

THE EVALUATION OF FACTORS DETERMINING THE HEALTH CONDITION OF *ACER PLATANOIDES* AND *TILIA CORDATA* PLANTINGS IN SELECTED SITES OF URBAN GREENERY IN POZNAŃ, POLAND

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Abstract: Heavily urbanised areas are not a favourable habitat for plant growth and development. On the other hand, urbanised areas can be a favourable habitat for harmful fauna. In our study, those trees growing along the roadside were more heavily infested by pests than trees growing in parks. Three orders of insects, mites and lugs were identified on the Norway maple. The dominant insect species was *Periphyllus aceris*. On small-leaved lime four insect orders (the dominant species was *Eucallipterus tiliae*) and mites were found. An overall visual inspection confirmed that of maple and lime growing in city parks were in better condition than those growing by roads.

Key words: *Periphyllus aceris*, *Eucallipterus tiliae*, plant pests, Norway maple, small-leaved lime

INTRODUCTION

The paper is part of a study on the evaluating those factors which determine the condition of Norway maple and small-leaved lime plantings in selected urban areas of Poznań, Poland. The condition of trees growing in the vicinity of busy routes and of trees growing in parks, was compared. Both the influence of abiotic (in particular soil chemical properties) and biotic factors were studied (identification of disease and pests on trees). In part one of the paper (Wilkaniec *et al.* 2013), the results describing soil properties, the content of mineral elements in leaves as well as disease occurrence on plants were presented. This part describes the harmful fauna occurring on the trees, the results of overall visual inspections of the trees growing on the sites, and the various degrees of human pressure.

MATERIALS AND METHODS

In the city of Poznań, two busy streets, Lechicka St. And Nowina St., were selected as study sites. Lechicka St. now serves as a northern link of the city's transport network (*e.g.* the traffic volume on the lane adjacent to the plantings on 26.09.2011 was 12,026 vehicles in 24 hrs) (Zarząd Dróg Miejskich – ZDM – Poznań Road Author-

ity). Nowina St. is one of the main streets in the Ogrody district (*e.g.* the traffic volume on the lane adjacent to the plantings on 26.09.2011 was 4,948 in 24 hrs) (ZDM). The selection was aimed at finding areas where trees adjacent to streets are exposed to the influence of typical unfavourable environmental factors characteristic of urban areas (Szczepanowska 2001; Kosmala *et al.* 2009). The selected areas were meant to be in the vicinity of busy roads. Both the of the study site streets were assumed to be exposed to the following factors: air pollution related to heavy traffic, soil pollution, and the used of salt in winter. Nowina St. also had additional large paved areas. The trees were in a green lane. The lane was c. 4 m wide and 0.6 to 1 m away from the road edge. The additional paved areas could significantly influence water retention and the soil structure. On Lechicka St., the trees were 4 to 10 m away from the road edge, on a non-paved grass surface. The trees were separated from the road edge by a drain ditch.

The control group was made up of trees growing around Lake Rusałka. This area is a vast green zone located in the western greenery wedge of the city of Poznań. This was an area without traffic. There were few paved surfaces and or other factors which could potentially be undesirable for trees.

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Two tree species described in the references as fit for planting in cities were selected (Szczepanowska 2009): the Norway maple, *Acer platanoides* L. on the Nowina St. site and in the control group at Lake Rusalka, and the small-leaved lime, *Tilia cordata* Mill. on the Lechicka St. and Lake Rusalka sites.

Harmful fauna infesting the leaves of Norway maple and small-leaved lime

Ten plants were selected on each site to be used for evaluating the threat of harmful fauna infesting the trees. Twice a month, from the beginning of May, 2011, till the end of September, 2011, a sample of 100 leaves was collected from the ten plants. This sample was then taken to the laboratory of the Department of Entomology and Environment Protection. The leaves were checked, and the cause of damage identified on the basis of pest developmental stages or symptoms of pest feeding.

The evaluation of tree condition

The overall condition of the trees was evaluated with the visual method created by Kosmala *et al.* (2009). The visual evaluation of a tree's condition, if conducted by experienced people, is considered a method which yields objective and repetitive results (Suplat 1992; Kosmala *et al.* 2009).

The visual method takes into consideration the condition of the crown (branches, shoots and leaves), trunk, and roots of the tree (including the evaluation of soil quality in the rooting zone). The damage to particular tree parts is taken into consideration as well as infection with pathogens or pest infestation. The degree of damage is described as a % share of the total. We converted partic-

ular tree features related to the condition of the tree into points. A tree could have a maximum score of 100 points on a five-level scale, where: 0–15 points means very bad condition, 16–45 bad condition, 46–75 average condition, 76–95 good condition, 96–100 very good condition. We converted the score into degrees related to tree vitality phases (very good – expansion phase, medium degree – weakening, bad degree – stagnation, very bad degree – resignation phase). The condition of a tree was evaluated at the end of the vegetation season, in September.

