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Study of the richest gene pool of trees and shrubs in Slovakia, in the Mlyňany Arboretum SAS

Peter Hoťka[1], Marek Barta[2], Tomáš Bibeň[3]

Arboretum Mlyňany SAS, Vieska nad Žitavou 178, 951 52 Slepčany, Slovak Republic,
[1]e-mail: peter.hotka@savba.sk, [2]e-mail: marek.barta@savba.sk,
[3]e-mail: tomas.biben@savba.sk

Abstract

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An inventory of the gene pool of woody plants in the Arboretum Mlyňany SAS was carried out in years 2001–2011. The results were summarized in 2012 to provide a data base for complete digitalisation of the living collections. This work discusses the history of introduction activities in the Arboretum, aged 120 years to this date. There are compared the results of introduction among the essential phases of building the woody plant collections. We discuss the characteristics of introduction of evergreen woody plants by the count Ambrózy-Migazzi (1892–1914), the phases of development of the research area of this academic institution from the year 1953 to the climax in the last 1990s, as well as the current state of its living collections. There are outlined possibilities for introducing new species into this park object.

Key words

Inventory of Living Collections, Mlyňany Arboretum SAS

Introduction

The woody plant collections in the Arboretum Mlyňany date their origin 120 years ago. Established in conditions of the historical Austro-Hungarian Monarchy, later they represented one of the most important sources of the gene pool of Central European woody plants in frame of the former Czechoslovak Republic. Their importance has been maintained until today. Currently, the woody plant collections in the Arboretum Mlyňany of the Slovak Academy of Sciences belong to the leading ones of this type in Slovakia. Their relevance is primarily for science. They provide the source of the study material for investigation of the acclimation process in exotic woody plants and they also serve for educational and recreational purposes. Thank to the considerable diversity of the plant material assorted on individual original plots, the park subject is very attractive, visited by a large number of visitors, all the year around.

The collections in the Arboretum were progressively extended. The present state is the result of the philosophy applied at their establishment, and the following intensive and high-quality management. The Arboretum Mlyňany was built as an evergreen park by the count Štefan Ambrózy-Migazzi (with the slogan Semper Vireo – I am ever green), intended to assemble as much as possible evergreen and semi-deciduous woody plants in the understorey of the original forest stand consisting of the Turkey oak and hornbeam. It was an unprecedented idea – to introduce sempervirent species in the foothills of the Carpathians. Later, after the management of the collections which had been transformed to the Slovak Academy of Sciences, the project of sempervirent species introduction was extended with research of introduction and adaptation of all promising exotic woody plants and their assortment on so called phyto-geographic plots. The principal goal was to enrich the gene pool of domestic woody plants primarily with woody plants suitable for use in forestry and with woody plants suitable for use in settlement greenery and landscape creation, thanks to their high aesthetic values. The plant material in the Arboretum Mlyňany

was used in study of a number of scientific projects dealing with issues of taxonomy, ecology, physiology, genetics, phytopathology, garden and park architecture, landscape architecture and settlement greenery.

The overall inventories of the living collections of trees and shrubs carried out in the course of history of the Arboretum Mlyňany, mainly in occasions of its anniversaries, reflected the actual state of collections at the given moment and the results the institution had recorded in woody plant introduction to that moment. They outlined next possibilities for introduction activities. The results of the inventories should serve for creation of a comprehensive database for the cultivated assortment. There should also be carried out complete digitalisation of the data gathered in the field, supplementing the list of the grown woody plant taxa. For the upcoming years in the Arboretum Mlyňany SAS, such synthetic knowledge is critically important as it will facilitate the access to the collections for scientific purposes as well as for educational activities.

