

5. Labanowski G., Orlikowski L., Soika G., Wojdyla A. 2001. Ochrona drzew i krzewow igliastych. Krakow.
6. Minkevičius A., Ignatavičiūtė M. 1991. Lietuvos grybai V. *Uredinales* 1. Vilnius.
7. Navasaitis M. 2004. Dendrologija. Vilnius.
8. Pileckis S., Valenta V., Vasiliauskas A., Žuklys L. 1968. Svarbiausių miško medžių kenkėjai ir ligos. Vilnius.
9. Polujanski A. 1854. Opisanie lasow Krolewstwa Polskiego i gubernij Zachodnich cesarstwa rosyskiego. Warszawa, T. I–IV.
10. Ramanauskas V. (red.). 1973. Dendrologija. Vilnius.
11. Sinclair W. A., Lyon H. H. 2005. Diseases of trees and shrubs. Ithaca and London.
12. Stoncelis A. 2013. Maumedynų taksacija, našumas ir paplitimas Lietuvoje. Jaunasis mokslininkas 2013, p. 61–65.
13. Šurkus J., Gaurilčikienė I. (sudarė). 2002. Žemės ūkio augalų kenkėjai, ligos ir jų apskaita. Dotnuva.
14. Žiogas A. (red.). 2000. Miško apsaugos vadovas. Kaunas.
15. Žiogas A., Juronis V., Snieškienė V., Gabrilavičius R. 2006. Pathological condition of introduced conifers in the forests of South-Western and Western Lithuania. Baltic Forestry. Vol. 12, No. 2(23), p. 234–243.
16. Žiogas A., Juronis V., Snieškienė V. 2009. Pathological condition of *Larix* in Lithuania. Insects and Fungi in Storm Areas. Zvolen, p. 115–117.
17. Янушкевичюс Л. Ю. 1989. Биолого-экологические исследования интродуцированной дендрофлоры Литовской ССР. Вильнюс.

## PHYTOSANITARY CONDITION OF WOODY PLANTS GROWING IN FOREST PARKS IN THE CITY OF LITHUANIA

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## ФИТОСАНИТАРНОЕ СОСТОЯНИЕ ДРЕВЕСНЫХ РАСТЕНИЙ В ЛЕСОПАРКАХ В ГОРОДАХ ЛИТВЫ

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После проведения мониторинга состояния наиболее распространенных деревьев растений (10 родов, 12 видов), растущих в четырех лесопарках, второго по величине города Литвы, установлено: дефолиация, дехромация, увеличение количества сухих веток. Обнаружено 6 видов патогенных грибов: *Rhytisma acerinum* и *Sawadea bicornis* повреждали *Acer platanoides*, *Apiognomonina errabunda*, *Erysiphe alphitoides* – *Quercus robur*, *Mycosphaerella millegrana* и сажиевая болезнь – *Tilia cordata*. Вредители: *Caliroa annulipes* повреждал липу, *Pristiphora subbifida* – клена. *Sorbus aucuparia*, *Quercus robra* были неповреждены.

Establish green plantations in urban areas do not guarantee routine maintenance for all the residential areas: too small territories, some of them far away from residential areas. The function of these green plantations is partially offset by the large urban recreational forests that retained the basic features of natural forest - forest parks. The state of forest parks in Lithuania best reflects city parks of Lithuania's second largest city (Kaunas) located in the Middle of Lithuania. Kaunas has four forest parks, which have significant impact on the city ecological state. (Tatariuniene et al., 2011). Native plant species dominate in these parks (*Pinus sylvestris*, 44%; *Quercus robur* and *Tilia cordata*, 11%; *Betula pendula*, 7%; *Picea abies*, 6%; *Acer platanoides*, 5%; et al.).

The aim of the work. To determine the state of the most common woody plants growing at the urban forest parks.

**Materials and Methods.** For the health condition establishment of green plantations of four parks at Kaunas city (Lithuania), nine constant monitoring spots (CMS) for trees observation were chosen (Table 1). According to the program of forest parks under the EU methodology there were selected six trees for each mostly similar nearest of observation spots to the aspect of four world directions (Manual on methods, 1994).

