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THE STATE AND FUNCTIONALITY OF DENDROFLORA IN THE CEMETERIES IN OBRENOVAC

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Abstract: *Urban cemeteries represent important human-made special-purpose green areas. On the territory of the city area of the Municipality of Obrenovac, there are two urban cemeteries: the New Cemetery (Serbian: Novo Groblje) and the Old Cemetery (Serbian: Staro Groblje). The New Cemetery with an area of 5.4 ha is at 2.84 km west of the center and Staro Groblje with an area of 4.5 ha lies at 2 km from the city center.*

In the framework of the development of the Cadastre of Public Green Areas of the Municipality of Obrenovac, 29 woody species with a total of 271 trees were recorded in the New Cemetery. The Old Cemetery had 32 woody species recorded with a total of 348 trees. The paper studies the vitality, the ornamental value, as well as the functionality and adaptability of the species to the existing environmental conditions.

Keywords: dendroflora, Obrenovac, urban cemeteries, adaptability, vitality, ornamental value.

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STANJE I FUNKCIONALNOST DENDROFLORE NA GROBLJIMA U OBRENOVCU

Abstrakt: *Gradska groblja predstavljaju značajne antropogene zelene površine specijalne namene. Na teritoriji gradskog područja opštine Obrenovac nalaze se dva gradska groblja: Novo i Staro groblje. Na 2,84 km zapadno od centra nalazi se Novo groblje, površine 5,4 ha, na 2 km Staro groblje površine 4,5 ha.*

U okviru izrade Katastra javnih zelenih površina gradske opštine Obrenovac, na Novom groblju evidentirano je 29 drvenastih vrsta sa ukupno 271 stablom. Na Starom groblju evidentirane su 32 drvenaste vrste sa ukupno 348 stabala.

U radu je izvršena analiza vitalnosti, dekorativnosti, funkcionalnosti i adaptivnosti korišćenih vrsta na postojeće uslove sredine.

Ključne reči: dendroflora, Obrenovac, gradska groblja, adaptivnost, vitalnost, dekorativnost.

1. INTRODUCTION

Cemeteries are important elements of urban areas. Apart from cherishing the memory of the deceased and buried, urban cemeteries also represent important special-purpose green areas (Anastasijević, 2002; Vujković, 2003) with multiple benefits in terms of environmental protection. These areas, connected with other green areas of different categories, constitute the green structure of the city whose functions contribute to the healthier environment of the polluted urban area. The development of the Cadastre of Public Green Areas of the urban municipality of Obrenovac (Veselinović *et al.*, 2010) included the inventory of the urban cemetery dendroflora and the study of its state and the functionality.

There are two urban cemeteries on the territory of the urban area of the Municipality of Obrenovac – the New Cemetery and the Old Cemetery.

2. MATERIAL AND METHODS

Within the field surveys conducted in the area of the urban cemeteries, trees were identified in the field and recorded as point objects.

GPS locations were determined using a Trimble® GeoExplorer® series GPS device with the Microsoft® Windows Mobile™ 2003 software platform which communicates with the TruPulse 360 B laser distance meter produced by Laser Technology Inc. These two devices are paired using a Bluetooth connection. The Trimble licensed TerraSync™ software was used for the purpose of data collection. The type of greenery and the species of trees were determined in the field. If there were any doubts, dendrological material was collected (a leaf and a twig), and the species was subsequently determined using the identification key and literature data (Hessayonu, 2001; Hillier, 1982; Idžojtić 2009; Jovanović, 1985; Ocokoljić and Ninić-Todorović, 2003; Vidaković, 1982; Vukićević, 1996; Ward, 2001; Šijak, 2000).

The heights of trees, as well as the heights of trunks and the spread of crowns were measured using the TruPulse 360 B laser distance meter (Veselinović *et al.*, 2014).

The diameter of all trees was measured at `breast` height (1.30 m), using a caliper gauge. The diameter was determined as the arithmetic mean of two cross-measured tree diameters.

