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## APHIDIINAE (HYMENOPTERA, BRACONIDAE) OCCURRING IN AGRICULTURAL ENVIRONMENTS, FORESTS AND URBAN AREAS IN POLAND

APHIDIINAE (HYMENOPTERA, BRACONIDAE)  
WYSTĘPUJĄCE W ŚRODOWISKU ROLNICZYM I LEŚNYM  
ORAZ W ZIELENI MIEJSKIEJ NA TERENIE POLSKI

### Abstract

The authors of the article used literature data to present the species diversity of the Aphidiinae (Braconidae) subfamily in agricultural crops, forests and urban green space in Poland. In total, 83 species of parasitoids were found in all the environments. Aphidiinae preferred forests most: 61 species of the parasitoids were found there. The agricultural and urban environments did not attract so many Aphidiinae parasitoid species as forests. There were 41 species found in the agricultural environment and 38 species in the urban green space. All the environments were infested by the following 15 species: *Aphidius ervi*, *A. matricariae*, *A. picipes*, *A. salicis*, *A. setiger*, *A. sonchi*, *Diaeretiella rapae*, *Ephedrus persicae*, *E. plagiator*, *Lysiphlebus ambiguous*, *L. fabarum*, *Praon abjectum*, *P. volucre*, *Trioxys acalephae* and *T. angelicae*.

**Key words:** Aphidiinae, parasitoid, agricultural environment and forest, urban areas

### Introduction

Parasitic Hymenoptera are one of the factors limiting the number of aphids. They parasitise both larval instars and adult aphids. They mainly belong to the Aphidiinae

Haliday subfamily (Hymenoptera: Braconidae), which includes about 615 species worldwide (Yu et al., 2012). According to the Fauna Europea database, 213 species were recorded in Europe until 2013 (Fauna Europaea..., n.d.). During the European studies there were about 109 species found in Germany (Belokobylskij et al., 2003), 145 species in the Czech Republic (Starý, 2006), 37 species in Bulgaria (Atanassova, 1997) and 32 species in Belgium (Lopes et al., 2016).

Although aphid parasites are characterised by good crop protection potential, they have not been studied thoroughly in Poland, especially in terms of species diversity in different environments.

The aim of the study was to demonstrate the current state of knowledge about aphidiid parasitoids occurring in different environments in Poland, such as: the agricultural environment, forests and urban green space. The study was based on reference publications.

## Results

Hymenoptera Aphidiinae is a small wasp that specialises in parasitising aphids. Aphidiines mummify the host and undergo pupation inside the dead host mummy. Until now several studies have been conducted in Poland. 83 species of the Aphidiinae subfamily have been recorded in the agricultural environment, forests and urban areas in Poland. Kierych (1975) was one of the first authors to identify 41 species of the Aphidiinae subfamily in all these environments in Poland.

### Agricultural environments

There were studies on the occurrence of Aphidiinae in different environments. Nowadays the agricultural environment in Poland is a mosaic of diverse habitats, consisting of arable land, semi-natural habitats, human infrastructures and occasional natural environments. In total 41 species of Aphidiinae were recorded in agricultural environments (Barczak, 1988; Barczak et al., 2005, 2014; Krawczyk et al., 2006; Pankanin-Franczyk, 1982; Wiąckowski, 1997). There were differences in the number of species collected in different regions. To be specific, 29 species were found in Bydgoszcz, 18 species in Kielce, 7 species in Opole, 9 species both in Warsaw and Wrocław (Table 1).