**Table 1. Regular monitoring points, coordinates, plant prevalence (<sup>K</sup> – Kleboniškis forest park, <sup>M</sup> –Kaunas Lagoon regional park, <sup>P</sup> – Panemunės forest park, <sup>R</sup> – Romainiai forest park)**

Coordinates of constant monitoring spot (CMS)		Name of forest park, area	Species and prevalence of investigated plants
X	Y		
54,93850000	23,96183333	Kleboniškis forest park, 484.2 ha	<i>Acer platanoides</i> L. <sup>K,M,P,R</sup> , <i>Betula pendula</i> Roth <sup>M,R</sup> , <i>Fraxinus excelsior</i> L. <sup>M</sup> , <i>Padus avium</i> Mill. <sup>K,M</sup> , <i>Picea abies</i> (L.) H. Karst. <sup>K,M,P</sup> , <i>Pinus sylvestris</i> L. <sup>K,P,R</sup> , <i>Populus x canadensis</i> Moench <sup>M</sup> , <i>Populus tremula</i> L. <sup>M</sup> , <i>Quercus robur</i> L. <sup>K,M,P,R</sup> , <i>Quercus rubra</i> L. <sup>K</sup> , <i>Sorbus aucuparia</i> L. <sup>K</sup> , <i>Tilia cordata</i> Mill. <sup>K,M,P,R</sup>
54,95183333	23,93566667		
54,95516667	23,95050000		
54,90916667	24,05550000	Kaunas Lagoon regional park, 246.3 ha	
54,87616667	23,97983333	Panemunės forest park, 298.4 ha	
54,89166667	23,97700000		
54,88366667	24,02083333		
54,93666667	23,84383333	Romainiai forest park, 223.5 ha	
54,92050000	23,83700000		

Monitoring of morphological parameters (crown defoliation, foliage discolouration, amount of dead branches, leaf necrosis), disease and pest intensity valuate according to five-point scale (0–4), during July and August: 0 points – relatively healthy trees (injuries up to 10%); 1 point – slightly damaged (11–25%); 2 – average damage (26–60%); 3 – strong damage (61–99%); 4 – dead trees (100% injuries).

Pathogens and pests were identified visually (by symptoms, morphological features, using a loupe) (Hartmann et al., 2005; Sinclair, Lyon, 2005). Fungi names described in accordance with generally accepted interactive code *Index fungorum* and pests by *Fauna Europaeae*. Damage intensity was calculated in accordance with the methodologies used in forestry (Juodvalkis and Vasiliauskas, 2002), using the formula:  $V = \sum(n \cdot b) / N$ , where V is the average grade of damage, n is the number of trees assigned to the same grade of damage, b is the grade of damage of individual tree, and N is the total number of investigated trees.

**Results.** After the most common woody plants (10 genera, 12 species) growing at the four of forest parks of the second largest Lithuanian city status monitoring, there was mainly morphological tree injuries noticed: defoliation, discolouration, increased number of dry branches at crowns, leaf necrosis. Biotic factors, noticed diseases and pests intensity change of individual tree species (Table 2).

**Table 2. State of woody plants in city forest parks, Lithuania (<sup>K</sup> – Kleboniškis forest park, <sup>M</sup> –Kaunas Lagoon regional park, <sup>P</sup> – Panemunės forest park, <sup>R</sup> – Romainiai forest park)**

Plant's name /Forest park	Year	The average grade of damage					
		Defoliation	Discolouration	Leaf necrosis	Dry branches	Fungal diseases	Pests
<i>Acer platanoides</i> <sup>K,M,P,R</sup>	2013	0±0,83	0±0,83	0±0,83	0,71±0,66	0,43±0,73	0±0,83
	2014	0±0,83	0±0,83	0±0,83	0±0,83	0,57±0,63	0±0,83
<i>Betula pendula</i> <sup>M,R</sup>	2013	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73
	2014	0,33±0,57	0,33±0,57	0±0,73	0,11±0,62	0±0,73	0±0,73
<i>Fraxinus excelsior</i> , <sup>M</sup>	2013	0±3,87	0±3,87	0±3,87	1±2,74	0±3,87	0±3,87
	2014	0±3,87	0±3,87	0±3,87	1±2,74	0±3,87	0±3,87
<i>Padus avium</i> <sup>M,K</sup>	2013	0,33±1,1	1±2,74	0±2,24	0±2,24	0±2,24	0±2,24
	2014	0,33±1,1	0,67±1,77	0±2,24	0±2,24	0±2,24	0±2,24
<i>Picea abies</i> , <sup>K</sup>	2013	1,64±0,9	1,39±0,08	0±0,13	1,84±0,09	0±0,13	0±0,13
	2014	1,54±0,1	1±0,09	0±0,13	1,54±0,09	0±0,13	0±0,13
<i>Pinus sylvestris</i> <sup>K,P,R</sup>	2013	0±0,05	0±0,05	0±0,05	0,3±0,04	0±0,05	0±0,05
	2014	0±0,05	0±0,05	0±0,05	0,3±0,04	0±0,05	0±0,05
<i>Populus x canadensis</i> , <sup>M</sup>	2013	0±3,87	0±3,87	0±3,87	1±2,74	0±3,87	0±3,87
	2014	0±3,87	0±3,87	0±3,87	1±2,74	0±3,87	0±3,87
<i>Populus tremula</i> , <sup>M</sup>	2013	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73
	2014	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73	0±0,73
<i>Sorbus aucuparia</i> , <sup>K</sup>	2013	0	0	0	0	0	0
	2014	0	0	0	0	0	0

