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THE HEALTH – THREATENING FACTORS OF STREET TREES IN THE CENTRE OF OPOLE

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ABSTRACT: The paper presents results of research, which aim was to determine trees' health state and show danger factors to health state of the street trees in the centre of Opole. As a result of the conducted analysis, 13 tree species were found out. The most numerous were: *Tilia cordata*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Tilia platyphyllos* – 63,8% of the analysed group of trees. All trees were angiosperms. Definitely the greatest share – 78,1% were trees in good health state. Trees in bad and very bad health state accounted for 19,3 and 2,6% respectively. The following danger factors to trees health state were noted: mechanical damage of trunk and crown (116 cases), *Cameraria ohridella* (43), chloroses (37), *Schizophyllum commune* (20), necroses and too little free space around the tree (17 cases each), tumour and *Microsphaera alphitoides* (4 cases each), and also *Apiognomonia errabunda*, *Entomosporium mespili*, *Tischeria complanella* (3 cases each).

KEY WORDS: dendrology, health state, street tree, danger factor of health state.

Introduction

Currently, withering, unhealthy trees (especially street trees) are common sight in our cities, although they are not as old as they look.

Many conferences and scientific publications, especially in the United States and in the countries of western Europe aimed to determine and characterize the factors that limit street trees development and to find various recover measures. Wide range research on the reasons of street trees condition aggravation began in Poland in early 70s of the last century (Borecka and Gołąbek 2009).

Habitat conditions in the cities have worsened along with increasing urbanisation. At present, habitat conditions in many places hinder tree' development, which fight for survival and fail to fulfil expected functions (Siewniak, Siewniak 2000). Among city trees, street trees have the least favourable living conditions.

Danger factors to city trees health state may be divided into abiotic and biotic ones (Łukasiewicz and Łukasiewicz 2006).

Among abiotic factors, including climate of a given geographical location, significant influence on development and life of city plants have: specific microclimate, depending on the size and character of agglomeration; soil conditions; air pollution; soil pollution; introduction of synthetic turf; mechanical damage (Łukasiewicz 1989).

As a rule, there should be considered not one, but the whole group of stress factors. However, one could say that the growth, vitality and life span of city trees is strongly influenced by widely understood soil habitat distortion. Hierarchy of danger factors – starting from most significant – is as follows: excessive soil compaction; too little soil capacity to rooting; soil salinity; water stress (Łukaszkiewicz 2008).

Biotic factors, among others, include viruses, bacteria, fungi, insects and parasitic and semi-parasitic flowering plants. However, most common are illnesses caused by fungi. These account for 85% of all illnesses (Łukasiewicz and Łukasiewicz 2006).

It is estimated that such factors as drought, soil compaction, salinity, chemical agents used to control weeds etc. result in a significant mortality of city trees than viruses, fungi and pests (Houston 1985).

Not only negative influence of habitat factors, but also improper tree selection results in weakening and withering of city street trees. Suggested plant selection usually has not taken into consideration habitat specificity so far. Therefore, it is necessary to create adequate selection and look for species and cultivar which might satisfactorily grow along the streets at least for the next 20 years (Borowski and Latocha 2006). That is why, it is necessary to conduct wide ranging research on health state of street trees and their dangers.

Method, research area and objects

The aims of researches (conducted in 2008) were to determine health state and show the factors which concentration endangers health state of street trees (growing between the road and the pavement) in the centre of Opole.

Opole is located in the central part of Opole province. Its area is 96 km^2. Dominant types of soil are rendzinas and alluvial soils – about 66% of all city soils. Climate conditions are one of the mildest in the country – low temperature ranges, moderate amount of rainfall, quickly changing thermal seasons in the first half of the year and slowly changing in second half of the year, long vegetation period (Badora 2006).