RESULTS AND DISCUSSION

Harmful fauna infesting the leaves of the Norway maple and small-leaved lime

The leaves on the Norway maple trees growing on the site adjacent to heavy traffic (Lechicka St.) were more severely damaged by pests than the leaves of the Norway maples in the park (Rusalka). The composition of the fauna on both sites was similar, but different in terms of abundance.

Damage symptoms from piercing-sucking and chewing were found on maple leaves. Mites, slugs and three insect orders were identified (Table 1). It was aphids that most frequently infested the leaves. Three species of the *Periphyllus* genus were found. Aphids were found to be more abundant on the road site, where *P. aceris* was dominant (Fig. 1), while on the other site it was *P. coracinus*, which was dominant, though much less numerous.

As in earlier studies conducted in the cities of Warsaw, Poznań and Lublin, Poland, the dominant position of *P. aceris* (Cichocka and Goszczyński 1991; Wilkaniec 1994;

Table 1. List of invertebrata species infesting leaves of *A. platanoides* and *T. cordata* in Poznań in 2011

Tree species	Pest species	
	Order and family	Species
Norway maple	Hemiptera: Aphidoidea, Drepanosiphidae	<i>Periphyllus aceris</i> (Linnaeus)
		<i>P. coracinus</i> (Koch)
		<i>P. testudinaceus</i> (Ferne)
	Hemiptera: Auchenorrhyncha, Cicadellidae	<i>Acericerus ribauti</i> Nickel & Remane
		<i>Acericerus heydenii</i> (Kirschbaum)
	Hemiptera: Aleyrodoidea, Aleyrodidae	<i>Aleurochiton aceris</i> (Modeer)
	Lepidoptera: Gracillariidae	<i>Phyllonorycter joannisi</i> (Le Marchand)
	Lepidoptera: Nepticulidae	<i>Stigmella aceris</i> (Frey)
	Lepidoptera: Tortricidae	<i>Acleris forsskaleana</i> (Linnaeus)
	Diptera: Cecidomyiidae	<i>Dasineura irregularis</i> (Bremer)
Acarida: Eriophyidae	<i>Aceria macrorhyncha</i> (Nalepa)	
Helicoidea: Helicidae	<i>Cepaea hortensis</i> (O. F. Muller)	
Small-leaved lime	Hemiptera: Aphidoidea, Drepanosiphidae	<i>Eucallipterus tiliae</i> (Linnaeus)
		<i>Eriophyes tiliae</i> (Pagenstecher)
	Acarida: Eriophyidae	<i>E. leiosoma</i> (Nalepa)
		<i>E. exilis</i> (Nalepa)
	Acarida: Tetranychidae	<i>Eotetranychus tiliarum</i> (Herms)
	Lepidoptera: Gracillariidae	<i>Phyllonorycter issikii</i> (Kumata)
	Lepidoptera: Bucculatricidae	<i>Bucculatrix thoracella</i> (Thunberg)
	Lepidoptera: Nepticulidae	<i>Stigmella tiliae</i> (Frey)
	Lepidoptera: Tortricidae	<i>Archips podana</i> (Scopoli)
		<i>A. rosana</i> (Linnaeus)
	Diptera: Cecidomyiidae	<i>Didymomyia tiliacea</i> Bremer
	Coleoptera: Curculionidae	<i>Phyllobius argentatus</i> (Linnaeus)

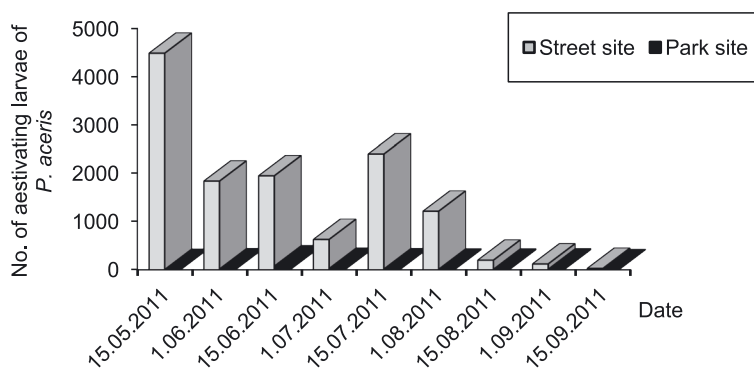


Fig. 1. Occurrence of *P. aceris* aestivating larvae on maple leaves at the street site (Lechicka) and the park site (Rusałka) in Poznań in 2011

