APHIDS AND OTHER HEMIPTEROUS INSECTS | VOL.17 (2011) 73–79

Aphid fauna (Sternorrhyncha, Aphidinea) in the nests of *Lasius flavus* (Fabricius, 1781) (Hymenoptera, Formicidae) of various plant communities

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ABSTRACT

The paper presents results of a research concerning the species composition of aphid fauna within the nests of *Lasius flavus* (Fabricius, 1781) in three different plant communities. The research was carried out in Piekary Śląskie (Upper Silesia), in the following three phytocoenoses: *Molinietum coeruleae*, *Lolio-Polygonetum arenastrii* and *Festuco-Stipion*. In these habitats the total number of 14 aphid species was recorded, representing various models of adaptation to the underground life mode as well as to trophobiosis. The most species-rich were the nests within a meadow localized in a housing estate while the lowest number of aphid species was recorded in a moist meadow. It has been concluded that the plant species composition of a habitat influences the species composition of aphids encountered in ant nests.

KEY WORDS: aphid fauna, *Lasius flavus*

INTRODUCTION

The mutualistic relationship existing between ants and various representatives of hemipterous insects: the Cooccidae, Membracidae and, in Europe, most commonly the Aphididae has been the subject of many studies. Detailed studies (Way,

1963; Pontin, 1978) showed, that ant exploit aphids as a source of proteins and carbohydrates, but also protect them from predators and parasites.

Lasius flavus (subfamily Formicinae) is an ant species living preferably underground, inhabiting various, mainly open habitats. It is strictly adapted to the trophobiotic relationship with root aphids, which serve it as the main source of food (Muir, 1959; Way, 1963; Godske, 1991).

Aphids occurring in the nests of *Lasius flavus* exhibit a series of interesting morphological features, enabling them to both a subterranean mode of living as well as to a mutualistic relationship with ants. Small body size, short legs and antennae are adaptations to the subterranean life while the absence of functioning siphunculi which would secrete pheromones, lack of a thick wax cover, dorsal position of an anus and a shortened cauda which prevents the fall of a honeydew drop, are all adaptations allowing ants to collect honeydew.

Myrmecophilous aphids present various degrees of dependency from this kind of symbiosis, ranging from simple accidental contacts to obligatory dependence between trophobionts, although no strict interspecific relations have been observed (Sudd, 1987; Depa & Wojciechowski, 2009). Zwölfer (1958) lists 22 species of European aphids living underground, which were recorded in the nests of 17 ant species. Muir's research (1959) indicated that one ant species may co-occur with up to seven aphid species, although in most cases only one species has been recorded.

It is also a well established fact that, as aphids can be either monophagous or oligophagous, there exist strong correlations between the species composition of aphid community and the plant community which they inhabit (Hałaj & Wojciechowski, 1996). Thus, it is suspected, that a similar correlation should exist in the species composition of aphid fauna within the ants nests. The aim of this research was to describe aphid fauna in the nests of *L. flavus* in three different plant communities and to study the correlation between the plant community type and aphid species composition.

MATERIAL AND METHODS

The research was conducted in three different plant communities, localized on the territory of Piekary Śląskie ($18^0$55''E $50^0$20''N; UTM: 58CA) in Upper Silesia.

The first studied plant community was the moist meadow recognized as the association of *Molinietum caeruleae*. It was localised in the river Brynica valley and was not managed as it was prone to temporary flooding, especially after heavy and prolonged rains.

The second community was the *Lolio-Polygonetum arenastrii* meadow. It was situated in a housing estate, intensively trodden on and regularly mown, with relatively poor plant species composition.

The third community was the *Festuco-Stipion* xerothermic grassland, with an ample number of ruderal species. It was localised on a stony hill slope with north-western exposure, consisting mainly of the limy substratum with a poorly developed soil layer.

The research was conducted in the nests of *Lasius flavus* a representative of the subfamily Formicinae. It is a small, yellow ant, with body length measuring 2.2 – 4.8 mm. It is one of the most common ant species, occurring throughout the country (Czechowski *et al.*, 2002). It is ubiquitous, but prefers to inhabit open areas. It usually builds anthills consisting of mineral material, inhabited by up to twenty thousand individuals (Nielsen *et al*., 1976). It's life mode is cryptic, mainly subterranean, with root-aphids as a dominant source of food, which makes it a good subject of the research on mutualistic relationships.

The studies were carried out from March to October of 2006. The number of samples depended on the number of ant nests, which was different in each habitat, and varied from 12 in xerothermic grassland up to 55 in the housing estate meadow. It was impossible to collect a comparable number of samples from each site, because the acreage and ant nest density was highly variable from one studied area to another.

After finding the nest the soil layer on the nest and around the plants was carefully dug out and aphids were removed from the roots or underground parts of the stem, or directly from the nest chambers if they were not feeding. Usually, the aphids were collected from the nest and the nearby area (up to 0.5 m from anthill), if they were visited by ants. In each case all aphids collected from one ant colony, either from the anthill or from the surrounding chambers and tunnels, were considered as one sample.

