

## Horticultural evaluation of woody plants in the National Cemetery Martin, Slovakia

Gabriela Juhásová<sup>1</sup>, Katarína Adamčíková<sup>2</sup>, Marek Kobza<sup>3</sup>, Pavel Hrubík<sup>4</sup>,  
Katarína Serbinová<sup>5</sup>, Emil Hanzel<sup>6</sup>

Branch of Woody Plants Biology, Institute of Forest Ecology of the Slovak Academy of Sciences, Akademická 2,  
949 01 Nitra, Slovak Republic,

<sup>1</sup>E-mail: gabriela.juhasova@savzv.sk, <sup>2</sup>E-mail: katarina.adamcikova@savzv.sk, <sup>3</sup>E-mail: marek.kobza@savzv.sk

<sup>4</sup>Horticulture and Landscape Engineering Faculty of the Slovak University of Agriculture in Nitra, Tulipánová 7,  
949 01 Nitra, Slovak Republic, E-mail: Pavel.Hrubik@uniag.sk

<sup>5</sup>Borodáčová 15, 821 03 Bratislava, Slovak Republic

<sup>6</sup>Mesto Martin, Námestie S. H. Vajanského 1, 036 49 Martin, Slovak Republic

### Abstract

JUHÁSOVÁ, G., ADAMČIKOVÁ, K., KOBZA, M., HRUBÍK, F., SERBINOVÁ, K., HANZEL, E., 2007. Horticultural evaluation of woody plants in the National Cemetery Martin, Slovakia. *Folia oecol.*, 34: 9–15.

In this article we present the results of horticultural evaluation of woody plants in the National Cemetery in Martin. There have been evaluated 486 woody plants, representing 43 taxons from 25 species. The obtained data reveal that 265 woody plants are of a very low horticultural value, corresponding to the degrees 1 and 2; 192 of them are acceptable (degree 3), and 29 are of a high value (degree 5). The Pearson's correlation coefficient ( $r$ ) was used for expressing the relation between the horticultural value and size of the woody plants evaluated.

### Key words

horticultural evaluation, trees, shrubs, cemetery

### Introduction

The National Cemetery in Martin is the burial place for a number of important Slovak people. This Museum „in situ“ makes us remember leading personalities of Slovak literature, arts, sciences and political life, buried there from 1866 to 2003. The cemetery is situated near a catholic church, at place of a former burial site dated from the period of Great Moravia. In the spring 1860, the local residents built the fence and planted lindens.

The National cemetery is divided into six sectors A, B, C, D, E, F. Two pathways in shape of a V run between these sectors crossed with another two pathways running north-south. The pathways are bordered with lindens more than 140 years old (BEDNÁRIK, 1972; RÓZOVÁ and HALAJOVÁ, 2002; FERIANCOVÁ, 2003).

The National Cemetery in Martin is a unique architectonic monument, a distinguished sacral spot with

high lindens, ashes, birches, but also firs and spruces pointing to heaven – as if they wanted to recall the dignity and importance of the people buried here (BEDNÁRIK, 1972; RÓZOVÁ and HALAJOVÁ, 2002; FERIANCOVÁ, 2003).

Horticultural evaluation is one of basic activities in woody plants assessment in urban greenery. It is a part of the complex evaluation of woody plants and their life expectancy.

Full-grown greenery used in horticulture and landscape creation cannot be replaced at all or it can be replaced at rather long intervals (several decades). Dendrological classification and horticultural evaluation of woody plants is necessary for ensuring competent interventions and regulating the growth properly. Based on the data achieved in evaluation, we can judge about possibilities of maintenance and eventual reconstruction of the greenery concerned (SERBINOVÁ et al., 2006; HRUBÍK and MOCKOVÁ, 2006).

The aim of this contribution was to evaluate the dendrological structure and horticultural value of woody plants in the National Cemetery in Martin.

## Materials and methods

Horticultural and dendrological parameters were evaluated in all the woody plants. For each tree we have recorded the following data:

- genus and species,
- trunk circumference ( $d_{1,3}$  in cm) measured at a height of 130 cm above the ground or immediately under the tree branching if it is situated lower than at 130 cm,
- horticultural value (degree 1–5) expressing the overall quality of the woody plant in terms of its landscape value.

Examination of health state, perspective of development and visual aspects of a woody plant allows us to determine its horticultural value. Horticultural evaluation of woody plants was conducted using the methods developed by MACHOVEC (1982). We used a single ranking from 1 to 5, according to increasing quality.

