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Predatory syrhpids /Diptera, Syrphidae/ and ladybird beetles /Coleoptera, Coccinellidae/ in the colonies of *Aphis fabae* Scopoli, 1763 /Hemiptera, Aphidoidea/ on *Philadelphus coronarius* L.

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Abstract

The observations were carried out between 2004-2006 in the urban green areas of the city of Kraków. The aim of the paper was to determine the population dynamics of *A. fabae* on Sweet Mock Orange and to assess species composition of predatory insects (Syrphidae and Coccinellidae) which control aphid populations.

During the years of the research aphids were recorded in different numbers; in 2006 their number was almost twice as much as in 2005. The least numerous colonies were recorded in 2004.

Eight Syrphidae species were recorded: *Episyrphus balteatus, Epistrophe eligans, Syrphus vitripennis, Syrphus ribesii, Eupeodes corollae, Platycheirus scutatus, Scaeva pyrastri* and *Sphaerophoria scripta*. In all the research years *E. balteatus* and *E. eligans* dominated, amounting to 62% of all the Syrphidae.

Out of all the four Coccinellidae species that were registered in *A. fabae* colonies *Coccinella septempunctata* was the most numerous constituting from 41 to 58% of all the collected Coccinellidae

Introduction

Shrubs of *Philadelphus coronarius* L. are a valuable decorative element of urban plant cultivated species because of creamy and strongly scented flowers.

They are little demanding shrubs which are capable of growing even in poor soil unless it is too dry and does not receive enough sunshine; they require half shade, are cold-resistant and can bear cutting well (SENETA, 1991). Nowadays they are recommended mainly to be planted in parks and housing estate green spaces, as single shrubs or in little groups and trimmed hedges.

Figure 1. *Aphis fabae* colony on *Philadelphus coronarius*

Decorative values of these shrubs are limited by *Aphis fabae* Scop. It forms several biotypes (*A. fabae* Scop. sensu stricte, *A. fabae solanella* Theob., *A. fabae cirsiiacanhoidis* Scop., *A. fabae evonymi* Fabr.) out of which two forms develop on Sweet Mock Orange. For one of them *Philadelphus* is a winter host, the second flies from spindle tree (*Euonymus europea* L.) (WEISMANN & VALLO, 1963; BARCZAK, 1991; BLACKMAN & EASTOP, 2007). Aphid colonies settle leaves on top parts of shoots, their feeding leads to an inhibiting of shoot growth, the attacked leaves are twisted and deformed, while shrubs are covered with honey dew. It is a nutrient for sooty mold which develops on leaves and thus limits the assimilating area of plants and damages them (Fig. 1).

The population of *A. fabae* is limited by a numerous group of predatory and parasitic insects among which syrphids – Syrphidae and ladybird beetles – Coccinellidae play a major role.

The aim of the paper was to determine the population dynamics of *A. fabae* on Sweet Mock Orange and to assess species composition of predatory insects (syrphids and ladybirds beetles) which limit aphid population.

Material and methods

Observations were carried out between 2004-2006 in urban green spaces of the city of Kraków (Prądnik Czerwony) on ten shrubs of *Philadelphus corona-*

rius. Five shoots with *A. fabae* colonies were selected on each shrub on which in weekly intervals from April until June aphids and predatory larvae of syrphids as well as larvae and adults of ladybirds were counted. The larvae of Syrphidae were collected from the remaining shoots and were reared in Petrie's dishes and were fed with living *A. fabae* aphids until they became adults.

Adults of syrphids were identified in terms of species on the basis of keys of Bańkowska (1963) and van Veen (2004), whereas Coccinellidae – on the basis of the Bielawski key (1959).

Results and discussion

In the years of the research aphids were presented in varied intensity – in 2006 their number was almost twice as high as in 2005. The smallest aphid colonies were registered in 2004 (Fig. 2).

Aphids appeared on Sweet Mock Orange shoots in mid-April. The maximum number was reached in the second (2006 – 300 specimens/ shoot) and third decade of May (2004 – 150 specimens/ shoot and in 2005 – 170 specimens/ shoot), after which their number decreased as a result of migration and predators' activity until they disappeared entirely at the end of June. When analyzing the influence of air pollution on *A. fabae* and their predators' presence on Sweet Mock Orange Gospodarek (2007) registered the presence of first aphid colonies in the beginning of May. She claimed that during the period of the maximum number, aphid colonies amounted to 700-1000 specimens.