The presence and the type of damage were determined on the basis of the symptoms observed (Ćirković-Mitrović *et al.*, 2016). The damage was classified as mechanical, physiological, entomological or phytopathological based on which the vitality and the ornamental value were assessed.

The vitality of each individual tree was assessed according to the following evaluation scale by the method (literature):

- 1 – a seriously diseased, damaged or dead tree
- 2 – a severely diseased or damaged tree or a tree affected by decaying processes but still alive
- 3 – a vital tree that needs regular tending measures to survive
- 4 – a vital tree that needs occasional tending to survive
- 5 – a completely healthy tree, or a tree of exceptional vitality

Each individual tree was further assigned an ornamental value rating. In accordance with the standard characteristics specific for each individual species, the following method was used for the evaluation (literature):

- 1 – a tree without ornamental features
- 2 – a tree with poor ornamental features
- 3 – a tree with a standard habitus but with some defects
- 4 – a tree with very good ornamental features, a regular habitus and minor defects
- 5 – a tree with excellent ornamental features, an extremely well-developed habitus and without any visible defects in the appearance

In exceptional cases, trees without the distinguishable characteristics of a species had their ornamental value rated high because they are interesting and draw attention with a curved trunk, twisted branches and or some other characteristics that give an added value to the landscape.

The data collected in the field were transferred from the Trimble® GeoExplorer® series GPS device to the computer. The GPS Pathfinder® Office ver. 4.20 was used for this purpose. The data that were hand-written in purposeful tables were entered into the computer using Microsoft Office Excel 2007.

3. RESULTS AND DISCUSSION

The municipality of Obrenovac is located in the central part of the lower Kolubara River Basin and stretches between 44° 30' and 44° 43' N and 19° 58' and 20° 20' E. The largest part of the land is extremely flat.

The largest part of the Municipality of Obrenovac is located in the macro-alluvial fan of the Kolubara River. Alluvial fans are deposits of sediment that belong to a group of accumulative fluvial forms. Macro-alluvial fans were mainly formed during the Quaternary in a particularly humid climate. Obrenovačka Posavina makes the macro-alluvial fan of the Kolubara River pushing the Sava

River to the north about ten kilometers away from its initial flow below the Posavski Section. The macro-alluvial fan of the Kolubara with Tamnava covers a surface area of 288 km² (Dragičević and Karić, 2007).

According to the research of the Institute of Soil Science (2009), hydromorphic soils are the most frequent on the territory of the urban municipality of Obrenovac. The area is intersected by the flows of the Sava, Kolubara, Tamnava and Peštan Rivers with the alluvial soil, humofluvisol and humogley being the dominant soil types. The land on which the cemetery was built originally had the humofluvisol, but it has been altered by human activity.

The basic climatic characteristics of the Municipality of Obrenovac are determined by its geographical position, terrain and wide openness to the Pannonian Plain. Obrenovac is located almost in the middle of the north temperate zone, with a climate milder than the typical Pannonian, continental climate. It is characterized by humid continental climate with warm summers and cold winters. The average annual temperature in this area is around 11°C. It is around 22°C in summer and about -1°C in winter, with the maximum range between -28°C and 40°C. Because of its openness to the north, *i.e.*, the Pannonian Plain, the effects of the continental precipitation regime on the area of Obrenovac are evident. Cyclones cause maximum precipitation in late spring and early summer, with the secondary maximum of rainfall in late autumn. The annual amount of precipitation is about 640 liters of water per square meter. It is around 440 in dry years and 940 liters per m² in rainy years. During the year, the precipitation is highest in spring and late summer or early autumn. The study area has the surplus of water in the period from January to March, and from May, the evapotranspiration (ETP, ETR) exceeds the inflow of water from precipitation. The dry period, *i.e.* the water deficit ($D = ETP - ETR$) in the soil occurs in the period from June to September. In October, the water reserves in the soil are gradually being restored. Then, depending on the soil conditions and the precipitation regime, there is a surplus of water (S) which flows into rivers or groundwater either as surface runoff or through the soil (Veselinović *et al.*, 2010).