The Pearson's product-moment correlation coefficient ( $r$ ) measures the power of linear dependence between two variables. It was used to describe the relation between horticultural value and size of woody plants.

## Results and discussion

### Dendrological structure of woody plants in the National Cemetery Martin

Fundamental qualitative and quantitative characteristics of the trees and shrubs were evaluated according to the methods described by MACHOVEC (1982), JUHÁSOVÁ et al. (2003). The names of woody plants follow the nomenclature by ČERVENKA et al. (1986). Together 486 woody plants representing 43 taxons and 25 genera occur in the evaluated site. The most frequent genera are *Picea* (30 exemplars), *Thuja* (190 ex) and *Tilia* (135 ex). On the other hand, the taxa *Fraxinus monophylla*, *Chamaecyparis pisifera*, *Juniperus virginiana*, *Larix decidua* and *Ilex aquifolium* are rare. The results of evaluation of woody plants in the National Cemetery in Martin are in Table 1. According to SUPUKA (2003), evidently dominant taxons in cemeteries are deciduous *Acer platanoides*, *Aesculus hippocastanum*, *Betula pendula*, *Tilia cordata* and *T. platyphyllos*, evergreen genera *Berberis*, *Hedera*, *Prunus*, *Mahonia* and coniferous *Thuja occidentalis*, *T. orientalis*, *Picea abies*, *P. pungens*. All these species or genera are present in the evaluated site, but in different numbers (Table 1). *Tilia cordata* (128 ex) was found the most abundant tree in the National Cemetery, not only in deciduous species, but in total, too. The second most abundant species was *Betula pendula*, present, however, in a much lower number (14 ex). *Thuja occidentalis*

Table 1. Dendrological structure of woody plants in the National Cemetery in Martin

Num. order	Taxon's name	Number of woody plants in each taxon	Circumference of trees (cm)	
			Min	Max
1.	<i>Acer platanoides</i> L.	5	28	75
2.	<i>Aesculus hippocastanum</i> L.	1		213
3.	<i>Berberis vulgaris</i> L. 'Atropurpurea'	2		
4.	<i>Betula pendula</i> (Roth)	14	32	188
5.	<i>Buxus sempervirens</i> L.	24		
6.	<i>Caragana arborescens</i> Lam.	5		
7.	<i>Cotoneaster Dammeri</i> Schneid.	2		
8.	<i>Forsythia europaea</i> Degen et Bald.	5		
9.	<i>Fraxinus excelsior</i> L.	6	134	264
10.	<i>Fraxinus monophylla</i> Desf.	1		116
11.	<i>Fraxinus ornus</i> L.	4		169
12.	<i>Hedera helix</i> L.	4		
13.	<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl.	11	30	90
14.	<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl. 'Erecta viridis'	1		

was the most abundant conifer (114 + 25 ex). The next dominant coniferous species in the National Cemetery were *Thuja orientalis* (37 ex) and *Picea abies* (19 ex).

Similar evaluation was done for the cemetery in Modra and for Slavín in Bratislava. There were found 254 woody plants in total, representing 38 species in the locality Modra. The most frequent coniferous species were *Thuja orientalis*, *Thuja occidentalis*, from deciduous it was *Acer platanoides*, *Fraxinus excelsior* and *Tilia* sp. (unpublished data). In Slavín

were evaluated 1,134 woody plants from 132 species. The most abundant species were *Acer platanoides*, *Fraxinus excelsior*, *Pinus nigra*, *Pseudotsuga menziesii*. The same coniferous genus (*Thuja* sp.) was found the most frequent abundant in Martin and Modra. *Tilia* sp. belongs to the most abundant deciduous in both cemeteries, but *Acer platanoides* and *Fraxinus excelsior* occur in different numbers, and they are numerous in Modra and Slavín.