In *A. fabae* colonies predatory larvae of Syrphidae were registered. They appeared in aphid colonies with a delay which amounted even to 3 weeks (Fig. 2). The highest number of predatory larvae was observed at the end of May and the beginning of June, after aphid maximum number was reached. Having arrived at their maximum, aphid number was decreasing and the population of Syrphidae also decreased leading to the entire disappearance at the end of June. The ratio of predator/ prey was very diversified in particular times of the observation. In the beginning of aphid occurrence, a high number of aphids per one syrphid larva was recorded (Fig. 2). As time passed and the number of syrphid larvae increased the ratio predator/prey was becoming more favourable for the predator.

In the years of the research 178 larvae of 8 species (*Episyrphus balteatus, Epistrophe eligans, Syrphus vitripennis, Syrphus ribesii, Eupeodes corollae, Platycheirus scutatus, Scaeva pyrastri, Sphaerophoria scripta*) were collected from Sweet Mock Orange (Tab. 1, Fig. 3). Most larvae were collected in 2006. Most species occurred in all the research years, with the exception of 2004 and 2006 when no larvae of *S. pyrasti* were recorded; *S. scripta* occurred only in 2004. In all the research years *E. balteatus* and *E. eligans* dominated, constituting about 62% of all the collected syrphids (Tab. 1, Fig. 4).