The New Cemetery is located in the western part of Obrenovac (Figure 1), 2.84 km away from the city center. It is at Rvaćanska bb, in Rvati settlement. It covers an area of 5.4 ha.



Figure 1. *The location of the New Cemetery and the Old Cemetery*

The Old Cemetery, measuring 4.5 hectares, is located in the western part of Obrenovac (Figure 1), 2 km from the city center, at 97 Nemanjina Street.

Table 1. *The participation of broadleaves and conifers in the New Cemetery and the Old Cemetery*

Vegetation type	The New Cemetery		The Old Cemetery	
	ind.	%	ind.	%
Broadleaves	174	64	53	15
Conifers	97	36	295	85
Total	271	100	348	100



Figure 1. *The position of the New Cemetery*

In the New Cemetery, 271 trees were analyzed (Figure 2), 174 of which were broadleaved and 97 coniferous species. There were 29 different tree species in total.

The most common wood species were *Tilia tomentosa* Mnch. with 40 individuals, *Betula verrucosa* Ehrh. with 37 seedlings and *Chamaecyparis lawsoniana* (Murr.) Parl. with 28 specimens. The ratio of the broadleaves to conifers was 64:36.

Table 2. Average values of the recorded tree parameters in the New Cemetery

S. n°	Species	Tree height (m)	Trunk height (m)	Trunk diameter (cm)	Crown spread (m)	Crown height (m)	Vitality score	Ornamental value
1	<i>Abies alba</i> Mill.	1.5	0.0	3.0	1.0	1.5	4.0	4.0
2	<i>Acer campestre</i> L.	6.5	1.4	17.5	3.6	5.1	4.0	4.0
3	<i>Acer pseudoplatanus</i> L.	3.4	1.2	10.3	2.2	2.3	4.0	3.7
4	<i>Aesculus hippocastanum</i> L.	4.7	1.3	13.7	3.2	3.3	3.0	3.0
5	<i>Betula verrucosa</i> Ehrh.	3.0	0.5	6.7	2.0	2.4	4.0	3.8
6	<i>Catalpa bignonioides</i> Walt.	2.0	1.5	4.0	1.0	0.5	3.7	3.9
7	<i>Cedrus atlantica</i> Man.	2.3	0.0	7.3	1.4	2.3	4.3	3.7
8	<i>Cercis siliquastrum</i> L.	1.5	0.0	3.0	1.5	1.5	3.0	2.0
9	<i>Chamaecyparis lawsoniana</i> (Murr.) Parl.	2.1	0.0	5.4	1.1	2.1	3.7	3.6
10	<i>Cupressus sempervirens</i> L.	5.0	0.0	10.0	1.0	5.0	4.0	4.0
11	<i>Fraxinus angustifolia</i> Vahl.	4.5	1.6	10.3	2.8	2.9	4.0	4.0
12	<i>Juglans regia</i> L.	7.0	1.5	41.0	7.0	5.5	3.0	3.0
13	<i>Juniperus scopulorum</i> 'Skyrocket' Sarg.	2.7	0.1	5.4	0.8	2.6	3.4	3.9
14	<i>Koelreuteria paniculata</i> Laxm.	2.0	0.5	4.0	1.5	1.5	4.0	3.0
15	<i>Libocedrus decurrens</i> Torr.	2.6	0.0	8.1	1.2	2.6	3.4	4.3
16	<i>Liriodendron tulipifera</i> L.	2.3	1.4	2.9	0.9	0.9	3.9	4.0
17	<i>Picea abies</i> (L.) Karst.	3.8	0.3	12.5	2.3	3.5	3.5	3.5
18	<i>Picea omorika</i> (Pančić) Purkyne.	2.0	0.0	7.0	1.0	2.0	4.0	4.0
19	<i>Picea pungens</i> Engelm.	2.5	0.0	5.0	1.2	2.5	4.0	3.0
20	<i>Pinus nigra</i> Arn.	3.6	0.7	16.6	2.6	3.0	4.0	4.0
21	<i>Platanus acerifolia</i> (Ait.) Willd.	5.0	1.0	1.5	4.0	4.0	5.0	5.0
22	<i>Platanus occidentalis</i> L.	8.3	1.7	23.3	4.3	6.7	3.0	3.0
23	<i>Prunus avium</i> L.	1.9	0.7	4.0	1.4	1.2	4.8	4.7
24	<i>Prunus pissardii</i> Ehrh.	2.1	0.2	4.5	1.4	1.9	4.2	4.2
25	<i>Quercus rubra</i> Michx f.	3.4	1.4	7.5	2.3	2.0	4.8	4.8
26	<i>Robinia pseudoacacia</i> L.	3.4	2.0	3.0	1.0	1.4	3.8	3.8
27	<i>Thuja orientalis</i> L.	1.8	0.0	4.3	0.7	1.8	4.1	4.1
28	<i>Tilia cordata</i> Mill.	3.5	1.3	14.0	3.5	2.3	3.5	3.5
29	<i>Tilia tomentosa</i> Mnch.	2.5	1.1	6.6	1.4	1.4	3.9	4.0