Table 1. Continued

Num. order	Taxon's name	Number of woody plants in each taxon	Circumference of trees (cm)	
			Min	Max
15.	<i>Chamaecyparis pisifera</i> Siebold & Zucc.	2	48	60
16.	<i>Ilex aquifolium</i> L.	2	19	20
17.	<i>Juniperus communis</i> L.	5		
18.	<i>Juniperus communis</i> L. 'Hibernica'	1		
19.	<i>Juniperus chinensis</i> L.	2		
21.	<i>Juniperus squamata</i> Buch.-Ham. & D.Don 'Meyeri'	1		
22.	<i>Juniperus virginiana</i> L.	11	8	107
23.	<i>Larix decidua</i> Mill.	5	127	266
24.	<i>Ligustrum ovalifolium</i> Hassk.	2		
25.	<i>Ligustrum vulgare</i> L.	2		
26.	<i>Mahonia aquifolium</i> (Purch.) Nutt.	3		
27.	<i>Picea abies</i> (L.) Karst.	19	6	209
28.	<i>Picea glauca</i> (Moench) Voss 'Conica'	1		
29.	<i>Picea pungens</i> Engelm.	6	8	176
30.	<i>Picea pungens</i> Engelm. 'Argentea'	4	105	163
31.	<i>Pinus mugo</i> Turra	2		
32.	<i>Pinus sylvestris</i> L.	2	61	126
33.	<i>Prunus laurocerasus</i> L.	2		
34.	<i>Rosa</i> sp.	1		
35.	<i>Spirea van Houttei</i> (Briot). Zab.	1		
36.	<i>Thuja occidentalis</i> L. 'Malonyana'	25	3	75
37.	<i>Thuja occidentalis</i> L.	114	7	166
38.	<i>Thuja occidentalis</i> L. 'Ericoides'	1	69	
39.	<i>Thuja occidentalis</i> L. 'Aurea'	2	29	130
40.	<i>Thuja orientalis</i> L.	37	28	169
41.	<i>Thuja plicata</i> D. Don.	11	8	130
42.	<i>Tilia cordata</i> Mill.	128	16	379
43.	<i>Tilia platyphyllos</i> Acop.	7	55	417
44.	<i>Ulmus carpiniifolia</i> Gled.	1		345
45.	<i>Ulmus glabra</i> Huds.	1		207
Total		486		

### Horticultural value of woody plants in the National Cemetery in Martin

Horticultural value of woody plants was evaluated during the growing season 2004. From the total of 486 woody plants, 265 were evaluated with low degrees 1 and 2, 192 woody plants were found of medium quality (3 points), and 25 woody plants were evaluated with a high degree. The results of horticultural evaluation of woody plants in the individual sectors in the National Cemetery Martin are listed in Table 2; the results according to the taxons are in Table 3.

The three most numerous genera were subjected to correlation analysis – to examine the relation between the horticultural value and size of woody plants (*Tilia*, *Thuja* and *Picea*). The results are listed in Table 4. The interpretation of the Pearson's product-moment ( $r$ ) was done according to COHEN (1988). The general strategy for interpreting  $r$  value is to consider  $r < 0.1$  as trivial,  $r = 0.1-0.3$  as small,  $r = 0.3-0.5$  as medium and  $r > 0.5$  as large. In our case, the correlation between the horticultural value and size was found small (for *Tilia*) and medium (for *Picea* and *Thuja*).

Table 2. Summarised results of horticultural value of woody plants in the National Cemetery in Martin

Sector	Planting value					Total
	1	2	3	4	5	
A	17	51	49	12	2	131
B	32	35	36	2	0	105
C	22	40	46	0	1	109
D	17	10	30	1	0	58
E	6	13	17	3	1	40
F	16	6	14	4	3	43
Total	110	155	192	22	7	486

Number of trees in each category, 1 = lowest value, 5 = highest value

Table 3. Horticultural value of woody plants in the National Cemetery in Martin

Taxon's name/ Number of trees	Horticultural value				
	1	2	3	4	5
<i>Acer platanoides</i> L.	2	1	2	0	0
<i>Aesculus hippocastanum</i> L.	0	0	1	0	0
<i>Berberis vulgaris</i> L. 'Atropurpurea'	1	0	1	0	0
<i>Betula pendula</i> (Roth)	3	2	8	1	0
<i>Buxus sempervirens</i> L.	17	3	3	1	0
<i>Caragana arborescens</i> Lam.	1	1	3	0	0
<i>Cotoneaster Dammeri</i> Schneid.	0	0	0	2	0
<i>Forsythia europaea</i> Degen et Bald.	5	0	0	0	0
<i>Fraxinus excelsior</i> L.	3	1	2	0	0
<i>Fraxinus monophylla</i> Desf.	1	0	0	0	0
<i>Fraxinus ornus</i> L.	0	3	1	0	0
<i>Hedera helix</i> L.	4	0	0	0	0
<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl.	0	4	7	0	0
<i>Chamaecyparis lawsoniana</i> (A. Murr.) Parl. 'Erecta viridis'	0	0	1	0	0
<i>Chamaecyparis pisifera</i> Siebold & Zucc.	0	0	2	0	0
<i>Ilex aquifolium</i> L.	0	0	2	0	0

