

Arthropods settling *Tilia cordata* Mill. in landscape of Lublin

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Abstract

Observations on the presence and number of arthropods settling *Tilia cordata* Mill. were carried out in the city of Lublin in 2008-2009. The research was carried out in housing estate and by-the-road sites and the collected arthropods were divided into trophic groups with respect to their nutrient preferences. The observations were concerned with the extent of presence of phytophags and beneficial arthropods in urban conditions depending on the extent of anthropopressure. From the research results it follows that herbivore arthropods with a piercing-sucking mouth apparatus were a dominating trophic group settling *T. cordata*. In both sites *Eucallipterus tiliae* (L.) was most numerous. Moreover, in the housing estate site apart from aphids, also the representatives of Thysanoptera were numerous whereas in the by-the-road site – Tetranychidae. Among predators in both sites mites of the Phytoseiidae dominated. The representatives of the Anthocoridae family were most numerous in the housing estate site, while the Coccinellidae in the by-the-road site.

Introduction

Small-leaved lime tree (*Tilia cordata* Mill.) is one of the most frequent tree species in the city of Lublin, both in housing estate greenery as well as street

greenery. In Poland in natural habitat there are two domestic species – small-leaved lime (*T. cordata*) and large-leaved lime (*Tilia platyphyllos* Scop.). In urban plantations one plants also other species from this genus: European lime (*Tilia x europaea* L.) which is a natural hybrid *T. cordata* and *T. platyphyllos* and Caucasian lime (*Tilia x euchlora* K. Koch, *Tilia x europaea* 'Euchlora') which is a hybrid of small-leaved lime with *Tilia dasystyla* (SENETA & DOLATOWSKI, 1997).

The natural environment of urban area which undergoes strong anthropogenic transformations, forms specific conditions for plants' life and development. A unique climate of the city which is influenced by air pollution, changes in water economy and habitat condition connected with degradation and a change in physical-chemical properties of the soil which are harmful to trees. In the formation of plant structure in the city the man plays a crucial role as he decides about its distribution and occupied space and most of all about plant species composition. Not all the plants species, trees in particular, can adapt to difficult conditions. A negative impact of urbanizing pressure, threatens plants which grow along communications tracks rather than those in neighbourhood greens which are usually separated from large roads and taking up more space. By the road trees, planted as a green belt stretching across from few to a dozen meters, are more susceptible to an increased air pollution resulting from communication pollution and from saltiness which is the result of applying salt to icy roads (CHUDZICKA, 1978). Moreover, because of limits put on the space available to root system development and a low level of ground waters, trees dry out having no access to water. *T. cordata* is resistant to urban conditions – it can bear well drought and air pollution. Nonetheless, it is sensitive to soil saltiness (BORATYŃSKA & DOLATOWSKI, 1991; FOBER, 1991) and to SO₂ (KRAWIARZ, 1991) which makes those which are planted by communication tracks weaker and more susceptible to pathogens and phytophags. So far the research carried out on *Tilia* spp. and other tree species planted by the roads in Warsaw and Poznań show that as the level of urbanization grows and the greens zone spaces decrease the number of piercing-sucking phytophags increases while that of biting mouth parts declines (CICHOCKA & GOSZCZYŃSKI, 1991; WILKANIEC, 1994). Moreover, according to CHUDZICKA (1978), anthropogenic pressure and impoverishment of plants has a direct impact on species composition, the number and dominance structure of the fauna settling trees in cities.

During this research observations on the presence and number of arthropods settling *T. cordata* were carried out in urban conditions of Lublin.

Material and methods

The research was carried out in Lublin in 2008-2009 and will be continued. For comparison two research sites were selected:

Site 1: situated by the road, it constituted a line of trees grown along a busy street, in an industrial part of the city ('Krochmalna' Street).

Site 2: situated in a housing estate green, it constituted trees grown in a bigger complex of greenery, surrounded by other plants, within a distance from communication tracks ('Kalinowszczyzna' neighbourhood).

In each site 4 – 5 trees were selected, out of which every 10 – 14 days (from the end of March until the end of October) 100 leaves were collected together with green and wooden shoots. The collected material was searched under stereoscopic microscope, whereas arthropods were counted, described and photographed with a digital camera.

In the present paper the collected arthropods were divided with respect to their feeding preferences into the following trophic groups: herbivore, predatory and parasitic and those who live on mixed nutrient. Moreover, the herbivore arthropods were subdivided with respect to their mouth apparatus (biting and piercing-sucking), because their feeding and way of taking in nutrient has a significant impact on the looks and development of the settled plants.

Arthropods species names are according to BOGDANOWICZ *et al.* (2004).