The average vitality score of woody species was 3.9. As many as 234 trees received the highest vitality rating (4 and 5). The species with the mean value of the vitality rating above the average were: *Abies alba*, *Acer campestre*, *Acer pseudoplatanus*, *Betula verrucosa*, *Cedrus atlantica*, *Cupressus sempervirens*, *Fraxinus angustifolia*, *Koelreuteria paniculata*, *Picea omorika*, *Picea pungens*, *Pinus nigra*, *Platanus acerifolia*, *Prunus avium*, *Prunus pissardii*, *Quercus rubra*, and *Thuja orientalis*.

Of the registered deciduous species, *Cercis siliquastrum* got the lowest average vitality rating, while *Juniperus scopulorum* 'Skyrocket' and *Libocedrus decurrens* were the conifers with the lowest vitality rating.

The ornamental value of woody species was scored with the average rating of 3.8. As many as 49 trees received the maximum rating for their ornamental value. The following species were rated 5: *Prunus avium* (17 trees), *Chamaecyparis lawsoniana* (10), *Libocedrus decurrens* (4), *Juniperus scopulorum* 'Skyrocket', *Quercus rubra* and *Tilia tomentosa* (3 trees each), *Betula verrucosa*, *Prunus pissardii* and *Thuja orientalis* (2 trees each) and *Cedrus atlantica*, *Pinus nigra* and *Platanus acerifolia* (1 tree each).

The species with both the vitality score and the ornamental value score above the average were: *Abies alba*, *Acer campestre*, *Cupressus sempervirens*, *Fraxinus angustifolia*, *Picea omorika*, *Pinus nigra*, *Platanus acerifolia*, *Prunus avium*, *Prunus pissardii*, *Quercus rubra* and *Thuja orientalis*.



Figure 3. The position of the Old Cemetery

The Old Cemetery had 348 trees analyzed (Figure 3), 53 of which were broadleaves and 295 conifers. There were 32 different tree species in total. The most common genus was *Picea* sp. with 3 species (*P. abies*, *P. omorika*, *P. pungens*). By far the most abundant woody species was *Thuja orientalis* with 166 trees. The ratio of broadleaves to conifers was 15:85.