Table 3. Continued

Taxon's name/ Number of trees	Horticultural value				
	1	2	3	4	5
<i>Juniperus communis</i> L.	3	0	1	1	0
<i>Juniperus communis</i> L. 'Hibernica'	1	0	0	0	0
<i>Juniperus chinensis</i> L.	0	1	1	0	0
<i>Juniperus squamata</i> Buch.-Ham. & D. Don 'Meyeri'	0	0	1	0	0
<i>Juniperus virginiana</i> L.	7	2	1	1	0
<i>Larix decidua</i> Mill.	3	2	0	0	0
<i>Ligustrum ovalifolium</i> Hassk.	0	2	0	0	0
<i>Ligustrum vulgare</i> L.	2	0	0	0	0
<i>Mahonia aquifolium</i> (Purch.) Nutt.	0	3	0	0	0
<i>Picea abies</i> (L.) Karst.	2	6	9	1	1
<i>Picea glauca</i> (Moench) Voss 'Conica'	0	1	0	0	0
<i>Picea pungens</i> Engelm.	0	1	5	0	0
<i>Picea pungens</i> Engelm. 'Argentea'	0	0	3	1	0
<i>Pinus mugo</i> Turra	0	1	1	0	0
<i>Pinus sylvestris</i> L.	1	0	1	0	0
<i>Prunus laurocerasus</i> L.	2	0	0	0	0
<i>Rosa</i> sp.	1	0	0	0	0
<i>Spirea van Houttei</i> (Briot). Zab.	0	0	1	0	0
<i>Thuja occidentalis</i> L. 'Malonyana'	6	5	13	1	0
<i>Thuja occidentalis</i> L.	23	52	33	2	4
<i>Thuja occidentalis</i> L. 'Ericoides'	0	0	1	0	0
<i>Thuja occidentalis</i> L. 'Aurea'	0	0	0	2	0
<i>Thuja orientalis</i> L.	3	13	18	2	1
<i>Thuja plicata</i> D. Don.	0	3	7	1	0
<i>Tilia cordata</i> Mill.	19	47	56	6	0
<i>Tilia platyphyllos</i> Acop.	0	1	5	0	1
<i>Ulmus carpinifolia</i> Gled.	0	0	1	0	0
<i>Ulmus glabra</i> Huds.	0	0	1	0	0
Total	110	155	192	22	7

Planting value 1 = lowest value, 5 = highest value

Table 4. The results of correlation analysis between horticultural value and size of selected woody plants

Genus of woody plant	r
<i>Picea</i>	0.421206
<i>Thuja</i>	0.356686
<i>Tilia</i>	0.247772

r – Pearson's product moment correlation coefficient

$$r = \frac{\overline{xy} - \bar{x}\bar{y}}{s_x s_y}$$

Monumental trees are frequently planted very close to headstones and memorials. The primary function of the roots is mechanical support (fixing the plant in soil), sorption (uptake of water and soluble minerals from soil) and conduction (distribution of water and soluble minerals across the above-ground parts of the plant). Well functioning roots are very

important for appropriate sorption. Damaged roots disturb the physiological balance of trees that are weakened. Damaged roots caused withering of both thin and thick branches in the tree crowns.

## Conclusions

The presence of big and impressive trees in urban greenery, especially in greenery in cemeteries is connected with problems with their maintenance. According to our results obtained in evaluation of health of woody plants in the cemeteries in Modra, Levice, Nitra, similar problems arise when cultivating procedures (obstacles to appropriate maintenance, difficult access, climbing). A lot of dry branches in the crowns of mighty trees can break spontaneously and cause damage to memorials. Stems of trees with connected hollow spots can break on sloping terrain. Leaves falling down from deciduous and needles released by coniferous trees are one of the reasons why the memorials get dirty and why the trees are frequently required to be cut. We urgently recommend paying attention to appropriate treatment of woody plants in cemeteries, removing dry and damaged branches once a year at least, removal of broken branches clinched in tree crowns and checking occurrence of branches endangered by spontaneous splitting-off. It is necessary to pay attention to wounds from removal of healthy branches and prevent infection by parasitic fungi, bacteria, and other biotic harmful agents (by painting with special substances: Pellacol, Dendrosan balsam). Woody plants represent an indispensable constituent of cemeteries; therefore it is necessary to address the advocates of tree cutting and explain them patiently that the period of leaf-fall takes 10–14 days only. It is also necessary to rake over rotting leaves fading the solemn and stately mood of these pious places.