<i>Tilia cordata</i> , K, M, P, R	2013	0,31±0,4	0,75±1,22	0±0,44	0,31±0,39	3,23±0,34	1±0,27
	2014	0,31±0,4	0,75±1,22	0±0,44	0,31±0,39	1,71±0,24	1,15±0,3
<i>Quercus robur</i> <sup>K, M, M, P</sup>	2013	0±0,58	0±0,58	0±0,58	0,1±0,56	2,2±0,34	0±0,58
	2014	0±0,58	0±0,58	0±0,58	0,1±0,56	1,2±0,49	0±0,58
<i>Quercus rubra</i> <sup>K</sup>	2013	0	0	0	0	0	0
	2014	0	0	0	0	0	0

Similarly like in all Lithuania forest parks, among growing *Picea abies*, most common matters are rarefy crowns, abundance of dry branches; also *Fraxinus excelsior* distinguish oneself with dry branches (pathogens and climate influence are the causes). Leaf of *Acer platanoides*, *Tilia cordata*, *Quercus robur*, *Populus x canadensis* and *P. tremula* were injured by fungi – pathogens and saprotrophes. The best status had plants of these species: *Quercus rubra*, *Sorbus aucuparia* (Table 2).

Plants of three species were injured by six species of fungal disease agents and fungi- saprotrophes – sooty mould agents, and four species of pests did harm on two species of woody plants growing at city forest park (Table 3).

**Table 3. Fungal disease agents and pests injuring woody plants growing at city forest parks, Lithuania (<sup>K</sup> – Kleboniškis forest park, <sup>M</sup> – Kaunas Lagoon regional park, <sup>P</sup> – Panemunės forest park, <sup>R</sup> – Romainiai forest park)**

Host plant	Year	Disease agents, pests	The average grade of damage
Diseases			
<i>Acer platanoides</i> L. <sup>K,M,P,R</sup>	2013	<i>Rhytisma acerinum</i> (Pers.) Fr.	0,89±0,47
	2014		1,00±0,46
	2014	<i>Sawadea tulasnei</i> (Fuckel) Homma (= <i>Uncinula tulasnei</i> )	0,11±0,62
<i>Quercus robur</i> L. <sup>K,M,P,R</sup>	2013	<i>Apiognomonina errabunda</i> (Roberto ex Desm.)	0,50±0,26
	2014	Höhn (=)	0,05±0,09
	2013	<i>Erysiphe alphitoides</i> (Griffon & Maubl.) U.	1,63±0,15
	2014	Braun & S. Takam. (= <i>Microsphaera alphitoides</i> )	2,06±0,18
<i>Tilia cordata</i> Mill. <sup>K,M,P,R</sup>	2013	<i>Mycosphaerella millegrana</i> (Cooke) J. Schröt.	1,36±0,33
	2014	(= <i>Cercospora microsora</i> Sacc., <i>Passalora microsora</i> (Sacc.) U. Braun)	2,00 ±0,3
	2013	<i>Didymosphaeria petrakiana</i> Sacc.	0,50±0,33
	2014		1,50±0,97
	2013	Sooty mould (agents: <i>Fumago</i> spp.,	1,89±0,3
	2014	<i>Cladosporium</i> sp. et al.)	2,80±0,3
Pests			
<i>Tilia cordata</i> Mill. <sup>K,M,P,R</sup>	2013	<i>Caliroa annulipes</i> (Klug 1816)	1,18±0,35
	2014		2±2,24
	2013	<i>Phyllonorycter issikii</i> (Kumata, 1963)	0,53±0,25
	2013		0,27±0,48
	2013	<i>Eucalipterus tiliae</i> (Linnaeus, 1758)	1,89±0,3
2014		2,80±0,3	
<i>Acer platanoides</i> L. <sup>K,M,P,R</sup>	2013	<i>Pristiphora subbifida</i> (C. G. Thomson 1871)	1,08±0,45
	2014		1,00±0,52

Detected six species of fungal disease agents: leaves of Norway maple (*Acer platanoides*) were injured by leaf spots agent *Rhytisma acerinum* and mildew (agent – *Sawadea bicornis*); leaves of common oak (*Quercus robur*) injured *Apiognomonina errabunda* and *Erysiphe alphitoides*; and small-leaved linden (*Tilia cordata*) – *Mycosphaerella millegrana*, sooty mould (agents: *Fumago* spp., *Cladosporium* sp. et al). Pests: *Caliroa annulipes*, *Phyllonorycter issikii* and *Eucalipterus tiliae* in-

jured small-leaved linden (*Tilia cordata*), *Pristiphora subbifida* – Norway maple (*Acer platanoides*) (Table 3).