RESULTS

In total, 82 samples were collected (Tab. 1.). The highest number of samples was collected in the housing estate meadow *Lolio-Polygonetum*, namely 55, with 10 aphid species recorded, which represented 4 families (Anoeciidae, Eriosomatidae, Lachnidae, Aphididae). In xerothermic grassland 12 samples were collected, with 8 species representing 3 families (Anoeciidae, Eriosomatidae, Aphididae). Finally, in the moist meadow 15 samples were collected, with 6 species representing two families (Anoeciidae and Eriosomatidae). The total number of 14 aphid species were recorded: *Anoecia corni* (Fabricius, 1775), *Anoecia nemoralis* Börner, 1950, *Anoecia pskovica* Mordvilko, 1916, *Trama rara* Mordvilko, 1908, *Trama troglodytes* von Heyden, 1837, *Aphis taraxacicola* (Börner, 1940), *Aphis vandergooti* (Börner, 1939), *Aphis medicaginis* Koch, 1854, *Aphis confusa* Walker, 1849, *Tetraneura ulmi* (Linnaeus, 1758), *Geoica setulosa* (Passerini, 1860), *Geoica utricularia* (Passerini, 1856), *Forda formicaria* von Heyden, 1837, *Forda marginata* Koch, 1857.

DISCUSSION

Only three among all of the recorded species had not previously been collected from the nests of *L. flavus* and all of them belonged to the genus *Aphis*. It is also worth noting that among all 14 species only representatives of the Eriosomatidae show all morphological modifications connected with the underground life mode and the relationship with ants. All species of the genus *Aphis* have a long cauda and siphunculi, enabling them also to feed overground, especially on lower parts of the stem and the rosette of leaves. It is supposed that strong modifications within the Eriosomatidae indicate their close, obligatory association with ants. Less modified representatives of the genus *Aphis* are probably associated with ants less closely, and it is supposed that the relationship is facultative (Sudd, 1987). It seems to be confirmed by the fact that in each habitat the species of the Eriosomatidae are either the most frequent or the species are diversified (Tab. 1.).

Table 1. List of aphid species recorded in the nests of *L. flavus* and their host plants in the studied plant communities

	Molinietum caeruleae					*Lolio-Polygonetum*							*Festuco-Stipion*				
	Poa annua	*Agropyron repens*	*Lolium perenne*	*Festuca pratensis*	among ants	*Poa annua*	*Agropyron repens*	*Lolium perenne*	*Achillea millefolium*	*Taraxacum officinale*	*Bellis perennis*	among ants	*Festuca ovina*	*Medicago lupulina*	*Scabiosa ochroleuca*	among ants	total
An. corni	1			1		4	6	2					1				15
An. nemoralis		1		1													2
An. pskovica																5	5
F. formicaria	1			2	1	2		1					1				8
F. marginata			1	1		2	2	2									8
G. setulosa	1			1	2	2							1				7
G. utricularia								1					1				2
T. ulmi				1		3		8					1				13
Tr. rara										3							3
Tr. troglodytes										4							4
A. taraxacicola										4							4
A. vandergooti									5		4						9
A. medicaginis														1			1
A. confusa															1		1
total:	3	1	1	7	3	13	8	14	5	11	4	0	5	1	1	5	82

When analysing the occurrence of the recorded aphid species in particular plant communities, it is noteworthy that the fewest species were recorded in the moist meadow while drier habitats, i.e. the housing estate meadow and xerothermic grassland, were more species-rich. Such a fact can be explained by differences in plant species composition in particular habitats. The moist meadow was vastly overgrown with grasses, which were dominant plants in that habitat. Therefore, only grass-feeding aphids for which the grasses were secondary hosts occurred there. Aphids feeding on dicotyledon plants were absent from ant nests, although such dicotyledonous plants were present in that habitat.

A different situation was observed in the second community – the housing estate meadow, where aphids feeding on dicotyledones constituted a significant percentage of aphids found in the ant nests. Those were species feeding on various species of the Asteraceae, usually the common participants of this type of communities (e.g. *Taraxacum officinale* or *Bellis perennis*). One of the species recorded in xerothermic grassland – *A. confusa* – is proven to be a characteristic element of aphid communities developed in xerothermic grasslands (Hałaj & Wojciechowski, 1996; Depa & Wojciechowski, 2009).

The plant cover of *L. flavus* nest and its surroundings is characteristic and has similar features in various parts of Europe (Kovář *et al*., 2000). It was indicated that the presence of the plants with long underground stems and stolons was characteristic. It is significant, because these are plant parts, apart from roots, which are most often infested with subterranean aphids. It is also important, because as aphids are the most important and dominant source of food for ants, the long underground parts of plants allow them to develop numerous and abundant colonies, providing ants with suitable amounts of nutritional substances.