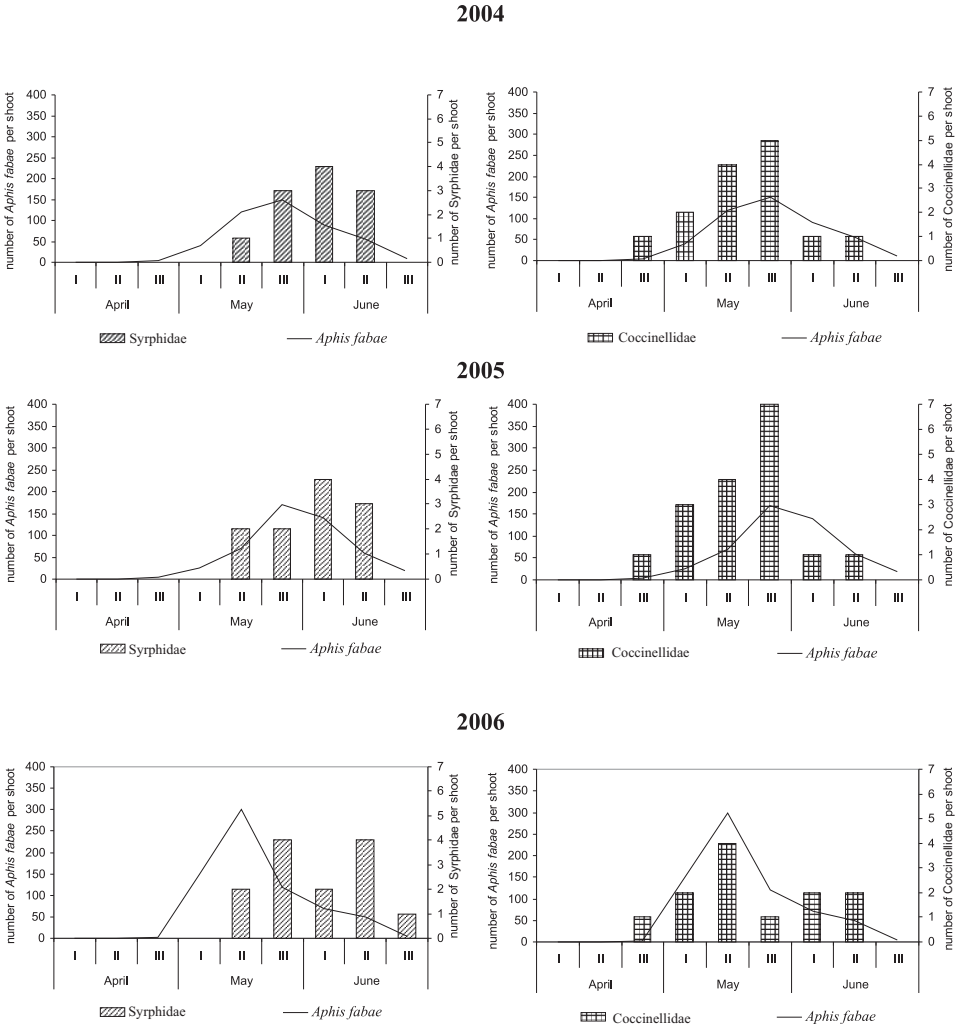

Figure 2. Population dynamics of *Aphis fabae*, Syrphidae and Coccinellidae on *Philadelphus coronarius* (Kraków 2004-2006)

The importance of Syrphidae in controlling the *A. fabae* number, apart from the predator/prey ratio, is determined also by the percentage of colonies attacked by syrphids. In the beginning of aphid appearance, the extent of predator domination over aphid colonies was small, and during the maximum number of Syrphidae larvae appearance it reached from 20% (2004) to 35% (2006). This means that at this time, aphid colonies may have been damaged or their number was limited by the feeding of syrphid larvae (Tab. 2).

Figure 3. Syrphidae larva on *Philadelphus coronarius*

Table 1. Number of predatory syrphids and coccinellids in *Aphis fabae* colonies on *Philadelphus coronarius* (Kraków 2004-2006)

Species	2004	2005	2006
Syrphidae			
Episyrphus balteatus (Deg.)	12	19	38
Epistrophe eligans (Harr.)	9	12	20
Syrphus vitripennis Meig.	6	9	5
Syrphus ribesii (L.)	5	7	15
Eupeodes corollae (Fabr.)	1	3	6
Platycheirus scutatus (Meig.)	0	5	2
Scaeva pyrastri (L.)	0	2	0
Sphaerophoria scripta (L.)	2	0	0
total	**35**	**57**	**86**
Coccinellidae			
Coccinella septempunctata L.	16	22	44
Adalia bipunctata L.	12	16	12
Propylaea quatuordecempunctata (L.)	9	10	17
Coccinula quatuordecimpustulata (L.)	2	0	3
total	**39**	**48**	**76**

Table 2. *Aphis fabae* colonies infested by Syrphidae and Coccinellidae (Kraków 2004-2006)

Year	Mean number of *Aphis fabae* in colony	% colonies with Syrphidae	% colonies with Coccinellidae
2004	67	20.5	28.5
2005	70	22.6	44.6
2006	99	35.7	32.6

In the research on the role of aphids settling ornamental shrubs in the Syrphidae development, WNUK & GOSPODAREK (1999) and WNUK (2000) confirmed the presence of 10 species of syrphids in *A. fabae* colonies. Having one generation during the whole year early spring species clearly dominated on Sweet Mock Orange. *E. eligans* larvae constituted 90% of larvae collected from *A. fabae* colonies from the shrubs. The authors observed that on Sweet Mock Orange from 13 to 44% of *A. fabae* colonies were controlled by Syrphidae larvae, the greatest number of aphid colonies with Syrphidae larvae was recorded in the third decade of May. WNUK (2005) stated that in aphid colonies on trees and shrubs most often only few Syrphidae species occurred (e.g. *E. balteatus, S. vitripennis* or *S. ribesii*).

The data concerning the presence of aphidophagous Syrphidae in aphid colonies on different ornamental shrubs can be found also in publications by ZIARKIEWICZ & KOZŁOWSKA (1973), CICHOCKA & GOSZCZYŃSKI (1991), JAŚKIEWICZ (1996, 2004), JAŚKIEWICZ *et al.,* (2001a), WNUK (2000), WOJCIECHOWICZ-ŻYTKO (2004).