Results and discussion

In the research that was conducted in both years (2008 and 2009) in both sites herbivorous arthropods dominated. The lowest number of phytophags was registered in 2008 in the housing estate site and it was close to the total number of predators and parasites (Tab. 1). The highest number of herbivore arthropods was recorded in the by-the-road site in 2008 in which it amounted to almost 97% of all the collected arthropods (Fig. 1B). The number of predators and parasitoids in the housing estate site was the same in both years of the research (2008 and 2009), while in the by-the-road site in 2009 it was half the number of 2008 (Tab. 1).

Table 1. Total number of arthropods of particular trophic groups collected in both research sites in 2008-2009

	Housing-estate site		By-the-road site	
	2008	2009	2008	2009
Herbivore arthropods	244	2115	3989	1517
Predatory arthropods	196	197	127	60
Parasitic arthropods	15	10	12	15
Arthropods feeding on mixed nutrient	5	170	0	11

A larger percentage share of beneficial arthropods was observed in the housing estate site than in the by-the-road site. In the housing estate site in 2008 it amounted to 45% in relation to 54% of phytophags and in 2009 almost 8.5% in relation to 85%. In the by-the-road site in 2008 the share of predators and parasitoids was less than 3.5% in relation to 96.5% of herbivores, and in 2009 – 4.6 to 94% (Fig. 1). Arthropods feeding on mixed nutrient were few and their feeding did not influence either the looks and the development of trees or the limiting of phytophags number.

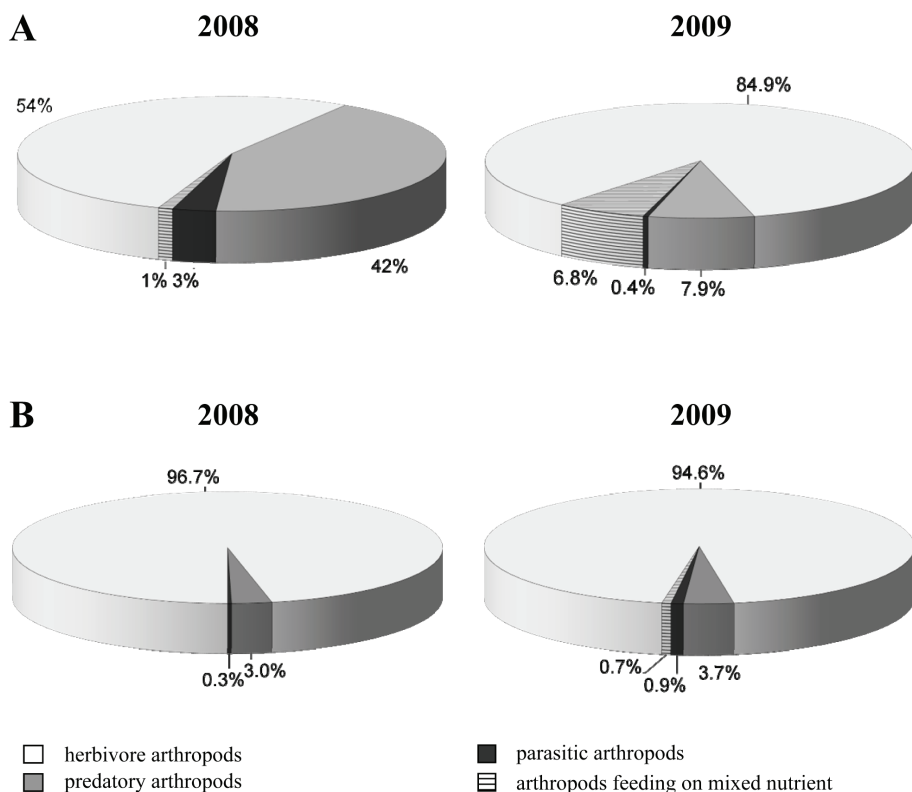


Figure 1. Percentage share of particular trophic groups of arthropods settling *Tilia cordata* in 2008-2009. **A** – housing estate site, **B** – by-the-road site

A. Herbivore arthropods

Among herbivore arthropods species with a piercing-sucking mouth apparatus (aphids and mites) dominated. Similar observations were obtained during research carried out on lime and other tree species in Warsaw and Poznań

(CHUDZICKA, 1978; CICHOCKA & GOSZCZYŃSKI, 1991; WILKANIEC, 1994). Only in 2008 in the housing estate site more biting than piercing-sucking phytophags were collected, however, it was the year in which the total number of herbivorous species in that site was very small. In the by-the-road site the percentage share of piercing-sucking arthropods (99%) in relation to the biting ones (1%) was the same in both years of the research (Fig. 2).