The analysis comprised all street trees (265) growing along 21 streets: 11 Listopada (7 trees), Kardynała Bolesława Kominka (9 trees), Powstańców Śląskich (20 trees), Pasiecznej (26 trees), Strzelców Bytomskich (11 trees), Piastowskiej (9 trees), Norberta Barlickiego (4 trees), Księcia Jana Dobrego (7 trees), Biskupa Jana Kropidły (13 trees), Tadeusza Kościuszki (22 trees), Hugona Kołłątaja (24 trees), Władysława Reymonta (9 trees), Leona Powolnego (4 trees), Franciszka Żwirki i Stanisława Wigury (12 trees), Mały Rynek (4 trees), Sądowej (21 trees), Henryka Sienkiewicza (29 trees), Mieczysława Niedziałkowskiego (21 trees), Konsularnej (4 trees), Haliny Poświatowskiej (6 trees), Marii Konopnickiej (3 trees).

A method offered by J. Duda (table 1) was used to assess the health state of the trees. According to this method tree health state is assessed in a three-grade scale ("good", if total points for trunk and crown do not exceed 3, "bad" – if it is between 4 to 7 and "very bad" if, it exceeds 7 points). An injury is a mechanical damage of a trunk in the form of tear of bark and phloem, reaching to pulp (cambium) or deeper, and its width is determined perpendicularly to trunk axis, in the widest place (Wika and Włoch 1994).

Table 1. Trees health state (J. Duda).

Injury grade	Damage size		Remarks
	Trunk (S)	Crown (K)	
0	Undamaged cambium and phellogen	No damage	Growth of a new tree ring and phloem in the whole tree girth
1	Single injury or few injuries in total up to 10 cm of girth	Up to 15% of crown, withered 1-2 branches or boughs with girth at the base of above 5 cm	Frost cracks, mechanical damage, not scared up outer bark in the trunk up to 10 cm
2	Injuries of 10-25%of trunk girth	15-25%, more than 2 uninjured boughs	At least ¾ of trunk girth has conductive functions in the wood and phloem
3	Injuries of 25-50% of trunk girth	25-50%	Cambium functions are preserved in at least ½ of trunk girth
4	Injuries of 50-75% of trunk girth	50-75%	At least ¼ of trunk girth has conductive functions
5	Injuries above 75% of trunk girth	Above 75%	Less than ¼ of trunk girth has conductive functions

Source: Wika S., Włoch W. (eds.), 1994, p. 44.

Results and discussion

There were examined 13 species: *Tilia cordata* (18,5%), *Aesculus hippocastanum* (16,6%), *Robinia pseudoacacia* (15,5%), *Tilia platyphyllos* (13,2%), *Sorbus intermedia* (6,8%), *Acer platanoides* (6,8%), *Catalpa bignonioides* (6,4%), *Crataegus monogyna* (4,1%), *Fraxinus excelsior* (3,0%), *Quercus robur* (2,6%), *Quercus rubra* (2,3%), *Sorbus aucuparia* (2,3%) and *Tilia tomentosa* (1,9%).

The most numerous were: *Tilia cordata*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Tilia platyphyllos* – 63,8% of the analysed trees group.

All trees were angiosperms.

Among the examined trees the greatest share constituted – 78,1% of trees in good health state. Trees in bad and very bad health state accounted for 19,3 and 2,6% respectively.

Table 2. Health state of street trees in the centre of Opole according to species.

Species	Health state		
	good	**bad**	**very bad**
Acer platanoides	61,1%	22,2%	16,7%
Aesculus hippocastanum	90,9%	6,8%	2,3%
Catalpa bignonioides	88,2%	11,8%	-
Crataegus monogyna	81,8%	18,2%	-
Fraxinus excelsior	100,0%	-	-
Quercus robur	100,0%	-	-
Quercus rubra	100,0%	-	-
Robinia pseudoacacia	63,4%	34,2%	2,4%
Sorbus aucuparia	50,0%	50,0%	-
Sorbus intermedia	83,3%	16,7%	-
Tilia cordata	69,4%	26,5%	4,1%
Tilia platyphyllos	80,0%	20,0%	-
Tilia tomentosa	100,0%	-	-

Table 2 shows that 4 tree species: *Fraxinus excelsior*, *Quercus robur*, *Quercus rubra* and *Tilia tomentosa* were in the best health state (all trees in good state). Above 30% of trees in bad and very bad state were found among *Tilia cordata*, *Robinia pseudoacacia*, *Acer platanoides* and *Sorbus aucuparia*.