Table 2. Health condition of trees in selected sites of urban greenery in Poznań in 2011

Species	<i>T. cordata</i> Mill				<i>A. platanoides</i> L.			
	street site (Nowina)		park site (Rusałka)		street site (Lechicka)		park site (Rusałka)	
Locality	No of points	health class	No of points	health class	No of points	health class	No of points	health class
1	76	D	97	BD	92	D	100	BD
2	81	D	95	D	87	D	95	D
3	63	S	95	D	86	D	97	BD
4	79	D	92	D	86	D	95	D
5	81	D	94	D	86	D	95	D
6	83	D	94	D	86	D	60	S
7	86	D	89	D	86	D	100	BD
8	81	D	94	D	86	D	92	D
9	73	S	86	D	86	D	97	BD
10	81	D	89	D	86	D	92	D
Mean	78,4	D	92,5	D	86,7	D	92,3	D

Health class: BD – very good, D – good, S – medium, Z – bad, BZ – very bad

Wilkaniac and Piekarska-Boniecka 1996; Mackoś 2008) on Norway maples growing along the streets, was confirmed. Besides aphids, there often were hoppers, and whiteflies, and mining insects found on leaves. Insect feeding led to leaf yellowing, wilting and premature falling.

The leaves of the maples growing along Lechicka St. showed a high level of damage from chewing, throughout the whole season. A level of 40–59% of the total number of these leaves showed damage from chewing. In comparison with this result, only a 20–47% level of leaf damage was noted in the collected samples from the Rusałka site. In spring, this damage was attributed mainly to leafrollers and weevils, and in autumn, to slugs.

A frequent symptom of leaf damage was leaf mining. *P. platanoidella* larvae feeding on leaves caused rather big oval mines. The larvae of other species, i.e. *Stigmella aceris*, chewed out narrow, long, curving mines. Heavily infested leaves prematurely wilted and fell. Both mining species more often damaged tree leaves in the park. Similarly many puparia of *Aleurotichon aceris* were found on the trees by the Rusałka site. On the trees by the road, only single examples of *A. aceris* puparium were found.

Eriophyoid mites, spider mites, and four insect orders were found on the leaves of small-leaved lime (Table 1). Like on the maples, the most often found insects included aphids. Limes were infested by the lime aphid, *E. tiliae*, at

the beginning of August. An abundance of over 300 specimens were found in the sample of 100 leaves, from the busy Nowina St. site, and there were about three times fewer in the park (Rusałka site) (Fig. 2). The numerous population of the lime aphid was accompanied by a high abundance of predators and parasites, among them ladybirds, green lacewings, and aphid parasites. Even in mid-August, the leaves in the lower part of tree crown were covered with a black layer of honey fungus mycelia, developing on honeydew, which aphids had secreted in large amount.

On the other hand, on lime trees growing by the Rusałka site, there was a heavier infestation by Eriophyoid mites than on the trees at the Nowina St. site. Throughout the whole season, the symptoms of feeding by three species were seen. These three species were, namely: *E. tiliae*, *E. leiosoma* and *E. exilis*. At the Rusałka site, there were also more symptoms of feeding by Microlepidoptera moths of the Gracillariidae and Lyonetiidae families (nearly twice as many mines on the leaves, up to 90 mines/100 leaves) and more damage by chewing (up to 37 damages/100 leaves), than on the trees by the busy Nowina St. site.

On both tree species in the park, a higher species richness of invertebrate fauna was found, but in a lower abundance. This finding shows the more natural character of the park habitat.

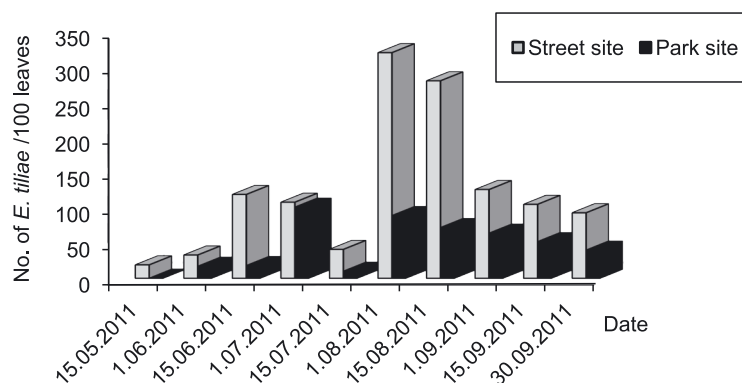


Fig. 2 . Numerical changes of *E. tiliae* on lime at the street site (Lechicka) and the park site (Rusałka) in Poznań in 2011

The first studies of entomofauna of urban dendroflora and its shaping under urbanisation pressure in Poland date back to the 1970s (Chudzicka 1979; Czechowska *et al.* 1979; Pisarski 1979). These early studies proved the different reaction of insects and mites to those factors. Under pressure of urbanisation, there was a diminished number of saprophages, many zoofages, and phytophages with chewing mouthpieces, while the number of species with piercing-sucking mouthpieces and some mining species increased.