Material and methods

In the years 2001–2011, a series of inventories, were carried out in the individual departments of the Arboretum Mlyňany SAS, on the area of nearly 67 ha. The Arboretum consists of the original **Ambrózy evergreen park** (ca 40 ha, Departments P1 to P56), phyto-geographic plots and supplementary plots. The phyto-geographic plots comprise: **Plot of East-Asian woody plants** (ca 14 ha, Departments A1 to A23), **Plot of North-American woody plants** (ca 7.5 ha, Departments S1 to S7) and **Plot of Korean woody plants** (ca 4.5 ha, Departments K1 to K7), the other plots are the **Plot of autochthonous woody plants of Slovakia** (ca 1.5 ha, in parts of Departments P42, P43, P44, P45, P46, P48 and P51), **Rosarium** (ca 1 ha, a part of plot K6) and **smaller representative plots** (collection of decorative woody plant cultivars, a patch of conifers, a patch of sempervirent species and a bed of ever-flowering taxa).

The aim of the inventory was not only to identify the taxa on individual plots but also to identify their origin: agenda *Index seminum* (free exchange of seed material among botanical institutions at the global level), expedition activities, gift or purchase from decorative plant nurseries.

The assessment of the current condition of the woody plants in individual departments was carried out with using the results of the previous inventories, the works by Nábělek (1958), Benčať (1967), Tábor and Tomaško (1992), background data from the seed boxes (since 1959) and plant charts (Hoťka, 2004; Hoťka and Fogadová, 2008). The accent was also put on assessment of the results of introduction of individual woody plant groups (conifers, evergreen and semideciduous broadleaf and deciduous broadleaf species) in the individual periods of the history of the Arboretum Mlyňany: i) the period of the founder of the Arboretum and the period after his departure when the development of collections of sempervirent species was managed by the horticulturist Mr. Mišák (1894–1925), documented by Tábor and Tomaško (1992), ii) the period between WWI and WWII before incorporating the Arboretum in SAS (1926–1953), documented by Benčať (1967), iii) inventory of the flora in the Arboretum documented by Nábělek (1958), iv) the results of inventory at the 75-th anniversary of the establishment of the Arboretum Mlyňany documented by Benčať (1967), v) the results of inventory at the 100-th anniversary of the starting of the Arboretum Mlyňany documented by Tábor and Tomaško (1992), vi) results of the current inventory reflecting the development of collections after year 1993.

In this paper we present, apart from basic data (overall state of gene pool of woody plants), the results concerning the introduction of sempervirent and hiemirent taxa (evergreen and semievergreen woody plants).

In the text and tables, the plant categories are labelled with the following abbreviations: species – sp., subspecies – ssp., variety – var., forma – f., and cultivar – cv.

The number of taxa means the number of species and their infraspecific categories.

The botanical nomenclature used in this paper, during the recent inventory as well as during the preceding inventories, mostly follows Rehder (Rehder, 1949) and Krüssmann (Krüssmann, 1976, 1977, 1978 and 1983). The plant names in the text and in the tables are without abbreviations of their authors.

Results and discussion

The results of the recent inventory of the gene pool of trees and shrubs finished in 2012 are listed in Table 1.

Table 1. Taxonomic profile of the living collections of the Arboretum Mlyňany SAS in 2012

Category	Number	%
Species	1,107	57.3
Subspecies	11	0.6
Variety	180	9.3
Forma	18	0.9
Cultivar	617	31.9
Total	1,933	100.0

Comparisons of these results with the results of former inventories carried out in 1967 and 1992 show that the current number of taxa grown in the Arboretum today is by 250 less than in year 1992 (Tábor

and Tomaško, 1992), however by 275 more than in year 1967 (Benčať, 1967). The number of species (botanical species and hybrids obtained by cultivation) in year 2012 was by 360 less than in year 1992 (Tábor and Tomaško, 1992) and by 65 species less than in 1967 (Benčať, 1967) (Table 2).