In the table 3 we can find information on danger factors of health state of the examined trees. Definitely most, namely as many as 116 cases, were mechanical damage to trunk and crown. These was caused tree location (between the street and the pavement) and thus bigger exposure to damage. Borowski and Latocha (2006) give information that it is one of the primary factors limiting city trees development.

Apart from that – there were found: *Cameraria ohridella* (43 cases), chloroses (37), *Schizophyllum commune* (20), necroses and little free space around trees (17 cases each), tumour and *Microsphaera alphitoides* (4 cases each), and also *Apiognomonia errabunda*, *Entomosporium mespili*, *Tischeria complanella* (3 cases each).

Table 3. Danger factors of health state of street trees in the centre of Opole.

Factor	Number of cases
mechanical damage (trunk, crown)	116
little free space around trees	17
chlorosis	37
necrosis	17
tumour	4
Schizophyllum commune	20
Microsphaera alphitoides	4
Apiognomonia errabunda	3
Entomosporium mespili	3
Cameraria ohridella	43
Tischeria complanella	3

The size of free space around trees is one of the basic requirements conditioning its unrestricted growth. The best solution would be the replacement of pavement hole (where trees grow) with green belts or placing special perforated plates that enable free gas exchange between soil and atmosphere, and also water access. Often limitation of free area is accompanied by soil compaction. Łukasiewicz and Łukasiewicz (2006) maintain that in unfavourable soil conditions tree roots are reduced even up to about 25% which, among others, leads to reduction in the number of annual tree shoots growth and annual ring size in tree trunks, even up to above 80%.

Chloroses and necroses may be caused by various factors, for example infections, influence of danger abiotic factors, mechanical injuries but also shortage of nutrients.

In the cities one of the main reasons of necroses formation is heavy soil salinity, connected with winter road de-icing. Borowski and Latocha (2006) inform that the salt contents in the root often exceeds even several times normal concentration in the soil.

Salt causes changes in mineral substances management, which leads to damage of tree assimilation apparatus. External illness symptoms are: late shooting, creation of smaller leaves formation, necroses formation on leaf edges and premature leaf fall. There has been found damage to cambium activity and diversification of tree tissue (Greszta and Gruszka 2000). Salt also damages shoots and buds by aerosol, which is created as a result of spraying of particles of salted water by vehicles (Borowski and Latocha 2006). After salt is not use, trees suffer from salinity effects for around next 15 years (Kosmala 2004).

Tumours grow in places, where they would not grow on regular plant or they are deeply plastically transformed organs. They are called cecidia (gall) (Mańka 2005). There were found 4 such cases on the examined area – all on tree trunks of *Robinia pseudoacacia* species.

One of the fungi, which presence was ascertained on the street trees in the centre of Opole was *Schizophyllum commune*. It colonizes mostly wood of deciduous trees and causes shallow rot of sap-wood. Fungus fructifications are fan-shaped and can be found on the lit part of the trunk (Jahn 2005). During drought they fold. They last for several years and are very vital. This illness attacks weak plants (Młynik 1990). Fungus activity is slow. As a result a tree withers.

During the research there found 20 trees struck by *Schizophyllum commune*. These were: *Tilia cordata* – 35% of all infected trees, *Tilia platyphyllos* – 20%, *Aesculus hippocastanum*, *Acer platanoides*, *Robinia pseudoacacia*, *Tilia tomentosa* – 10% each and *Sorbus intermedia* – 5%. The above-mentioned data prove that more than a half (65%) of struck trees are lime trees.

The next pathogen was fungus: *Microsphaera alphitoides*. It was found on 4 trees of *Quercus robur*.

This illness strikes especially European oaks and is characterised mostly by the presence of white coating spreading on all area of leaf blades. As a result, leaves but also shoots, gradually wither. The damage done by this pathogen is about reduction in oak growth, and in the case of young trees, even withering. Some scientists emphasize that long persistence (especially in the winter and at the beginning of summer) of hot and

humid weather highly favours the development of *Microsphaera alphitoides* (Mańka 2005).