Most studies previously conducted were usually concerned with one selected insect or other arthropoda group (Cichočka and Goszczyński 1991; Wilkaniec 1996; Jaśkiewicz 1997; Cichočka *et al.* 1998; Wilkaniec 1999; Ruskowska and Wilkaniec 2002; Osiadacz and Wiczorek 2003; Wilkaniec 2004; Wiczorek and Osiadacz 2005; Borowiak-Sobkowiak and Wilkaniec 2010; Ratajczak and Wilkaniec 2011; Wrzeńska and Wawrzyniak 2011). Our paper deals comprehensively with the results of research on the occurrence of all insect and mite fauna infesting the leaves of the Norway maple and small-leaved lime. These, two taxa: Norway maple and small-leaved lime, are commonly planted in cities.

As in previous studies, out of all the insects, aphids most numerously infested lime leaves. The dominant species was the lime aphid, *E. tiliae*. The maximum abundance of this aphid on leaf samples, was on a medium level, in spite of rather unfavourable weather conditions (320 aphids/100 leaves from trees along the streets) (Fig. 2). The rule that aphid populations on leaves from those trees along the streets were more abundant than on leaves of those trees in the park was confirmed. Apart from aphids, the leaves were quite infested by Eriophyoid mites, mainly *E. tiliae* and *E. leiosoma*, as well as the mining species *P. issiki*, *B. thoracella* and *S. tiliae*.

Evaluation of tree condition

Among the trees inspected with the visual method used on the *T. cordata* species, the group of trees growing by Lake Rusałka was found to be in better condition (the mean score was 92.5). There were trees growing along an unpaved footpath, a bike trail, in a large group (4 specimens) and in dense groups along an asphalt access road to the "Olimpia" sports club area (6 specimens). Paved surfaces influence the evaluation of conditions related

to tree growth environment. The influence of the paved roads, was reflected in the score describing the condition of particular trees. Some of trees had crowns of a non-typical shape, which may be related to the high density of groups.

Visual inspection proved that the trees lining Nowina St. were in much worse condition (the mean score 78.4). Most specimens growing on the Nowina St. site had small crowns which had been reduced to various degrees. There were two specimens with crowns reduced by 26–50%. The trees on Nowina St. also had poor damaged foliage, trunks showing loss of bark, and cracks or badly healed spots formed after branches had been removed. There were paved surfaces below all of the tree specimens' crown outlines. The paved surfaces influenced the evaluation of conditions related to the root – growing environment.

Among *A. platanoides*, a higher score (mean score 92.3) was assigned to the group by Lake Rusałka. These trees were growing in file (8 specimens), along a dust footpath and a fence (2 specimens). Two trees in the file had cracked trunks. One specimen was in very poor condition, with numerous wilted branches. The low score of this specimen (60 points) influenced the mean score of this group.

The specimens of *A. platanoides* by Lechicka St. achieved considerably lower scores in the visual evaluation of their condition (the mean was 86.7 points). The trees on that site were growing in two large high-density groups. One was a solitary tree. The high-density group of *A. platanoides* trees resulted in small, atypically-shaped crown. Most of these trees displayed slight damage to the trunk: small cracks and discontinuation of bark. The foliage of all of the trees have showed traces of damage.

The trees located in the park by Lake Rusałka were in much better condition than those growing by the busy roads. They were also less infested by disease and pests, which is probably due to different environmental conditions. The trees in the park planting were much less exposed to: traffic-related air pollution, soil pollution and the occurrence of large paved areas. Moreover, the trees in the park, lining footpaths or bike trails or low-traffic roads were less exposed to mechanical damage.

CONCLUSIONS

1. The trees growing along side roads were more often infested by pests than those on the park site. Mites, slugs and three insect orders were identified on the Norway maple. Of the insects, it was aphids which were numerous – with *P. aceris* dominating. Mites and four insect orders were found on the small-leaved lime. The dominant species was the lime aphid *E. tiliae*.
2. The overall visual evaluation of the condition of the trees confirmed that the maple and lime trees in the park were in better condition than those trees in the sites situated by busy roads.

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