### Forests

Although there has not been much research on Aphidiinae parasitoids in forests, results point to a significant number of species of the Aphidiinae subfamily. 61 Aphidiinae species were identified from specimens collected in forests (Table 1). This environment was the most abundant in aphid parasites. There is great potential for discovering new species, which could be used for scientific and other purposes. The scientific accomplishments of Barczak et al. (2013), Wiąckowski and Wiąckowska (2000), and Wiąckowski et al. (2001) need to be mentioned. Wiąckowski and Wiąckowska (2000) isolated 30 species of forest Aphidiidae on 27 species of trees and shrubs. So far only one species of aphid in the forest environment, namely *Tuberculoides unicornfish*, underwent

Tran Dinh, D., Piekarska-Boniecka, H., Rzańska-Wieczorek, M. (2017). Aphidiinae (Hymenoptera, Braconidae) occurring in agricultural environments, forests and urban areas in Poland. *Nauka Przyr. Technol.*, 11, 3, 305–313. <http://dx.doi.org/10.17306/J.NPT.00197>

Table 1. A list of species of the Aphidiinae subfamily occurring in agricultural environments, forests and urban areas in Poland

Place	Species	Number
1	2	3
Agricultural environments		
Bydgoszcz surrounding area	<i>Aphidius avenae</i> (Hal.), <i>A. ervi</i> (Hal.), <i>A. matricariae</i> Hal., <i>A. rhopalosiphii</i> Dest., <i>A. transcaspicus</i> Telenga, <i>A. urticae</i> Hal., <i>A. uzbekistanicus</i> Luzh., <i>Diaeretiella rapae</i> (M'Int.), <i>Ephedrus persicae</i> Frog., <i>E. palaestinensis</i> Mack., <i>E. plagiator</i> (Nees), <i>Lipolexis gracilis</i> Forst., <i>L. scutellaris</i> Mack., <i>Lysephedrus validus</i> (Hal.), <i>Lysiphlebus cardui</i> (Marsh.), <i>L. ambiguous</i> (Hal.), <i>L. dissolutus</i> (Nees), <i>L. fabarum</i> (Marsh.), <i>L. safavii</i> Starý, <i>L. testaceipes</i> Cress., <i>Monoctonus crepidis</i> (Hal.), <i>Praon abjectum</i> (Hal.), <i>P. volucre</i> (Hal.), <i>Trioxys acalaphae</i> (Marsh.), <i>T. angelicae</i> (Hal.), <i>T. auctus</i> (Hal.), <i>T. centaureae</i> (Hal.), <i>T. heraclei</i> Hal., <i>T. indicus</i> S.R.S.	29