Table 2. Comparison between results of current inventory and previous ones published in 1967 nad 1992

Year	1967	1992	2012
Family	78	93	83
Genus	272	294	235
Species	1,172	1,467	1,107
Subspecies	–	6	11
Variety	191	78	180
Form	58	5	18
Cultivar	237	627	617
Total	1,658	2,183	1,933

From the total number, the currently grown cultivars represent almost 32% of the woody plants assortment, while in 1992 it was 29% and in 1967 a little more than 14%. The number of cultivars in the Arboretum Mlyňany SAS has increased mainly thanks to the extension of the rosarium plot and introduction of new rose cultivars in 2004. The numbers of cultivars exhibit distinct increasing trends also in several other botanical collections in Slovakia and abroad thanks to constantly increasing numbers of ornamental cultivars that were given preference in many collections with the aim to give the expositions as much attractive look as possible. The raised number of cultivars in the recent inventory also reflects the changes in taxonomical classification of botanical items – today many of former varieties and forms are recognised as clones or cultivars. However, we have identified a number of botanical species. Today, the collections of the Arboretum Mlyňany SAS comprise 180 varieties of woody plants.

Since 1992, there have been several distinct changes, primarily concerning presence of families and selected genera (Table 2). Until 1992, the collections in the Arboretum contained in overall 93 woody plant families, by 10 more than their present number (83). The number of genera showed a decrease by 59 compared with the year 1992. This may be due to several fragile, mostly evergreen species experimentally introduced to the Arboretum from plant nurseries in 1992. Many of these species were extinct because they could not tolerate less favourable climatic conditions in the Arboretum. Another negative phenomenon was growing several, mainly monotypic genera in only a few exemplars. Such genera were the most vulnerable against adverse ecological conditions and also against flaws in the cultivation process. From the total number of 27 of very rarely cultivated woody plant taxa in the collections of the Arboretum, 20 are represented each only by one single living exemplar today (Hoťka, 2011).

In terms of woody plant groups – coniferous, evergreen, semi-deciduous and deciduous – dominant are deciduous broadleaf species, representing 1,333 taxa (69%, Table 3). As for the species, there are 822 from this group, representing 74% of the overall number of the species. The proportion of cultivars is almost 56% of the total number of growing cultivars.

The Arboretum Mlyňany SAS is extraordinary important, owing to the collection of evergreen and semi-deciduous woody plant taxa. Table 4 illustrates the presence of taxa in collections and provides historical data about introduction of this group of woody plants. The records from the period 1894–1925 need not fully correspond to the state at that time as they seem to be

Table 3. Categories of trees and shrubs growing in the Arboretum Mlyňany SAS in 2012

Group	sp.	ssp.	var.	f.	cv.	Total	%
Conifers	131	4	14	7	171	327	16.9
Broad-leaved							
(Semi-) Evergreens	154	0	15	3	101	273	14.1
Deciduous trees and shrubs	822	7	151	8	345	1,333	69.0
Total	1,107	11	180	18	617	1,933	100.0

Table 4. Summary of broad-leaved evergreens and semievergreens introduction in the Arboretum Mlyňany

Period	1894–1925	1926–1952	1958	1953–1967	1968–1992	1993–2012
Families	48	22	28	39	38	26
Genera	104	44	53	90	85	56
Species	236	74	106	225	251	154
Taxa	248	123	126	291	408	273

only records made by the founder of the Arboretum, the count Ambrózy-Migazzi and the gardener Mr. Mišák, concerning the purchase of woody plants from nurseries in Europe and transport from nurseries in Bohemia by gardener Mišák.

Today, the plant collections in the Arboretum contain altogether 273 taxa of semperviren and hiemivirent taxa of woody plants, which makes 14% of the total number of the taxa cultivated in the Arboretum. In year 1992, there were 408 taxa of this group representing more than 18% of the total. The decrease by 135 units compared with the year 1993 was probably due to the changes in the management of collections after 1993. The decrease in the number of cultivated genera was considerable – by 29, the decrease in the species number represented 97. The number of cultivars grown in this group of woody plants is very low compared to the number of coniferous and deciduous broadleaf cultivars – only little more than 16%, which is not favourable for the collections in 2012.

