). In case of Japanese rose plantations, both pests and beneficial fauna showed a more complex population structure. Larvae of several species of moths belonging to *Pterophoridae* (plume moths), *Geometridae* (*Operophtera brumata*) and *Lasiocampidae* were collected. Among the pests affecting the fruits, *Rhagoletis alternata* and *Grapholita tenebrosana* were the most diffuse, while *Megastigmus aculeatus* was detected only in one plantation. Several species for which Japanese rose is not considered a host plant were also observed. Numerous parasitoids belonging to *Ichneumonidae* were present in the plantations.

Keywords: Beneficial fauna, pests, raspberry, Japanese rose

Introduction

In Poland raspberry production is very important for fresh fruit and processing. On conventional plantations few pests are noted, they are: spider mites, mainly two-spotted spider mite (*Tetranychus urticae*), raspberry leaf and bud mite (*Phyllocoptes gracilis*) (Milenković & Marčić, 2012; Tartanus et al. 2015), leaf rollers (*Tortricidae*), raspberry beetle (*Byturus tomentosus*), strawberry blossom weevil (*Anthonomus rubi*), raspberry cane midge (*Resseliella theobaldi*) and few other minor pests (Alford, 2007; Łabanowska, 2013). The main pests have to be systematically controlled, depending on the season.

Organic Japanese rose plantations are sources of flower petals for jam processing and fruits for juice production, typical ingredients of Polish cuisine. On these plantations, no plant protection treatments are carried out, only the weeds in interrows are mowed twice in the season and every 4-5 years the shoots are cut to rejuvenate the shrubs. However, in the last years some concerns for pest damages were raised by the growers.

The aim of the study was to get to know harmful and useful insects on organic plantations of raspberry and Japanese rose to assess the suitability of various methods for rose fruit fly control.

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Material and Methods

The study was conducted during 2016-2017. In case of raspberry, observations were carried out on 10 organic plantations of raspberry cv. Polka and Polana in the area of Lublin (Eastern Poland), Skierniewice and Tarczyn (Central Poland). In the period from May to September, once a month, surveys were carried out and the presence of harmful and beneficial fauna was checked. Four representative samples were collected each time. The number of spider mites (Tetranychidae) and raspberry leaf and bud mite (*Phyllocoptes gracilis*) and predatory mites (Phytoseiidae) was determined on 200 leaves (4 samples, each 50 leaves), aphids (Aphididae) and leafrollers (Tortricidae) on 200 shoot tips (4 samples, each 50 shoots). In order to determine the species of leafrollers, 50-100 shoots with caterpillars were collected, and caterpillars were reared under laboratory conditions to obtain adults. The presence of some leafrollers and the raspberry stem midge (*Resseliella theobaldi*) was checked using pheromone traps to catch the adults.

With regards to Japanese rose, observations were carried out in 2017 on five organic plantations located in: Dolice n. Stargard Szczeciński (Pomeranian Lake District), Skierniewice and Żurawieniec n. Kutno (Mazovian Lowland), Ostrów Nowy n. Sokółki (Podlasie Lowland), Krzyżowniki n. Poznań (Wielkopolsko-Kujawska Lowland). From each plantation, 100 leaves and 100 fruits were sampled once or twice during the season; additionally, insects were collected after shaking off the shrubs on the entomological sheet and the rose hip fly was trapped on yellow sticky traps. Caterpillars were reared under laboratory conditions to adults and, together with other adult insects, were determined in the laboratory under a stereoscopic microscope.

Results

Raspberry. The two-spotted spider mite (*Tetranychus urticae*) was found on the leaves of all plantations of raspberry. The average number of mobile stages of spider mites per leaf found in the growing season ranged from 0.4 to 2.8 and from 0.3 to 5.0, in 2016 and 2017, respectively. The raspberry leaf and bud mite (*Phyllocoptes gracilis*) in 2016 was found on two plantations and the next season only in one. Its average number per leaf in each plantation was 2.1; 3.1 and 4.1 mobile stages. It is important, however, that in 2016 on plantations where the most numerous populations of spider mite and raspberry leaf and bud mite were observed were present also on average about 4 and 3 motile stages of their predators Phytoseiidae and Tydeidae, respectively. In the following season, the high number of two-spotted spider mites and eriophyid mites was not always correlated with a high number of predators' population. Phytoseiidae were found only on two plantations, in an amount of 0.2-0.9 per leaf in the season. Single individuals of Tydeidae were recorded on 5 plantations. Usually on plantations, where the two-spotted spider mite and raspberry leaf and bud mite were rare, also the predators' population was small, which indicates that it had little preys to feed on.

Aphids (Aphididae) occurred at a low frequency during both years on almost all raspberry plantations, below 0.23 aphids per leaf in the season. The reason for the low number of aphids could be the weather conditions, which are not very favourable for their development, but also the presence of beneficial fauna. In the second year of the monitoring, a rich beneficial fauna was observed. Common green lacewing eggs (Chrysopidae) were recorded on 3 out of 6 plantations, larvae of Anthocoridae on 4 plantations, larvae of ladybirds (Coccinellidae) and larvae of predatory flies of Cecidomyiidae on 2 plantations. This group of predators are considered interesting since they feed mainly on aphids, thrips, but also on other small insects and even mites.