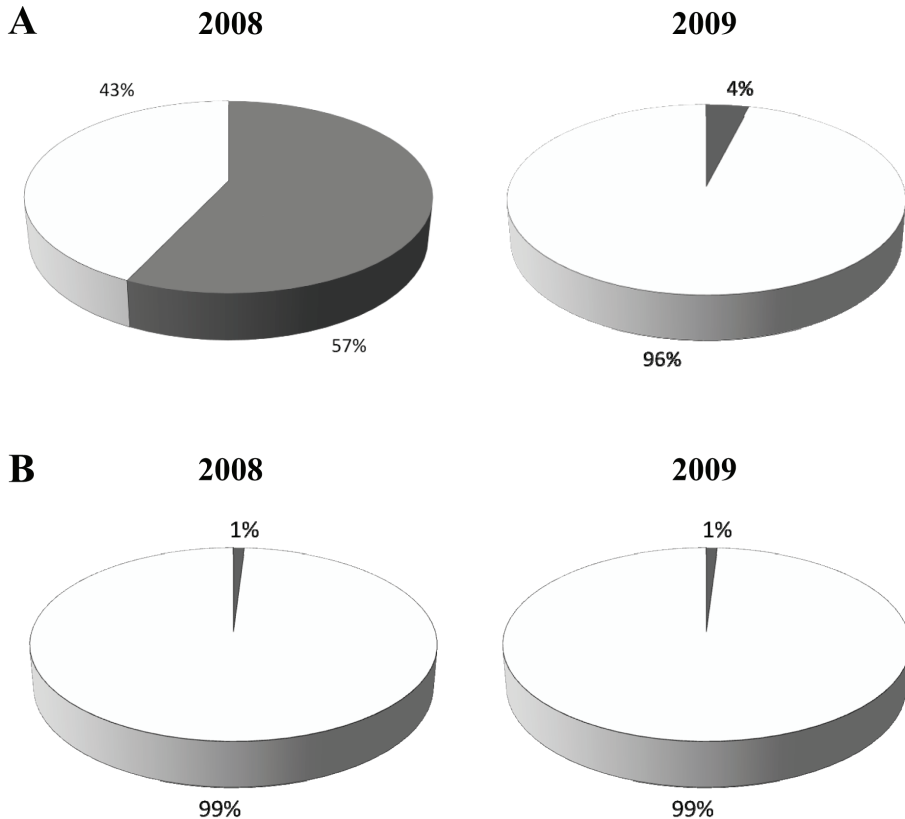


Figure 2. Percentage share of sucking-piercing and biting arthropods settling *Tilia cordata* in 2008-2009. **A** – housing estate site **B** – by-the-road site

Among piercing-sucking arthropods *Eucallipterus tiliae* (L.) dominated, though their number was changeable both in the consecutive years and in other sites. In 2009 in the by-the-road site the number of *E. tiliae* fell almost four times in relation to 2008, whereas in the housing estate site it increased 36 times in relation to the previous year. Moreover, in 2009 the number of collected specimens from the housing estate site was twice the number of specimens from

the by-the-road site (Figs. 3, 4). Therefore, this does not confirm the results obtained from Poznań (WILKANIEC, 1996), from which it follows that *E. tiliae* was more eager to settle by-the-road trees. In 2008 in the housing estate site, the representatives of Thysanoptera appeared next to the dominating aphids, amounting to 36.53% of the piercing-sucking arthropods. It is worth mentioning that they were not observed in the by-the-road site in neither of the research years. In the by-the-road site, apart from aphids there were also mites from the Tetranychidae family, the number of which was higher in comparison with the housing estate site (Figs. 3, 4). Moreover, on the lower leaf surface felt galls caused by eriophyoids from the *Eriophyes* genus were observed.

Hymenopterons and butterflies larvae dominated among arthropods with a biting mouth part. In the by-the-street site the larvae of hymenopterons from the Tenthredinidae family were most numerous constituting in 2008 about 91.5% and in 2009 87.5% of all the collected biting arthropods in this site. The representatives of the Tenthredinidae family were both species biting off the leaf blade, for instance *Caliroa annulipes* (Klug), as well as mining species for instance *Parna apicalis* (Brischke) larvae. In the housing estate site mining larvae of butterflies from the Lithocolletinae subfamily were most numerous as their number amounted in 2008 less than 98% and in 2009 – 80% of biting arthropods collected in this site. They were not observed in the by-the-road site.