Table 2. Average values of the recorded tree parameters in the Old Cemetery

S. n°	Species	Tree height (m)	Trunk height (m)	Trunk diameter (cm)	Crown spread (m)	Crown height (m)	Vitality score	Ornamental value
1	<i>Abies alba</i> Mill.	15.0	2.5	23.0	5.0	12.5	3.0	4.0
2	<i>Betula verrucosa</i> Ehrh.	10.5	2.9	24.3	5.6	7.7	3.7	3.7
3	<i>Carpinus betulus</i> L.	16.5	2.1	32.5	6.8	14.4	3.7	3.7
4	<i>Catalpa bignonioides</i> Walt.	9.0	2.1	25.5	7.8	6.9	4.5	4.5
5	<i>Cedrus atlantica</i> Man.	18.5	5.2	38.0	9.0	13.3	4.0	4.0
6	<i>Chamaecyparis lawsoniana</i> (Murr.) Parl	8.6	2.4	19.4	3.6	6.3	3.3	3.5
7	<i>Cupressus arizonica</i> Greene	10.0	1.9	24.7	4.2	8.1	3.3	3.4

S. n°	Species	Tree height (m)	Trunk height (m)	Trunk diameter (cm)	Crown spread (m)	Crown height (m)	Vitality score	Ornamental value
8	<i>Cupressus sempervirens</i> L.	10.3	2.0	21.9	3.4	8.3	3.3	3.4
9	<i>Gleditsia triacanthos</i> L.	13.6	2.5	29.4	7.0	11.1	4.0	4.0
10	<i>Juglans regia</i> L.	11.8	3.3	42.8	8.8	8.6	3.3	3.3
11	<i>Juniperus excelsa</i> Bieb.	5.2	1.4	16.0	3.3	3.8	3.3	3.3
12	<i>Juniperus scopulorum</i> 'Skyrocket' Sarg.	4.7	0.7	9.5	1.3	4.0	2.8	3.1
13	<i>Libocedrus decurrens</i> Torr.	5.0	2.2	8.0	2.8	2.8	3.0	4.0
14	<i>Magnolia x soulangeana</i> Soul.-Bod.	5.7	1.5	14.3	5.0	4.2	3.3	3.3
15	<i>Malus</i> sp. Mill.	5.0	2.0	11.0	3.5	3.0	3.5	3.0
16	<i>Picea abies</i> (L.) Karst.	6.8	2.2	16.1	4.0	4.6	2.8	2.7
17	<i>Picea omorika</i> (Pančić) Purkyne.	6.8	3.4	12.5	2.0	3.4	4.0	4.0
18	<i>Picea pungens</i> Engelm.	7.0	2.8	17.7	3.7	4.2	3.3	3.3
19	<i>Pinus nigra</i> Arn.	9.2	2.8	25.7	5.5	6.4	3.7	3.7
20	<i>Pinus sylvestris</i> L.	13.3	4.7	41.0	6.5	8.7	3.3	3.7
21	<i>Prunus avium</i> L.	8.0	1.3	25.0	4.8	6.8	3.5	3.5
22	<i>Prunus cerasus</i> Ehrh.	5.0	1.7	14.0	3.7	3.3	3.3	3.3
23	<i>Prunus persica</i> (L.) Batsch	3.0	1.7	6.0	3.0	1.3	3.0	3.0
24	<i>Pseudotsuga menziesii</i> (Mirbel.) Franco	9.8	2.6	21.8	4.3	7.2	3.2	3.5
25	<i>Pyrus communis</i> L.	5.3	1.7	17.3	4.0	3.7	3.3	3.3
26	<i>Quercus robur</i> L.	17.0	2.5	36.5	7.0	14.5	3.0	3.0
27	<i>Syringa vulgaris</i> L.	3.0	0	6.0	2.0	3.0	3.0	3.0
28	<i>Taxus baccata</i> L.	6.0	0.5	24.0	5.0	5.5	4.0	4.0
29	<i>Thuja occidentalis</i> L.	7.9	2.1	22.8	3.7	5.8	3.3	3.8
30	<i>Thuja orientalis</i> L.	5.9	1.6	13.9	3.3	4.2	3.1	3.2
31	<i>Tilia cordata</i> Mill.	9.9	2.8	30.6	8.0	7.1	2.8	3.6
32	<i>Tilia tomentosa</i> Mnch.	17.0	2.6	75.7	11.7	14.4	4.0	4.0

The average score of the vitality of woody species was 3.4. The following species received the maximum average vitality rating (4): *Cedrus atlantica*, *Gleditsia triacanthos*, *Picea omorika* and *Tilia tomentosa* (species with one or two individuals on the green area were excluded from the study). Two trees had their vitality rated 5 - *Catalpa bignonioides* and *Chamaecyparis lawsoniana*.