Aphids developing in early spring on trees and shrubs are a valuable nutrient reservoir for the first Syrphidae larvae (WNUK, 1972; WNUK & MEDVEY, 1986; WOJCIECHOWICZ-ŻYTKO, 2007). As the developmental stage is finished adult *Syrphidae* fly over onto crop plants on which they lay eggs in aphid colonies starting new generations (WNUK, 2005). When analyzing species composition of Syrphidae feeding on *A. fabae* colonies, which were on broad bean - its summer host WOJCIECHOWICZ-ŻYTKO (1998a,b; 1999), WNUK & WOJCIECHOWICZ-ŻYTKO (2007) observed the presence of species similar to those reared from *A. fabae* colonies on Sweet Mock Orange. *E. balteatus* dominated. It was also the most numerous on sugar beet, faba bean and cabbage (HUREJ, 1982; SĄDEJ & CIEPIELEWSKA, 1996; JANKOWSKA, 2005).

In the colonies of *A. fabae* WNUK (2005) confirmed the presence of 12 Syrphidae species among which the following played the greatest role: *E. balteatus*, *E. eligans*, *S. ribesii* and *Meligramma triangulifera* (Zett.).

He also observed the presence of larvae on average in 1/3 of the studied colonies and at the time of their maximum appearance the control of colonies by larvae ranged from 50-100%.

During the research in *A. fabae* colonies on Sweet Mock Orange, apart from Syrphidae larvae, the presence of adult and larva of ladybirds was observed. Predatory ladybirds appeared on Sweet Mock Orange shrubs in early spring during first aphid colonies appearance (Fig. 2). Their number increased until they reached a maximum during aphid number peak. The presence of 4 ladybird species was registered (*Coccinella septempunctata, Adalia bipunctata, Propylaea quatuordecempunctata, Coccinula quatuordecimpustulata*) (Tab. 1). *C. septempunctata* turned out to be the most numerous species, as it amounted to 41% (2004) and to 58% (2006) of all the ladybirds (Fig. 5). When assessing the role of predators, apart from delineating number ratio between predators and preys it is important to determine the percentage of aphid control by the predators during growth season. During the period of maximum number of ladybirds from 28% to 44% colonies with predators feeding in them were observed (Tab. 2).

Ladybird beetles are considered to be the most effective predators of aphids on trees and shrubs in early spring. This may be connected with their overwintering in an adult stage in natural hiding-places on bark (Olszak, 1978; Olszak & Niemczyk, 1986).

Barczak *et al*. (1996) claimed that in *A. fabae* colonies on spindle tree (*Euonymus* sp.) two lady bird species dominated: *A. bipunctata* and *C. septempunctata*. They also stated that *A. bipunctata* is tightly connected with *A. fabae* colonies on winter host where it goes through its entire development while chiefly regulating aphid numbers. *A. fabae* colonies are also a primary source of nutrients for larvae and adults of *C. septempunctata*.

When observing species composition of insects limiting *A. fabae* populations on winter and summer hosts Prelipcean *et al*. (2004) claimed the presence of 15 ladybird species. They also considered *A. bipunctata* and *C. septempunctata* as eudominants while *C. quinquepunctata*, *A. decempunctata* and *P. quatuordecimpunctata* as subdominants. The remaining species are accidental to *A. fabae* colonies. Ciepielewska (1991), Kordan & Ciepielewska (1998), Wojciechowicz-Żytko (1998; 1999) wrote about a large impact of Coccinellidae on the control of *A. fabae* on *Fabaceae* plants.

Jaśkiewicz (1995), Jaśkiewicz *et al.* (2001a,b) and Wojciechowicz-Żytko (2004) state that Coccinellidae are the most numerous group of predators which regulate *Liosomaphis berberidis* Kalt. aphids on berberis. The authors also considered the following as dominating species: (*C. septempunctata, C. quinquepunctata* and *A. bipunctata*).