Kielce surrounding area	<i>Aphidius aquilus</i> Mack., <i>A. avenae</i> (Hal.), <i>A. ervi</i> (Hal.), <i>A. megourae</i> Starý, <i>A. picipes</i> (Nees), <i>A. salicis</i> Hal., <i>A. setiger</i> (Mack.), <i>A. sonchi</i> Marsh., <i>Diaeretiella rapae</i> (M'Int.), <i>Ephedrus lacertosus</i> (Hal.), <i>E. plagiator</i> (Nees), <i>Lysiphlebus fabarum</i> (Marsh.), <i>Praon abjectum</i> (Hal.), <i>P. dorsale</i> (Hal.), <i>P. volucre</i> (Hal.), <i>Trioxys acalaphae</i> (Marsh.), <i>T. angelicae</i> (Hal.), <i>T. brevicornis</i> Hal.	18
Opole surrounding area	<i>Aphidius ervi</i> (Hal.), <i>A. rhopalosiphii</i> Dest., <i>A. uzbekistanicus</i> Luzh., <i>Ephedrus plagiator</i> (Nees), <i>Praon gallicum</i> Starý, <i>P. volucre</i> (Hal.), <i>Trioxys angelicae</i> (Hal.)	7
Warsaw surrounding area	<i>Aphidius ervi</i> (Hal.), <i>A. picipes</i> (Nees), <i>A. rhopalosiphii</i> Dest., <i>A. uzbekistanicus</i> Luzh., <i>Diaeretiella rapae</i> (M'Int.), <i>Ephedrus plagiator</i> (Nees), <i>Praon necans</i> Mack., <i>P. volucre</i> (Hal.), <i>Trioxys auctus</i> (Hal.)	9
Wrocław surrounding area	<i>Aphidius ervi</i> (Hal.), <i>A. picipes</i> (Nees), <i>A. rhopalosiphii</i> Dest., <i>A. uzbekistanicus</i> Luzh., <i>Diaeretiella rapae</i> (M'Int.), <i>Ephedrus plagiator</i> (Nees), <i>Praon gallicum</i> Starý, <i>P. volucre</i> (Hal.), <i>Toxares deltiger</i> (Hal.)	9
Total		41
Forests		
Bydgoszcz surrounding area	<i>Ephedrus plagiator</i> (Nees), <i>Praon abjectum</i> (Hal.), <i>P. volucre</i> (Hal.)	3
Kielce surrounding area	<i>Aphidius aquilus</i> Mack., <i>A. cingulatus</i> Ruthe, <i>A. hortensis</i> Marsh., <i>A. rosae</i> Hal., <i>A. setiger</i> (Mack.), <i>A. sonchi</i> Marsh., <i>A. urticae</i> Hal., <i>Diaeretus leucopterus</i> (Hal.), <i>Dyscritulus planiceps</i> (Marsh.), <i>Ephedrus lacertosus</i> (Hal.), <i>Lysiphlebus ambiguous</i> (Hal.), <i>L. fabarum</i> (Marsh.), <i>L. salicaphis</i> (Fitch.), <i>Pauesia abietis</i> (Marsh.), <i>P. cupressobii</i> (Starý), <i>P. infulata</i> (Hal.), <i>P. juniperorum</i> Starý, <i>P. laricis</i> (Hal.), <i>P. pini</i> (Hal.), <i>P. unilachni</i> (Gah.), <i>Praon abjectum</i> (Hal.), <i>P. bicolor</i> Mack., <i>P. flavinode</i> (Hal.), <i>P. volucre</i> (Hal.), <i>Trioxys acalaphae</i> (Marsh.), <i>T. angelicae</i> (Hal.), <i>T. cirsii</i> (Curt.), <i>T. falcatus</i> Mack., <i>T. pallidus</i> Hal., <i>T. parauctus</i> Starý	30