The history of building the woody plant collections has recorded several trials with introduction of a wide range of evergreen and semi-deciduous woody plants. From the families and genera grown in the individual periods of the collections history but not recorded (present) in the next inventories, there are worth of noting (in bold):

a) in the period 1894–1925: **Bignoniaceae (*Bignonia*)**, Caprifoliaceae (***Linnaea***), Compositae (***Cassinia***, ***Olearia***), Ericaceae (***Arctostaphyllos***, ***Epigaea***, ***Leiophyllum***), **Flacourtaceae** (***Azara***, ***Idesia***), **Garryaceae** (***Garrya***), **Iteaceae** (***Itea***), Labiatae (***Phlomis***), Leguminosae (***Ulex***), Philadelphaceae (***Carpenteria***), **Polygalaceae** (***Polygala***), Rosaceae (***Cercocarpus***), Rutaceae (***Choisya***), **Trochodendraceae** (***Trochodendron***), **Violaceae** (***Hymenanthera***)
b) in the year 1958 (one species): Myricaceae (***Myrica cerifera***)
c) in the period 1953–1967: Araliaceae (× ***Fatshedera***), **Casuariniaceae** (***Casuarina***), Cistaceae (***Helianthemum***), Cornaceae (***Corokia***), Hamamelidaceae (***Loropetalum***), Labiatae (***Teucrium***), Lauraceae (***Cinnamomum, Persea***), Leguminosae (***Ceratonia***), Loranthaceae (***Viscum***), Myrtaceae (***Acca, Eucalyptus, Myrtus***), Oleaceae (***Olea***), Palmae (***Chamaerops***), Ranunculaceae (***Clematis***), Rosaceae (***Rhaphiolepis***), **Schisandraceae** (***Schisandra***), Scrophulariaceae (***Penstemon***, ***Phygelius***)
d) in the period 1968–1992: Berberidaceae (× ***Mahoberberis***), Compositae (***Santolina***), **Daphniphyllaceae** (***Daphniphyllum***), Elaeagnaceae (***Elaeagnus***), **Empetraceae** (***Empetrum***), Ericaceae (***Andromeda***, ***Arbutus***, ***Arcterica***, ***Bruckenthalia***, ***Calluna***, ***Cassiope***, ***Chamaedaphne***, ***Daboecia***, ***Gaulnettya***, ***Kalmiopsis***, ***Pernettya***, ***Phyllodoce***, ***Vaccinium***), **Escalloniaceae** (***Escallonia***), Graminae (***Shibataea***), Hamamelidaceae (***Distylium***), Lauraceae (***Umbellularia***), Leguminosae (***Genista***), Liliaceae (***Danae***), **Myrsinaceae** (***Ardisia***), **Myrtaceae** (***Callistemon***), Rhamnaceae (***Rhamnus***), Rosaceae (***Dryas***, ***Rubus***), Schisandraceae (***Kadsura***), **Theaceae** (***Camellia***).

Table 5. Genera of broad-leaved evergreens and semi-evergreens successfully cultivated in the Arboretum Mlyňany up to the present time

Family	Genus	Number of taxa in the period			
		1894–1925	1953–1967	1968–1992	1992–2012
Apocynaceae	*Vinca*	2	2	5	6
Aquifoliaceae	*Ilex*	10	10	40	23
Araliaceae	*Hedera*	2	2	28	6
Berberidaceae	*Berberis*	13	7	36	21
	Mahonia	11	3	6	6
Buxaceae	*Buxus*	4	4	19	18
	Pachysandra	1	1	2	2
Caprifoliaceae	*Abelia*	1	1	1	1
	Lonicera	8	12	9	12
	Viburnum	5	8	9	9
Celastraceae	*Euonymus*	3	6	13	15
Cistaceae	*Cistus*	1	3	1	1
Cornaceae	*Aucuba*	1	3	3	3
Cruciferae	*Iberis*	1	1	5	1

Table 5. Genera of broad-leaved evergreens and semi-evergreens successfully cultivated in the Arboretum Mlyňany up to the present time – continued