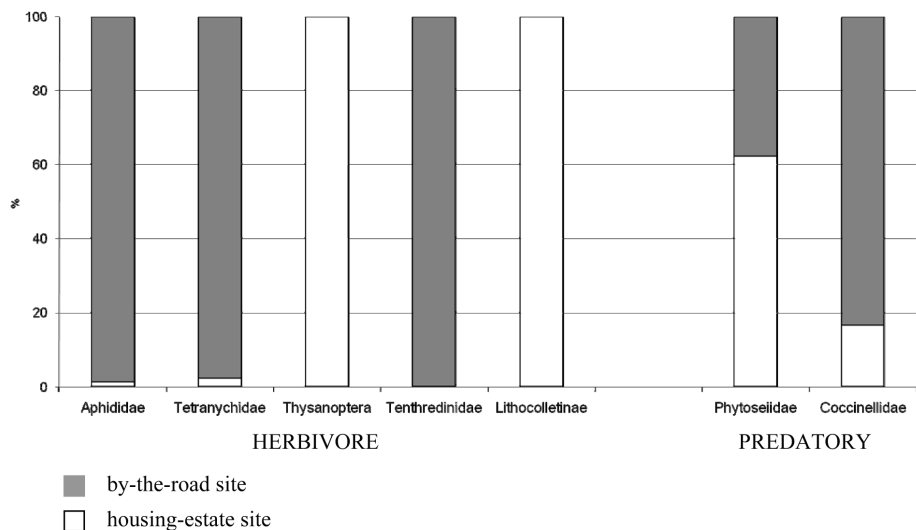


Figure 3. Percentage share of the most numerous taxa in both research sites collected in 2008

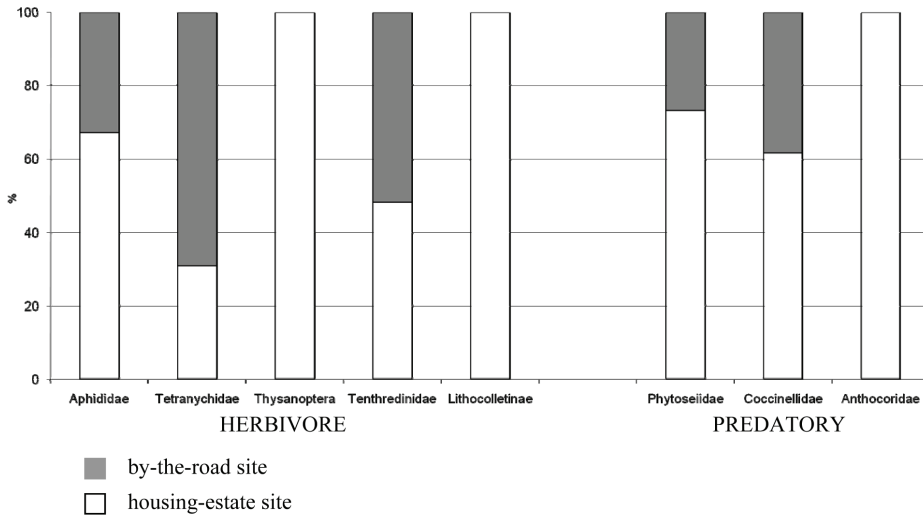


Figure 4. Percentage share of the most numerous taxa in both research sites collected in 2009

B. Predatory and parasitic arthropods

Predatory arthropods in both sites were well represented by mites from the Phytoseiidae family. Moreover, in the housing estate site in 2009, out of insect specimens of the Anthocoridae family were most numerous but were not observed in the by-the-road site in the research years 2008-2009 (Fig. 4). In the by-the-road site in 2008 and 2009 the most numerous predators were insects from the Coccinellidae family. Similar results were obtained by CZECHOWSKA *et al.* (1979) stating that insects from the Coccinellidae family are least sensitive to urbanizing pressure.

The number of parasitoids remained on almost the same level in both sites and in both research years (Tab. 1). Parasitic hymenopterons from the Aphididae family were most numerous on *T. cordata*. Their number was mainly estimated on the basis of mummies of parasitized aphids.

C. Arthropods feeding on mixed nutrient

Arthropods feeding on mixed nutrient were innumerable only in 2009 in the housing estate site, their number increased and in 2008 in the by-the-road site they were not recorded at all (Tab. 1). This group was represented by *Czespinskja lordi* and the representatives of Psocoptera.