Table 1 – cont.

1	2	3
Central and southern Poland	<i>Aclitus obscuripennis</i> (Forst.), <i>Aphidius absinthii</i> Marsh., <i>A. aulacorthi</i> Starý, <i>A. aquilus</i> Mack., <i>A. avenae</i> (Hal.), <i>A. cingulatus</i> Ruthe, <i>A. ervi</i> (Hal.), <i>A. funebris</i> Mack., <i>A. hieraciorum</i> Starý, <i>A. hortensis</i> Marsh., <i>A. loniceriae</i> (Marsh.), <i>A. matricariae</i> Hal., <i>A. megourae</i> Starý, <i>A. pascuorum</i> (Marsh.), <i>A. picipes</i> (Nees), <i>A. ribis</i> Hal., <i>A. rosae</i> Hal., <i>A. salicis</i> Hal., <i>A. setiger</i> (Mack.), <i>A. sonchi</i> Marsh., <i>A. urticae</i> Hal., <i>Areopraon lepellei</i> (Wat.), <i>Diaeretiella rapae</i> (M'Int.), <i>Dyscritulus planiceps</i> (Marsh.), <i>Ephedrus lacertosus</i> (Hal.), <i>E. minor</i> Stelf., <i>E. persicae</i> (Frog.), <i>E. plagiator</i> (Nees), <i>Lysiphlebus ambiguous</i> (Hal.), <i>L. fabarum</i> (Marsh.), <i>L. fritzmulleri</i> Mack., <i>L. salicaphis</i> (Fitch.), <i>Monoctonus pseudo-platani</i> (Marsh.), <i>Pauesia abietis</i> (Marsh.), <i>P. cupressobii</i> (Starý), <i>P. infulata</i> (Hal.), <i>P. juniperorum</i> (Starý), <i>P. laricis</i> (Hal.), <i>P. pini</i> (Hal.), <i>P. silvestris</i> Starý, <i>P. unilachni</i> (Gah.), <i>Praon abjectum</i> (Hal.), <i>P. absinthii</i> (Bign.), <i>P. bicolor</i> Mack., <i>P. dorsale</i> (Hal.), <i>P. exsoletum</i> (Nees), <i>P. flavinode</i> (Hal.), <i>P. pubescens</i> Starý, <i>P. rosaecola</i> Starý, <i>P. volucre</i> (Hal.), <i>Trioxys acalephae</i> (Marsh.), <i>T. angelicae</i> (Hal.), <i>T. brevicornis</i> Hal., <i>T. centaureae</i> (Hal.), <i>T. cirsii</i> (Curt.), <i>T. falcatus</i> Mack., <i>T. genistae</i> (Mack.), <i>T. hortorum</i> Starý, <i>T. pallidus</i> Hal., <i>T. parauctus</i> Starý	60
Total		61
Urban green space		
Bydgoszcz	<i>Aphidius colemani</i> Vier., <i>A. matricariae</i> Hal., <i>Diaeretiella rapae</i> (M'Int.), <i>Ephedrus persicae</i> Frog., <i>E. plagiator</i> (Nees), <i>Lysiphlebus cardui</i> (Marsh.), <i>L. fabarum</i> (Marsh.), <i>Praon abjectum</i> (Hal.), <i>P. volucre</i> (Hal.), <i>Trioxys acalephae</i> (Marsh.), <i>T. angelicae</i> (Hal.)	11
Kielce	<i>Aphidius absinthii</i> Marsh., <i>A. aulacorthi</i> Starý, <i>A. caraganae</i> (Starý), <i>A. ervi</i> (Hal.), <i>A. matricariae</i> Hal., <i>A. pascuorum</i> (Marsh.), <i>A. picipes</i> (Nees), <i>A. ribis</i> Hal., <i>A. rosae</i> Hal., <i>A. salicis</i> Hal., <i>A. setiger</i> (Mack.), <i>A. sicarius</i> Mack., <i>A. sonchi</i> Marsh., <i>Diaeretiella rapae</i> (M'Int.), <i>Dyscritulus planiceps</i> (Marsh.), <i>Ephedrus minor</i> Stelf., <i>E. lacertosus</i> (Hal.), <i>E. persicae</i> Frog., <i>E. plagiator</i> (Nees), <i>Lysiphlebus ambiguous</i> (Hal.), <i>L. fabarum</i> (Marsh.), <i>Praon abjectum</i> (Hal.), <i>P. bicolor</i> Mack., <i>P. dorsale</i> (Hal.), <i>P. exsoletum</i> (Nees), <i>P. flavinode</i> (Hal.), <i>P. pubescens</i> Starý, <i>P. rosaecola</i> Starý, <i>P. volucre</i> (Hal.), <i>Trioxys angelicae</i> (Hal.), <i>T. centaureae</i> (Hal.), <i>T. cirsii</i> (Curt.), <i>T. genistae</i> (Mack.), <i>T. pallidus</i> Hal.	34
Lublin	<i>Aphidius ervi</i> (Hal.)	1
Poznań	<i>Ephedrus persicae</i> Frog., <i>E. plagiator</i> (Nees), <i>Monoctonus cerasi</i> (Marsh.), <i>Praon volucre</i> (Hal.), <i>Trioxys angelicae</i> (Hal.)	5
Warsaw	<i>Ephedrus plagiator</i> (Nees), <i>Praon volucre</i> (Hal.), <i>Trioxys angelicae</i> (Hal.)	3
Wrocław	<i>Aphidius matricariae</i> Hal., <i>A. colemani</i> Vier., <i>Praon volucre</i> (Hal.)	3
Total		38

comprehensive development of its parasitoids (Barczak, 1994). *Ephedrus plagiator* and *Praon volucre* were the most common species in forests (Wiąckowski and Wiąckowska, 2000).