Family	Genus	Number of taxa in the period			
		1894–1925	1953–1967	1968–1992	1992–2012
Ericacea	*Erica*	8	12	1	1
	Kalmia	3	2	3	2
	Leucothoe	2	1	3	1
	Pieris	3	2	7	6
	Rhododendron	21	52	39	39
Fagaceae	*Quercus*	6	5	9	5
Hypericaceae	*Hypericum*	6	5	9	3
Labiatae	*Lavandula*	1	1	4	1
	Salvia	1	1	1	2
Liliaceae	*Ruscus*	2	2	3	2
	Yucca	6	1	4	2
Oleaceae	*Ligustrum*	6	8	7	6
	Osmanthus	2	2	2	3
	Phillyrea	2	4	3	2
Rosaceae	*Cotoneaster*	9	20	24	15
	Prunus	2	10	16	11
	Pyracantha	3	5	11	8
	Stranvaesia	2	3	4	3
Rutaceae	*Skimmia*	3	3	3	5
Thymelaeaceae	*Daphne*	5	4	2	1

On the other hand, over the whole history of the Arboretum, the introduction of sempervirent and hiemivirent species was successful with representatives of 19 families and 34 genera, mostly taxa of the genera *Ilex*, *Berberis*, *Buxus*, *Lonicera*, *Euonymus*, *Rhododendron*, *Cotoneaster* and *Prunus* (Table 5).

The potential of the development of the collections in the future is huge. The diversity of assortment grown in the leading arboretums is substantially higher. For comparison: in 2012, the Arboretum Mlyňany SAS, with its area of ca 67 ha comprised in summary 1,933 woody plant taxa (1,107 species), while several years ago, in the Arnold Arboretum of the Harvard University (USA) with an area of 132 ha there were 3,926 taxa (1,937 species) (Anonymus, 1999) and in an arboretum in Washington (Washington Park) with an area 81 ha even 4,605 taxa (Mulligan, 1977).

The high potential for introduction of new species in the Arboretum Mlyňany is also evident from the data according Krüssmann (Krüssmann, 1976, 1977, 1978 and 1983) who provides summary of the high taxonomic diversity of the gene pool of woody plants suitable for introduction in conditions of the moderate climatic zone (Fig. 1).

In the number of genera of coniferous species, the Arboretum Mlyňany SAS currently manifests only one half of their introduction potential. There are possible to introduce more than 470 additional species, the current proportion of conifers in the Arboretum is a bit more than 21%. Even more possibilities are for introduction of broadleaf woody plants with 590 additional possible genera with more than 4,500 species. The current state in the Arboretum is only cca 18% of potentially suitable broadleaf woody plants. This potential introduction does not include varieties of the two groups – coniferous and broadleaf woody plants (evergreen, semi-deciduous, deciduous).

Clearly, it is also necessary to keep in mind that individual species and lower-than-species level taxa in the individual genera differ in their acclimation capacity. This means that the actual numbers of the species and of infra-specific taxa suitable for the Arboretum Mlyňany SAS may be somewhat lower. Nevertheless, the potential of future introduction maintains huge.