Further research should focus on detailed studies of aphids in the nests of *L. flavus* in other habitats with respect to the seasonal dynamics of their occurrence and abundance. Recent studies showed that some species of aphids are found more often than others (Depa & Wojciechowski, 2009), which may be explained by different bionomics of each group and of particular species. Undoubtedly, the co-occurring ant species compete in order to obtain the widest access to aphid colonies (Depa & Wojciechowski, 2008) but also may affect the life cycle and biology of aphids (Depa, 2010). Thus, further detailed studies of ant vs. aphid relationships, both with respect to communities and single species, should be conducted.

REFERENCES

Czechowski W., Radchenko A., Czechowska W. 2002. The Ants (Hymenoptera, Formicidae) of Poland. Muzeum i Instytut Zoologii PAN, Warszawa, 200p.

Depa Ł., Wojciechowski W. 2008. Ant – root aphid relations in different plant associations. Polskie Pismo Entomologiczne, 77: 151-163.

Depa Ł., Wojciechowski W. 2009. Aphids (Hemiptera: Aphidinea) of Garb Tarnogórski and their trophobiotic relations with ants. Annals of the Upper Silesian Museum (Entomology), 18: 5-106.

Depa Ł. 2010. Possibility of overwintering of *Aphis sambuci* Linnaeus, 1758 (Hemiptera, Aphididae) on secondary host in the climatic conditions of Poland. Aphids and other Hemipterous Insect, 16: 21-25.

Godske L. 1991. Aphids in nests of *Lasius flavus* F. in Denmark. I Faunistic description. Entomologiske Meddelelser. 59(3); 85-89.

Hałaj R., Wojciechowski W. 1996. Zgrupowania mszyc (Homoptera, Aphidinae) związane ze zbiorowiskami murawowymi z klas *Festuco-Brometea* i *Sedo-Scleranthetea* Wyżyny Częstochowskiej. Acta Biologica Silesiana, 29(46): 83-105.

Kovář P., Kovářová M., Dostál P., Herben T. 2000. Vegetation of ant-hills in a mountain grassland: effects of mound history and of dominant ant species. Plant Ecology, 00: 1-13.

Muir D.A. 1959. The ant-aphid-plant relationship in west Dunbartonshire. Journal of Animal Ecology, 28: 133-140.

Nielsen M.G. Skyberg N. Winther L. 1976. Studies on *Lasius flavus* F. (Hymenoptera, Formicidae): I. Population density, biomass and distribution of nests. Entomologiske Meddelelser, 44: 65-75.

Pontin A.J. 1978 .The numbers and distribution of subterranean aphids and their esploitation by the ant *Lasius flavus* (Fabr.). Ecological Entomology, 3: 203 - 207.

Sudd J.H. 1987. Ant aphid mutualism. [In:] Minks A.K., Harrewijn P. (eds.) Aphids: their biology, natural enemies and control. Vol. 2A. Elsevier, Amsterdam, 355 – 365p.

Way M.J. 1963. Mutualism between ants and honeydewproducing Homoptera. Annual Review of Entomology, 8: 307 - 344.

Zwölfer H. 1958. Zur Systematik, Biologie und Oekologie unterirdisch lebender Aphiden (Homoptera; Aphidoidea). III. – Zeitschrift zur angewandte Entomologie, 42: 2.

Fauna mszyc (Sternorrhyncha, Aphidinea) w gniazdach *Lasius flavus* (Fabricius, 1781) (Hymenoptera, Formicidae) wybranych zbiorowisk roślinnych

STRESZCZENIE

Praca zawiera wyniki badań afidofauny gniazd mrówek *Lasius flavus* (Fabricius, 1781) trzech zbiorowisk roślinnych. Badania prowadzono w Piekarach Śląskich, w następujących zbiorowiskach: *Molinietum caeruleae*, *Lolio-Polygonetum arenastrii* i *Festuco-Stipion*. W zbiorowiskach tych znaleziono następujące gatunki: *Anoecia corni* (Fabricius 1775), *Anoecia nemoralis* Börner, 1950, *Anoecia pskovica* Mordvilko, 1916, *Forda formicaria* von Heyden, 1837, *Forda marginata* Koch, 1857*, Geoica setulosa* (Passerini, 1860), *Geoica utricularia* (Passerini, 1856), *Tetraneura ulmi* (Linnaeus, 1758), *Trama*

rara Mordvilko, 1908, *Trama troglodytes* von Heyden 1837, *Aphis vandergooti* (Börner, 1939), *Aphis taraxacicola* (Börner, 1940), *Aphis medicaginis* Koch, 1854, *Aphis confusa* Walker, 1849. Gatunki te reprezentują różne cechy przystosowujące zarówno do podziemnego trybu życia jak i do trofobiozy. Stwierdzono, że najbogatsza w gatunki mszyc jest afidofauna gniazd mrówek zamieszkujących murawę kserotermiczną i łąkę osiedlową, a najuboższa łąki podmokłej. Wyciągnięto wniosek, że flora zajmowanego przez mrówki siedliska, a za tym różnorodność roślin żywicielskich, ma wpływ na skład gatunkowy fauny mszyc w gniazdach *L. flavus*.