### Urban areas

Urban aphid parasitoids were studied by various authors in Kielce, Bydgoszcz, Lublin, Poznań, Warsaw and Wrocław (Barczak, 1991–1992a; Barczak et al., 1999, 2005; Cierniewska, 1973; Goszczyński et al., 2000; Halarewicz-Pacan and Sobota, 1998; Jaśkiewicz, 2003; Ślusarczyk, 1994; Wiąckowski and Wiąckowska, 1996; Wiąckowski et al., 1997). There were significant differences in the number of species collected in each region: 34 species in Kielce, 11 in Bydgoszcz, 1 in Lublin, 5 in Poznań, 3 species both in Warsaw and Wrocław. In total 38 aphid parasitoids were found in urban areas. *Aphidius*, *Ephedrus*, *Praon* and *Trioxys* were the most common genera. *Aphidius ervi*, *Ephedrus plagiator*, *Praon volucre*, *Trioxys angelicae* were common species in each area under study (Barczak et al., 1999; Goszczyński et al., 2000; Halarewicz-Pacan and Sobota, 1998; Jaśkiewicz, 2003; Ślusarczyk, 1994). However, some species were less common. They were found only in some urban areas in Poland, e.g. *Dyscritulus planiceps* in Kielce and *Monoctonus cerasi* in Poznań.

### Discussion

Some species were very common in agro-ecosystems. *Aphidius ervi*, *Ephedrus plagiator* and *Praon volucre* were found in all places under study in Bydgoszcz, Kielce, Opole, Warsaw and Wrocław. Other species were observed only in two or three places, e.g. *Trioxys auctus* and *Praon gallicum*. Some species were found in one place only, e.g. *Praon necans* in Warsaw (Pankanin-Franczyk, 1987), *Toxares deltiger* in Wrocław (Pankanin-Franczyk and Sobota, 1998), *Aphidius sonchi* and *Ephedrus lacertosus* in Kielce (Wiąckowski, 1997), *Lipolexis gracilis* and *Lysephedrus validus* in Bydgoszcz (Barczak, 1991–1992b).

Differences in species compositions depended not only on the region but also on the type of plant. The *Lysiplebus fabarum* parasitoid species seemed to predominate in beet plantations (Barczak, 1988; Barczak et al., 2005). *Aphidius uzbekistanicus* was the most important parasitoid for aphid control in rye, wheat and barley (Pankanin-Franczyk, 1982; Pankanin-Franczyk and Ceryngier, 1995; Pankanin-Franczyk and Sobota, 1998). *Aphidius uzbekistanicus* predominated in winter crops, whereas *Aphidius rhopalosiphi* was the most common species in spring crops (Sobota et al., 1998). In late spring and the first half of summer maize aphids were parasitised by Hymenoptera of the Aphidiinae subfamily. *Aphidius rhopalosiphi* was the dominant species among Aphidiinae, while *Praon volucre* was subdominant (Krawczyk et al., 2006). The *Diaeretiella* genus was predominant in sugar beet plantations. These insects are attracted by the volatiles (isothiocyanates) of the Cruciferae (Sobota and Gabryś, 2000). *Diaeretiella rapae* was the most common parasitoid (Sobota et al., 1998; Twardowski and Hurej, 2000).

Although the fewest species were recorded in urbanised habitats, they can be as rich in parasitoids as rural areas, if not richer in biodiversity. Midfield thickets, which make so-called ecological corridors in the agricultural environment, are very similar to urban habitats in terms of guilds of parasitoids of aphids of the *Aphis* genus. The faunas of parasitoids from both types of habitats were mixed. This fact shows that populations of parasitoids penetrated urbanised environments by migrating from agrocenoses, midfield thickets and from other semi-natural habitats in the agricultural environment, e.g. from meadows and forests, and vice versa. It seems that parasitoids of aphids are undergoing the process of synurbisation (Barczak et al., 1999).