## Acknowledgement

This research was supported by the Grant Agency for Science VEGA Project No 2/7026/27.

## References

BEDNÁRIK, R. 1972. *Cintoríny na Slovensku* [Cemeteries in Slovakia]. Bratislava: SAV. 308 p.

COHEN, J. 1988. *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates. 567 p.

ČERVENKA, M., ČINČURA, F., JASIČOVÁ, M., ZÁBORSKÝ, J. 1986. *Slovenské botanické názvoslovie* [Slovak botanical nomenclature]. Bratislava: Príroda. 520 p.

HRUBÍK, P., MOCKOVÁ, Z. 2006. Restoration of the historic park in Dolná Krupá. *Acta hort. regiotecturae*, 9: 5–8.

FERIANCOVÁ, E. 2003. Národný cintorín v Martine [The National Cemetery in Martin]. In *Zborník Medzinárodné sympóziu Cintoríny, Nitra, 17–18. 10. 2003*. Nitra: Spoločnosť pre záhradnú a krajinnú tvorbu. 138 p.

JUHÁSOVÁ, G., SERBINOVÁ, K. 1997. Metódy hodnotenia zdravotného stavu drevín v mestskom prostredí [Methods for health state evaluation of woody plants in urban greenery]. In *Zborník zo seminára pestovanie a ochrana rastlín v mestskom prostredí, ošetrovanie chránených a pamätných stromov, Nitra, 27.–28. 5. 1997*. Nitra: Ústav ekológie lesa SAV, p. 40–69.

JUHÁSOVÁ, G., TKÁČOVÁ, S., KOBZA, M., NITRYIOVÁ, M. 2003. Výsledky hodnotenia zdravotného a kondičného stavu drevín v mestskom cintoríne v Nitre a návrh opatrení [The results of evaluation of health and constitutional state of woody plants in the urban cemetery in Nitra and proposed measures for treatment]. In *Zborník Medzinárodné sympóziu Cintoríny, Nitra, 17–18. 10. 2003*. Nitra: Spoločnosť pre záhradnú a krajinnú tvorbu, p. 75–82.

MACHOVEC, J. 1982. *Sadovnícká dendrologie* [Orchard dendrology]. Skripta. Lednice na Moravě: Vysoká škola zemědělská. 228 p.

RÓZOVÁ, Z., HALAJOVÁ, D. 2002. *Parková tvorba* [Creation of gardens]. Nitra: SPU. 131 p.

SERBINOVÁ, K., JUHÁSOVÁ, G., JECKOVÁ, J. 2006. Výsledky sadovníckeho hodnotenia drevín v Sade Janka Kráľa [Results of horticultural evaluation of woody plants in the Janko Kráľ Park] In JUHÁSOVÁ, G. *Výsledky revitalizácie historického parku Sad Janka Kráľa Bratislava-Petržalka. Zborník z cezhraničnej slovensko-rakúskej vedeckej konferencie*. Bratislava: ÚEL SAV Zvolen, Mestská časť Bratislava Petržalka, Magistrat der Stadt Wien, Proeuro s. r. o. Bratislava, p. 10–18.

SUPUKA, J. 2003. Dendrologické aspekty cintorínov [Dendrological aspects of cemeteries]. In *Zborník Medzinárodné sympóziu Cintoríny*. Nitra: Spoločnosť pre záhradnú a krajinnú tvorbu, p. 59–64.

## **Sadovnicke hodnotenie drevín v Národnom cintoríne v Martine**

### **Súhrn**

V práci sú uvedené výsledky sadovnickeho hodnotenia drevín v Národnom cintoríne v Martine v roku 2004. Hodnotili sme 486 drevín (stromov a kríkov), 43 taxónov z 25 rodov. Na základe získaných poznatkov konštatujeme, že 265 drevín má nízku sadovnicu hodnotu ocenenú 1 a 2 bodmi. Vyhovujúcu sadovnicu hodnotu (ocenenú 3 bodmi) má 192 drevín a vysokým bodovým hodnotením sme ocenili 29 drevín.

Na zistenie súvislosti medzi sadovnicou hodnotou a veľkosťou drevín sme použili Pearsonov korelačný koeficient ( $r$ ).

Received April 10, 2007

Accepted August 5, 2007