On the examined area an illness caused by fungus *Apiognomonia errabunda* was also found. It was found in 2 trees of *Tilia platyphyllos* and one of *Tilia cordata*. It is mostly located on leaves, petioles, sometimes also on shoots of *Platanus*, *Fagus*, *Quercus*, *Tilia*, *Acer*. On young leaves, in spring, there appear at first slightly unclear, green-yellow colour change, gradually changing into brown, on bottom side usually lighter. Spot shape can vary depending on tree species. For instance on lime tree leaves, brown spots of various size and shape have dark edges.

On petioles there appear dark brown long spots. As a result leaves wither and fall, sometimes even at the end of spring or the beginning of summer. This illness is facilitated by very humid, not very warm April and May (Mańka 2005).

On 3 trees of *Crataegus monogyna* there was found fungus – *Entomosporium mespili* (appears on more than 60 plant species of family *Rosaceae*). This illness can be found on leaves and tree shoots. It is characterised by round or oval spots with diameter of 2 – 5 mm (dark brown on the top side of leaves, light brown on the bottom part). As a result leaves get brown and fall. The illness symptoms can be also found on the surface of the youngest tree shoots. Even already in the first half of summer all leaves can fall off a tree in some conditions, favourable to fungi development. Frequent rainfall and temperature from 20 to 26°C favour the illness development (Wojdyła 2005).

There was found pest – *Cameraria ohridella* on 43 trees of *Aesculus hippocastanum*. According to Bednarz and Scheffler (2008) the presence and gradation of this butterfly on the area of our country was influenced by climate warming. Depending on summer temperatures, this species may breed from 3 to 4 generations (Baranowski 2010). It feeds almost exclusively on trees of *Aesculus*, and most frequently attacks species of *Aesculus hippocastanum* (Kowalski 2000). This butterfly larva are dangerous for plants. It feeds on leaf pitch, creating this way, first oval and later rectangular (long) mines. First mines appear in mid May, a complete leave devastation may occur already in August. Damaged places are first light green, and at the end brown. Leaf mining by *Cameraria ohridella* leads to reduction in assimilation area, and as a consequence, to reduction in tree shoot growth, reduction in fruit size or complete lack of fruit.

Tischeria complanella butterfly is another insect, which appears on 3 trees of *Quercus robur.* At the beginning of summer its larva starts to prey on internal part of a leaf, right under upper skin, creating initially small, round, white mine. With time they make it bigger and in the middle a yellow shell-shape convexity is created,. The leaves fall premature. Throughout the year two generations of this pest develop (Szujecki 1998; Łabanowski 2001).

Conclusions

1. On the examined area have been found 13 species of trees. The most numerous were: *Tilia cordata*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Tilia platyphyllos* – 63,8% of analysed group of trees. All the trees were angiosperms.

2. Definitely the greatest share – 78,1% had trees in good health state. Trees in bad and very bad condition were respectively 19,3 and 2,6%. In the best health state were trees of 4 species: *Fraxinus excelsior*, *Quercus robur*, *Quercus rubra* and *Tilia tomentosa*. Above 30% of trees in bad and very bad state were found among *Tilia cordata*, *Robinia pseudoacacia*, *Acer platanoides* and *Sorbus aucuparia*.
3. There determined the following danger factors of health state of street trees: mechanical damage to the trunk and crown (116 cases), *Cameraria ohridella* (43), chloroses (37), *Schizophyllum commune* (20), necroses and little free space around tree (17 cases each), tumour and *Microsphaera alphitoides* (4 cases each), and also *Apiognomonia errabunda*, *Entomosporium mespili*, *Tischeria complanella* (3 cases each).
4. Over a half of (65%) struck trees by *Schizophyllum commune* were limes. *Microsphaera alphitoides* appeared on trees of *Quercus robur*, *Apiognomonia errabunda* on 2 trees of *Tilia platyphyllos* and one tree of *Tilia cordata* and *Entomosporium mespili* on *Crataegus monogyna*. *Cameraria ohridella* was found only on trees of *Aesculus hippocastanum. Tischeria complanella* was found on *Quercus robur*. All cases of tumour were noted on tree trunks of *Robinia pseudoacacia*.

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