The comparison of the environments revealed big differences in species composition as well as the number of species. Many species were extremely common in the agricultural environment, forests and urban areas. They were found in most of the areas and in all the environments under study. The *Aphidius* genus was represented by numerous species, such as: *Aphidius ervi*, *A. matricariae*, *A. picipes*, *A. salicis*, *A. setiger* and *A. sonchi*. The *Diaeretiella*, *Ephedrus*, *Lysiphlebus*, *Praon*, *Trioxys* genera also had their representatives, i.e. *Diaeretiella rapae*, *Ephedrus persicae*, *E. plagiator*, *Lysiphlebus ambiguus*, *L. fabarum*, *Praon abjectum*, *P. volucre*, *Trioxys acalephae* and *T. angelicae*. It is noteworthy that *Praon volucre* had a wide range of hosts. It was chiefly found on the edge of forests, but it also parasitised aphids in farmlands and orchards. *Trioxys angelicae* is a very useful species for biological methods. It is a polyphagous species found in forests, parks, and farmlands. It parasitised many aphid species, especially of the *Aphis* genus. *Lysiphlebus fabarum* could be found in each environment. It often parasitised aphids belonging to the *Aphis* spp. and *Brachycaudus* spp. (Ślusarczyk, 1994). On the other hand, some species occurred only in certain environments. The following species were found only in the agricultural environment: *Aphidius transcaspicus*, *Ephedrus palaestinensis*, *Lipolexis gracilis*, *Lysephedrus validus*, and *Toxares deltiger*. *Aclitus obscuripennis*, *Aphidius hieraciorum*, *Areopraon lepelleyi*, *Diaeretus leucopterus*, *Pauesia abietis*, *P. cupressobi*, and *P. infulata* were found only in forests, whereas *Aphidius caraganae*, and *Monoctonus cerasi* were observed in urban areas. These species were shown in certain environments only because of the narrow range of hosts or due to the lack of research data.

## Conclusion

Forests were the most abundant in Braconid parasitic wasps in Poland. They were followed by agricultural environments and urban areas. Populations of parasitoids are likely to infiltrate urbanised environments by moving from agrocenoses, fields and from other semi-natural habitats in the agricultural landscape, e.g. from grasslands, forests and back.

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APHIDIINAE (HYMENOPTERA, BRACONIDAE)  
WYSTĘPUJĄCE W ŚRODOWISKU ROLNICZYM I LEŚNYM  
ORAZ W ZIELENI MIEJSKIEJ NA TERENIE POLSKI

**Abstrakt**

W artykule przedstawiono na podstawie danych literaturowych zróżnicowanie gatunkowe parazytoidów z podrodziny Aphidiinae (Braconidae) stwierdzonych w uprawach rolniczych, w lasach i w zieleni miejskiej na terenie Polski. Łącznie we wszystkich środowiskach stwierdzono 83 gatunki parazytoidów. Lasy były środowiskiem najbardziej preferowanym przez Aphidiinae: wykazano w nich 61 gatunków tych parazytoidów. W środowisku rolniczym stwierdzono 41 gatunków, a w zieleni miejskiej 38. Wszystkie środowiska zasiedlało 15 następujących gatunków: *Aphidius ervi*, *A. matricariae*, *A. picipes*, *A. salicis*, *A. setiger*, *A. sonchi*, *Diaeretiella rapae*, *Ephedrus persicae*, *E. plagiator*, *Lysiphlebus ambiguous*, *L. fabarum*, *Praon abjectum*, *P. volucre*, *Trioxys acalephae* i *T. angelicae*.

**Słowa kluczowe:** Aphidiinae, parazytoid, środowisko rolnicze i leśne, zielen miejska

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*Accepted for publication – Zaakceptowano do opublikowania:*

5.09.2017

*For citation – Do cytowania:*

Tran Dinh, D., Piekarska-Boniecka, H., Rzańska-Wieczorek, M. (2017). Aphidiinae (Hymenoptera, Braconidae) occurring in agricultural environments, forests and urban areas in Poland. *Nauka Przyr. Technol.*, 11, 3, 305–313. <http://dx.doi.org/10.17306/J.NPT.00197>