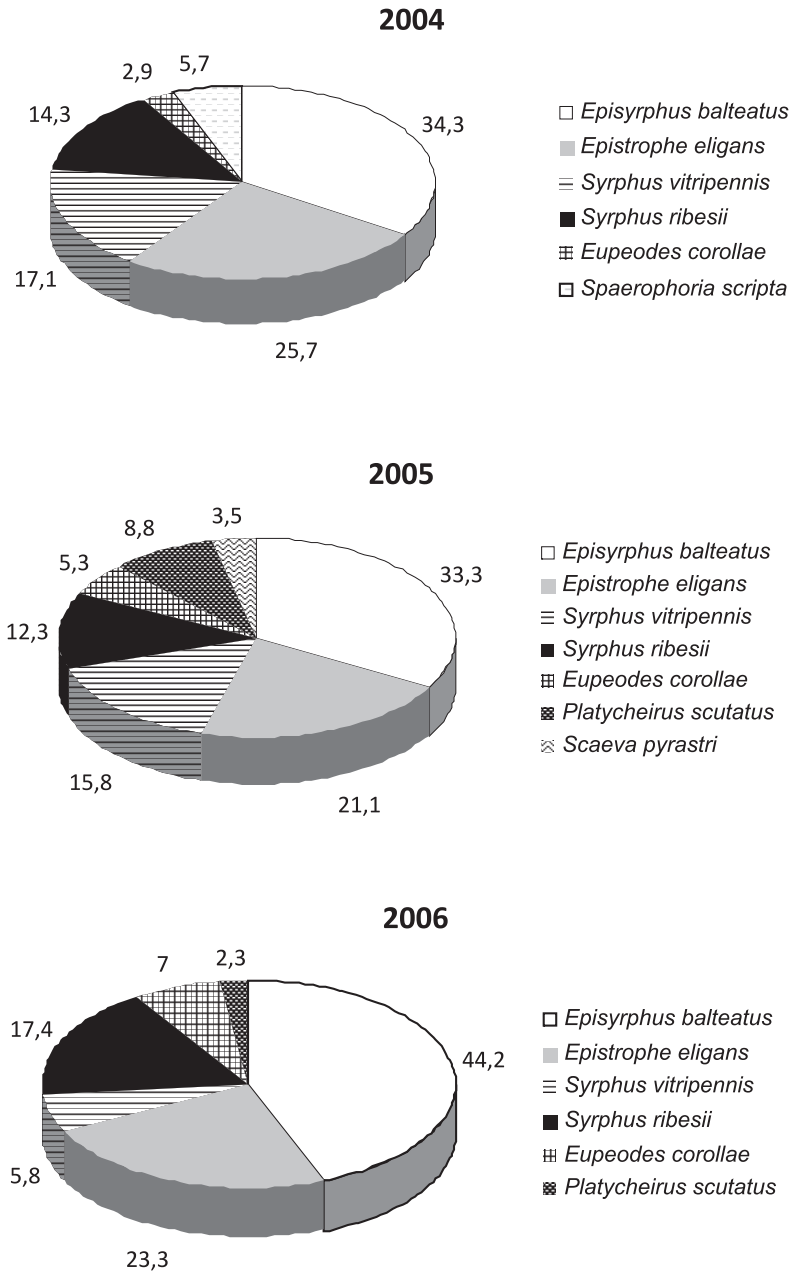

Figure 4. The percentage of Syrphidae occurring in *A. fabae* colonies on *Philadelphus coronarius* (Kraków 2004-2006)