The species that had the mean score of vitality above the average were: *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Malus* sp., *Picea omorika*, *Pinus nigra*, *Prunus avium*, *Taxus baccata* and *Tilia tomentosa*.

The ornamental value of woody species was scored with the average rating of 3.5. The above-mentioned species with the maximum average vitality rating (4) also had the maximum average ornamental value rating (4). In total, 5 trees received the rating 5. Besides the common catalpa and Lawson cypress, 3 trees of *Thuja orientalis* had the greatest ornamental value. The following species had the mean rating of the ornamental value above the average: *Abies alba*, *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Libocedrus decurrens*, *Picea omorika*, *Pinus nigra*, *Pinus sylvestris*, *Taxus baccata*, *Thuja occidentalis*, *Tilia cordata* and *Tilia tomentosa*.

The species with both the vitality score and the ornamental value score above the average were: *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Picea omorika*, *Pinus nigra*, *Taxus baccata* and *Tilia tomentosa*.

Table 3. The average values of the registered parameters of tree species present at both the New Cemetery and the Old Cemetery

Loc.	Species	Tree height (m)	Trunk height (m)	Trunk diameter (cm)	Crown spread (m)	Crown height (m)	Vitality score	Ornamental value score	Number of individuals
New	<i>Abies alba</i>	1.5	0.0	3.0	1.0	1.5	4.0	4.0	2
Old		15.0	2.5	23.0	5.0	12.5	3.0	4.0	1
New	<i>Betula verrucosa</i>	3.0	0.5	6.7	2.0	2.4	4.0	3.8	37
Old		10.5	2.9	24.3	5.6	7.7	3.7	3.7	6
New	<i>Catalpa bignonioides</i>	2.0	1.5	4.0	1.0	0.5	3.7	3.9	10
Old		9.0	2.1	25.5	7.8	6.9	4.5	4.5	2
New	<i>Cedrus atlantica</i>	2.3	0.0	7.3	1.4	2.3	4.3	3.7	3
Old		18.5	5.2	38.0	9.0	13.3	4.0	4.0	4
New	<i>Chamaecyparis lawsoniana</i>	2.1	0.0	5.4	1.1	2.1	3.7	3.6	32
Old		8.6	2.4	19.4	3.6	6.3	3.3	3.5	22
New	<i>Cupressus sempervirens</i>	5.0	0.0	10.0	1.0	5.0	4.0	4.0	1
Old		10.3	2.0	21.9	3.4	8.3	3.3	3.4	12
New	<i>Juglans regia</i>	7.0	1.5	41.0	7.0	5.5	3.0	3.0	1
Old		11.8	3.3	42.8	8.8	8.6	3.3	3.3	6
New	<i>Juniperus scop. 'Skyrocket'</i>	2.7	0.1	5.4	0.8	2.6	3.4	3.9	7
Old		4.7	0.7	9.5	1.3	4.0	2.8	3.1	11
New	<i>Libocedrus decurrens</i>	2.6	0.0	8.1	1.2	2.6	3.4	4.3	11
Old		5.0	2.2	8.0	2.8	2.8	3.0	4.0	2
New	<i>Picea abies</i>	3.8	0.3	12.5	2.3	3.5	3.5	3.5	2
Old		6.8	2.2	16.1	4.0	4.6	2.8	2.7	29
New	<i>Picea omorika</i>	2.0	0.0	7.0	1.0	2.0	4.0	4.0	1
Old		6.8	3.4	12.5	2.0	3.4	4.0	4.0	4
New	<i>Picea pungens</i>	2.5	0.0	5.0	1.2	2.5	4.0	3.0	1
Old		7.0	2.8	17.7	3.7	4.2	3.3	3.3	3
New	<i>Prunus avium</i>	1.9	0.7	4.0	1.4	1.2	4.8	4.7	20
Old		8.0	1.3	25.0	4.8	6.8	3.5	3.5	2
New	<i>Thuja orientalis</i>	1.8	0.0	4.3	0.7	1.8	4.1	4.1	13
Old		5.9	1.6	13.9	3.3	4.2	3.1	3.2	166
New	<i>Tilia cordata</i>	3.5	1.3	14.0	3.5	2.3	3.5	3.5	2
Old		9.9	2.8	30.6	8.0	7.1	2.8	3.6	5
New	<i>Tilia tomentosa</i>	2.5	1.1	6.6	1.4	1.4	3.9	4.0	40
Old		17.0	2.6	75.7	11.7	14.4	4.0	4.0	6