Mildew agents are common pathogens of some Lithuanian woody plants. *Erysiphe alphitoides* in all of the constant monitoring spots injured *Quercus robur*, *Acer platanoides* was injured by mildew agent (*Sawadea tulasnei*), leaf spots also did injuries (agent – *Rhytisma acerinum*, annually spread in Lithuanian green plantations). *Tilia cordata* was noticed to have stronger injuries done by leaf spots (*Mycosphaerella millegrana*), sooty mould fungi and leaf spot (*Didymosphaeria petrakiana*) which have outspreaded in Lithuania during recent years. The last one mentioned above was mostly common only at Kleboniškis forest park, which is specific for its humid areas; humidity stimulates the spread of this leaf spot.

Widespread pest – aphid (*Eucalipterus tiliae*) harms linden directly by sucking juice from leaf tissues and also indirectly – coating leaves with honeydew, which appears to be a good substrate for sooty mould agents. Sooty mould fungi are found on leaves of all linden species but they are most abundant on *Tilia cordata*. The nutritional substrate here is produced not only by linden aphid (*Eucalipterus tiliae*), which appear on linden leaves at the beginning of summer in greater amount, but also the plant itself isolates organic substances under sudden changes in temperature (Sinclair et al., 2005). Sooty mould reside less in rainy summers, since heavy rains washes sugary substrate and mycelium away from the leaves. Densely growing trees, creating shadows on each other, create favorable conditions for the spread of sooty mould fungi.

Only at Romainiai forest park maple sawfly (*Pristiphora subbifida*) had spread itself and injured single trees by 3 grades. The increased occurrence of this pest began three years ago. Moth *Phyllonorycter issikii* injured *Tilia cordata* trees at Kleboniškis forest park and Panemunė pinewood park up to 3 grades, the intensity of these injuries have increased in recent years.

**Conclusions.** After the monitoring of woody plants (10 genus, 12 species) commonly growing at four of forest parks at the second largest Lithuanian city, there were assessed: trees were mostly injured by defoliation (average damage grade – 0–1.64); discolouration (0–1.39), number of dry branches at crowns (0–1.84). Detected 6 species of fungal disease agents: Norway maple (*Acer platanoides*) injured *Rhytisma acerinum*, *Sawadea bicornis*; common oak (*Quercus robur*) – *Apiognomonina errabunda*, *Erysiphe alphitoides*, small-leaved linden (*Tilia cordata*) – *Mycosphaerella millegrana*, *Didymosphaeria petrakiana* and sooty mould agents. Less pest damage were: *Caliroa annulipes*, *Phyllonorycter issikii*, *Eucalipterus tiliae* on small-leaved linden (*Tilia cordata*); *Pristiphora subbifida* on Norway maple (*Acer platanoides*).

#### References

- Index fungorum* [previewed 2015-03-20]. Access via the Internet <http://www.indexfungorum.org/>  
Hartmann G., Nienhaus F., Butin H., 1988. Farbatlas Waldsschaden: Diagnose von Baukrankheiten. Eugen Ulmer Verlag, Stuttgart, 256 p.  
*Fauna Europaea* [previewed 2015-03-20]. Access via the Internet <http://www.faunaeur.org/>  
Juodvalkis A., Vasiliaskas A. 2002. Drying Extent of Lithuanian Ash-tree Woods and Factors Predetermining it. *Vagos*, 56(9), p. 17–22. (in Lithuanian).  
Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forest, 1994. 3<sup>rd</sup> edition. Edited by the Programme Coordinating Centres Hamburg and Prague. 177 p.  
Sinclair W. A., Lyon H. H. 2005. Diseases of Trees and Shrubs. Ithaca and London, p. 660.  
Tatariūnienė A., Dringelis L., Ramanauskas A. et al. 2011. The urban environment: the natural environment. Kaunas city general plan of the current state analysis study. Kaunas T. 2, D, Vilnius, p.18–45. (in Lithuanian).

Research carried out under contract with the city of Kaunas Municipality Environmental Department (contract: No. 2013-07-30, SR-1537).