Conclusions

From the observations carried out in 2008-2009 it follows that herbivore arthropods with a piercing-sucking mouth apparatus were a dominating trophic group settling *T. cordata*. In both research sites *E. tiliae* was most numerous. Moreover, in the housing estate site the representatives of Thysanoptera appeared, but they were not observed in the by-the-road site. In the by-the-road site next to aphids, mites from the Tetranychidae family were very numerous. Moreover, on the lower leaf surface felt galls were observed caused by eriophyoids from the *Eriophyes* genus. Within the predators group, mites of the Phytoseiidae family were observed to be most numerous. Out of predatory insects in the housing estate site Anthocoride representatives dominated, while in the by-the-road site – the Coccinellidae representatives. The number of predators and parasites in the housing estate site was in both years almost the same, irrespective of the number of herbivorous. In the by-the-road site in 2009 a decrease in the number of predators and parasites was observed and it was proportional to the decrease in the number of phytophags. In the housing estate site the greater species diversity was observed than in the by-the-road site, both within herbivorous and predators.

Numerous presence of herbivore arthropods resulted in severe leaf damage. The feeding of piercing-sucking arthropods caused leaf yellowing or as in the case of eriophyoids the formation of felt galls on the lower leaf surface which lowered decorative quality of leaves. Arthropods with a biting mouth part damaged leaf blade forming mines or biting off leaf skin.

References

- BOGDANOWICZ W., CHUDZICKA E., PILIPIUK I., SKIBIŃSKA E. 2004. Fauna Polski. Charakterystyka i wykaz gatunków. Vol. I. Muzeum i Instytut Zoologii PAN, Warszawa, 509p.
- BORATYŃSKA K., DOLATOWSKI J. 1991. Systematyka i geograficzne rozmieszczenie. [In:] Białobok S. (ed.). Lipy. Instytut Dendrologii PAN, Kórnik: 107-119.
- CICHOCKA E., CZAJKOWSKA B., GOSZCZYŃSKI W. 1991. Mszyce zasiedlające drzewa przyuliczne w Warszawie. Mszyce ich bionomia, szkodliwość i wrogowie naturalni. PAN, Warszawa: 9-18
- CHUDZICKA E. 1979. Wpływ struktury zieleni miejskiej na skład gatunkowy i liczebność fitofagów koron (na przykładzie *Tilia* sp.). [In:] Warunki rozwoju drzew i ich fauny w Warszawie. Mat. Konf. Nauk-Tech, PAN: 74-83
- CZECZOWSKA W., PISARSKA R., SKIBIŃSKA E., WEGNER E. 1979. Wpływ presji urbanizacyjnej na kompleks mszyce-afidofagi. [In:] Warunki rozwoju drzew i ich fauny w Warszawie. Mat. Konf. Nauk-Tech, PAN: 106-115

- FOBER H. 1991. Mineralne żywienie. [In:] Białobok S. (ed.). Lipy. Instytut Dendrologii PAN, Kórnik: 121-131.
- KRAWIARZ K. 1991. Wymiana gazowa i gospodarka wodna. [In:] Białobok S. (ed.). Lipy. Instytut Dendrologii PAN, Kórnik: 107-119.
- SENETA W., DOLATOWSKI J. 1997. Dendrologia. PWN, Warszawa, 559p.
- WILKANIEC B. 1996. Występowanie *Eucallipterus tiliae* (L.) (Homoptera: Phyllaphididae) na lipie w warunkach miejskich. Roczniki Akademii Rolniczej w Poznaniu 288, Ogrodn. 24: 85-92.

Stawonogi zasiedlające lipę drobnolistną (*Tilia cordata* Mill.) w krajobrazie Lublina

Streszczenie

Obserwacje nad występowaniem i liczebnością stawonogów zasiedlających lipę drobnolistną (*Tilia cordata* Mill.) prowadzono na terenie Lublina, w latach 2008-2009. Badania prowadzono w stanowisku osiedlowym i przyulicznym, a zebrane stawonogi podzielono na grupy troficzne ze względu na preferencje pokarmowe. Obserwacje dotyczą liczebności występowania fitofagów oraz stawonogów pożytecznych w warunkach miejskich, w zależności od nasilenia antropopresji. Z przeprowadzonych badań wynika, że dominującą grupą troficzną zasiedlającą *Tilia cordata* były stawonogi roślinożerne o kłująco-ssącym aparacie gębowym. W obu stanowiskach najliczniej występowała *Eucallipterus tiliae*. Ponadto w stanowisku osiedlowym, obok mszyc bardzo licznie występowali przedstawiciele Thysanoptera, a w stanowisku przyulicznym Tetranychidae. Wśród drapieżców w obu stanowiskach dominowały roztocze z rodziny Phytoseiidae. Najliczniej występującymi owadami drapieżnymi w stanowisku osiedlowym byli przedstawiciele rodziny Anthocoridae, a w stanowisku przyulicznym Coccinellidae.