Out of the total of 45 recorded species, 16 species occurred both in the New Cemetery and in the Old Cemetery. Only two coniferous species, *Picea omorika* and *Pinus nigra*, had the scores of vitality and ornamental value above the average at both sites. The average values of the mean tree and trunk heights, the diameter and crown spread were higher in the species at the site of the Old Cemetery, which was expected because the trees were older. On the other hand, the trees in the New Cemetery site had higher average scores of vitality and ornamental value because they were young and properly tended.

4. CONCLUSIONS

There are 45 species of trees identified at Obrenovac cemeteries. 15 of them are coniferous and 30 are broadleaved. The New Cemetery has 11 coniferous and 28 broadleaved species, while the Old Cemetery has 17 coniferous and 15

broadleaved species. Some specimens in the Old Cemetery have exceptional aesthetic value and represent true natural monuments. The diversity of species adds to the richness of colours of the area throughout the whole year.

The percentage ratio of broadleaved and coniferous species in the New Cemetery is 64:36, while it is 15:85 in the Old Cemetery.

Woody species that have the highest ratings are *Picea omorika* and *Pinus nigra*, so it can be concluded that they are best adapted to the environmental conditions in both cemeteries. In the New Cemetery, the species *Abies alba*, *Acer campestre*, *Cupressus sempervirens*, *Fraxinus angustifolia*, *Platanus acerifolia*, *Prunus avium*, *Prunus pissardii*, *Quercus rubra* and *Thuja orientalis* have shown extremely great adaptability. Based on the assessment of vitality and ornamental value, it can be concluded that *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Taxus baccata* and *Tilia tomentosa* have shown the best adaptability in the Old Cemetery.

Based on the above, it can be concluded that there are a large number of coniferous and broadleaved trees at the sites of the New and Old Cemeteries in Obrenovac, most of which have exceptional ornamental properties and represent special features of the green area of the urban core of Obrenovac.

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THE STATE AND FUNCTIONALITY OF DENDROFLORA IN THE CEMETERIES IN OBRENOVAC

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Summary

Cemeteries are important elements of urban areas, with multiple benefits in terms of environmental protection, connected with other green areas of different categories, constitute the green structure of the city whose functions contribute to the healthier environment of the polluted urban area.

There are two urban cemeteries on the territory of the urban area of the Municipality of Obrenovac. The New Cemetery is located in the western part of Obrenovac, 2.84 km away from the city center, covers an area of 5.4 ha. The Old Cemetery, measuring 4.5 hectares, located in the western part of Obrenovac, 2 km from the city center.

In the New Cemetery, 271 trees were analyzed, 174 of which were broadleaved and 97 coniferous species. There were 29 different tree species in total. The most common wood species were *Tilia tomentosa* Mnch. with 40 individuals, *Betula verrucosa* Ehrh. with 37 seedlings and *Chamaecyparis lawsoniana* (Murr.) Parl. with 28 specimens. The ratio of the broadleaves to conifers was 64:36.