Leafrollers (Tortricidae) were found on all plantations, but the number of damaged shoots was very different, ranging from 2.5% to 55.0%, depending on the plantation. During

breeding from caterpillars collected from the most damaged plantations, a different number of parasitoids was observed: 35 or 8 from 75 or 52 adults, respectively, as well as 2 from 38 moths. The predominant species of the leaf rollers was bramble shoot moth (*Notocelia uddmanniana*) and the parasitoids belonged mainly to the Ichneumonidae family. *N. uddmanniana* is a damaging species because it damages the tops of shoots in spring, which then dry up and as a result shoots grow from lateral buds, which are weaker and late in fruiting. In 2017, on 2 plantations of raspberries, single moth of *Archips rosana* and *Adoxophyes orana* as well as a large number of flies of raspberry stem midges *Resseliella theobaldi* were caught by pheromone traps.

Table 1: Fauna of parasitoids obtained from larvae of bramble shoot moth (*Notocelia uddmanniana*), 2017

Family	Species	No. of specimens
Bethylidae	<i>Goniozus claripennis</i> (Förster)	15
Eulophidae	<i>Euplectrus bicolor</i> (Swederus)	4
Ichneumonidae	<i>Campoplex</i> sp.	18
	<i>Itopectis maculator</i> (Fabricius)	1
	<i>Scambus brevicornis</i> (Gravenhorst)	3
	<i>Trichomma enecator</i> (Rossi)	12
Pteromalidae	<i>Habrocytus</i> sp.	3

Japanese rose. In leaves samples were found mainly the rose plum moth (*Cnaemidophorus rhododactyla*) and few individuals of the rose aphid (*Macrosiphum rosae*), the winter moth (*Operophtera brumata*) and the drinker moth (*Euthrix potatoria*). On the entomological sheet were shaken off the shrubs 295 insects belonging to 20 families and 64 individuals of spiders. The most numerous pest was garden chafer (*Phyllopertha horticola*), which destroys rose inflorescence and German cockroach (Ectobiidae) *Ectobius sylvestris* and *E. lapponicus*, which adults feed on young buds, leaves and flowers. Among predators, numerous were parasitoid wasps, the rovy beetle (*Tachyporus obtusus*), which feed on aphids and other tiny insects, and also the tree damsel bug (*Himacerus apterus*), which feeds on mites, aphids and other small insects. Quite numerous were also the hairy brown darkling beetle (*Lagria hirta*), which adult beetles feed on nectar and pollen, but the larvae live in the humus where they feed on decaying vegetables. Other insect species were rare and most of them are not commonly associated with Japanese rose. In samples of fruits were found 26.5% fruits with caterpillars of the deep-brown piercer (*Grapholita tenebrosana*), 60.8% fruits with larvae of the rose hip fly (*Rhagoletis alternata*) and 87% fruits with larvae of the rose seed gall wasp (*Megastigmus aculetatus*).

The best methods to control the rose hip fly was mulching the soil with non-woven fabric, which allowed limiting the appearance of the rose hip flies by 17.1%, and the number of damaged fruit decreased by 17.4%. Application of entomopathogenic fungi (*Beauveria bassiana* and *B. brongniartii*) and nematodes (*Heterorhabditis bacteriophora* and *Steinernema kraussei*) in field and under laboratory condition had no effect in controlling these pests or reducing their damages.

Discussion

On the raspberry plantations, *Tetranychus urticae*, *Resseliella theobaldi* and *Notocelia uddmanniana* were found in high numbers. Other pests such as *Archips rosana*, *Adoxophyes orana* and *Phyllocoptes gracilis* appeared less frequently. *Resseliella theobaldi*

is very important pest, which destroys stems and causes their drying (Łabanowska 1997). *Phyllocoptes gracilis* is a dangerous species because it can be a vector of the raspberry leaf blotch virus (RLBV) (Tartanus et al., 2015). Aphids were not so numerous, but it is an important group of pests also because are virus vectors (Łabanowska 2013). Quite a diverse population of beneficial fauna, predatory mites Phytoseiidae and Tydeidae, and predatory insects of Anthocoridae, Chrysopidae and Cecidomyiidae families were observed. Seven different species of beneficial fauna were obtained from *Notocelia uddmanniana* larvae.

Only moths from the leafrollers family (Tortricidae) appearing on noble roses located in urbanized areas have so far been reported in the national literature as pests of roses (Burdajewicz & Kokot, 1978; Ziarnkiewicz & Kozłowska, 1973). Recently, moths belonging to 13 families were collected from organic plantations of roses (*Rosa canina* and *R. rugosa*) (Łabanowski & Soika, 2012), but no other reports have been found on pests and beneficial fauna in Japanese rose. The outcomes of the present survey show that there are some risks of damage by different pests, but also that the predatory and parasitic species are quite well established in commercial organic plantations of the crop.

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