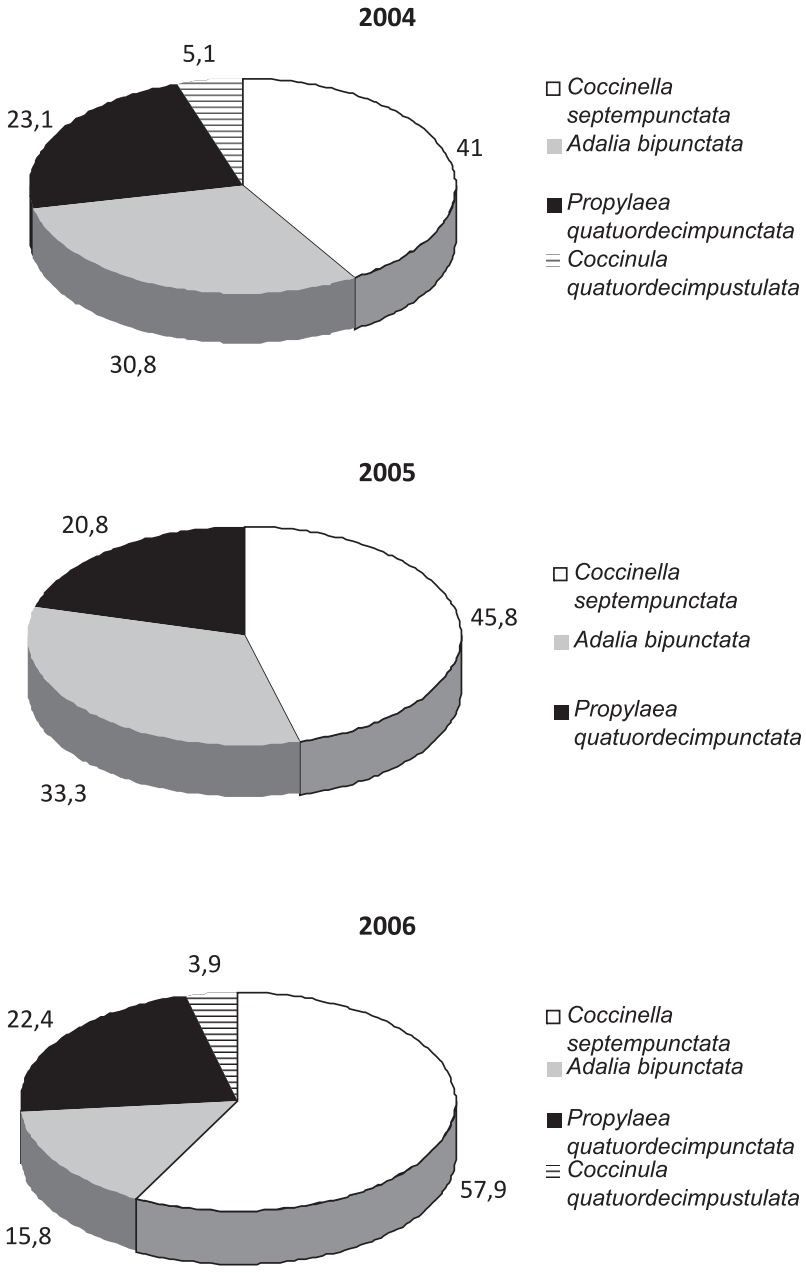

Figure 5. The percentage of Coccinellidae occurring in *A. fabae* colonies on *Philadelphus coronarius* (Kraków 2004-2006)

Conclusions

1. In *A. fabae* colonies on Sweet Mock Orange the occurrence of 8 Syrphidae species was observed. *Episyrphus balteatus* and *Epistrophe eligans* dominated, amounting to 62% of all the collected Syrphidae.
2. The presence of 4 ladybird species was recorded. *Coccinella septempunctata* was the most numerous.
3. More than a third of aphid colonies was controlled by predators which means that the colonies could have been distroyed or their number limited by Syrphidae and Coccinellidae feeding.

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Drapieżne bzygowate /Diptera, Syrphidae/ i biedronkowate /Coleoptera, Coccinellidae/ występujące w koloniach *Aphis fabae* Scopoli, 1763 /Hemiptera, Aphidoidea/ na jaśminowcu (*Philadelphus coronarius* L.)

Streszczenie

Obserwacje prowadzono w latach 2004 – 2006 na terenie zieleni miejskiej w Krakowie. Celem pracy było ustalenie dynamiki populacji mszycy burakowej *A. fabae* na jaśminowcu oraz określenie składu gatunkowego owadów drapieżnych (bzygowatych i biedronkowatych) ograniczających populację tej mszycy.

W latach badań mszyce występowały w różnym nasileniu – w 2006 r. stwierdzono prawie dwukrotnie więcej mszyc niż w 2005 r. Najmniej liczne kolonie zanotowano w 2004 r.

Stwierdzono występowanie 8 gatunków bzygowatych: *Episyrphus balteatus, Epistrophe eligans, Syrphus vitripennis, Syrphus ribesii, Eupeodes corollae, Platycheirus scutatus, Scaeva pyrastri* i *Sphaerophoria scripta*. We wszystkich latach badań dominowały *E. balteatus* i *E. eligans* stanowiąc około 62% wszystkich bzygowatych.

Wśród 4 gatunków biedronkowatych zanotowanych w koloniach *A. fabae* najliczniej występowała *Coccinella septempunctata* stanowiąc od 41% do 58% ogółu zebranych biedronkowatych.