The Old Cemetery had 348 trees analyzed, 53 of which were broadleaves and 295 conifers. There were 32 different tree species in total. The most common genus was *Picea* sp. with 3 species (*P. abies*, *P. omorika*, *P. pungens*). By far the most abundant woody species was *Thuja orientalis* with 166 trees. The ratio of broadleaves to conifers was 15:85.

Woody species that have the highest ratings are *Picea omorika* and *Pinus nigra*, so it can be concluded that they are best adapted to the environmental conditions in both cemeteries. In the New Cemetery, the species *Abies alba*, *Acer campestre*, *Cupressus sempervirens*, *Fraxinus angustifolia*, *Platanus acerifolia*, *Prunus avium*, *Prunus pissardii*, *Quercus rubra* and *Thuja orientalis* have shown extremely great adaptability. Based on the assessment of vitality and ornamental value, it can be concluded that *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Taxus baccata* and *Tilia tomentosa* have shown the best adaptability in the Old Cemetery.

In the area of research there are a large number of coniferous and broadleaved trees at the sites, most of which have exceptional ornamental properties and represent special features of the green area of the urban core of Obrenovac.

STANJE I FUNKCIONALNOST DENDROFLORE NA GROBLJIMA U OBRENOVCU

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Rezime

U gradskim sredinama, groblja predstavljaju značajne objekte sa svojim opštekorisnim funkcijama u smislu zaštite životne sredine povezane sa ostalim zelenim površinama različitih kategorija, i sačinjavaju zelenu strukturu grada koja svojim funkcijama utiče na zdravije okruženje zagađene gradske sredine.

Na teritoriji gradskog područja opštine Obrenovac nalaze se dva gradska groblja. Novo groblje se nalazi u zapadnom delu Obrenovca, 2,84 km od centra grada, ukupne površine 5,4 ha. Staro groblje, površine 4,5 hektara, se nalazi u zapadnom delu Obrenovca, 2 km od centra grada.

Terenskim istraživanjima na području gradskih grobalja drveće je evidentirano: na Novom groblju je analizirano 271 stabala, od čega je 174 liščarskih i 97 četinarskih vrste. Ukupno postoji 29 različitih vrsta drveća. Najzastupljenije drvenaste vrste su *Tilia tomentosa* Mnch. sa 40 jedinki, *Betula verrucosa* Ehrh. sa 37 sadnica i *Chamaecyparis lawsoniana* (Murr.) Parl. sa 28 primeraka. Odnos liščara i četinaraka je 64:36.

Na Starom groblju je analizirano 348 stabala, od toga 53 liščara i 295 četinaraka. Ukupno postoji 32 različitih vrsta drveća. Najprisutniji je rod *Picea* sp. sa 3 vrste (*P. abies*, *P. omorika*, *P. pungens*). Ubedljivo najzastupljenija drvenasta vrsta je *Thuja orientalis* sa 166 stabala. Odnos liščara i četinaraka je 15:85.

Drvenaste vrste koje imaju najviše ocene su *Picea omorika* i *Pinus nigra*, i može se konstatovati da su one najbolje adaptirane na uslove sredine na oba groblja. Na Novom groblju vrste: *Abies alba*, *Acer campestre*, *Cupressus sempervirens*, *Fraxinus angustifolia*, *Platanus acerifolia*, *Prunus avium*, *Prunus pissardii*, *Quercus rubra* i *Thuja orientalis* su pokazale izuzetno veliku adaptivnost. Na osnovu ocena vitalnosti i dekorativnosti može zaključiti da su vrste: *Betula verrucosa*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Gleditsia triacanthos*, *Taxus baccata* i *Tilia tomentosa*, pokazale najbolju adaptivnost na Starom groblju.

Na analiziranim grobljima zastupljen je veliki broj četinarskih i lišćarskih vrsta drveća, od kojih većina imaju izuzetna dekorativa svojstva i predstavljaju značaje zelene površine gradskog jezgra Obrenovca.