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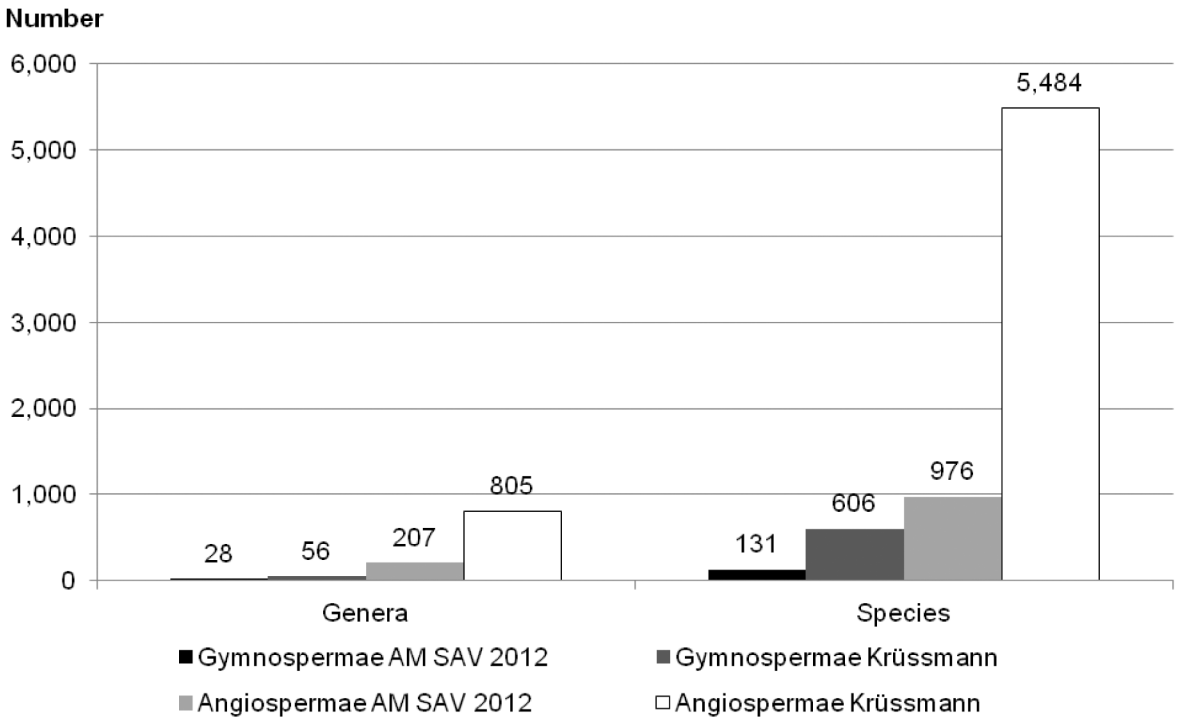

Fig. 1. Comparison between the recent numbers of genera and species of coniferous and broad-leaf trees and shrubs cultivated in the Arboretum Mlyňany SAS and the potential for introducing new plants according to Krüssmann (1976, 1977, 1978 and 1983).

droflora in Mlyňany Arboretum SAS and Project VEGA No. 2/0159/11 *Adaptability of selected evergreen woody plants and their possible uses in garden and landscape architecture*.

References

Anonymus 1999. *Inventory of living collections*. Compiled by the Living Collections Department of the Arnold Arboretum, The Arnold Arboretum of Harvard University. Jamaica Plain, Mass. 175 p.

Benčať, F. 1967. *Dendroflóra Arboréta Mlyňany. Prehľad a stručná analýza* [Dendroflora of the Arboretum Mlyňany. Survey and short analysis]. Bratislava: Vydavateľstvo Slovenskej akadémie vied. 122 p.

Hoťka, P. 2004. Novointroducenty čínskej dendroflóry v Arboréte Mlyňany introdukované v rokoch 1960–1965 [New-introduced taxa of Chinese dendroflora in the Arboretum Mlyňany, years 1960–1965]. In Supuka, J. (ed.). *Sídlo – park – krajina III. Krajinno-architektonická tvorba a vegetačné prvky v sídlach a krajine. Zborník referátov KZKA, 06/12/04, SPU v Nitre. Konferencia s medzinárodnou účasťou*. Nitra: SPU, p. 139–143.

Hoťka, P. 2011. Sortiment vzácnych taxónov drevín v Arboréte Mlyňany SAV [Assortment of rare woody plant taxa in the Arboretum Mlyňany SAS]. In Barta, M., Konôpková, J. (eds). *Dendrologické dni v Arboréte Mlyňany SAV 2011. Aktuálne otázky štúdia introdukovaných drevín. Zborník referátov z vedeckej konferencie. Arborétum Mlyňany SAV, 22. november 2011.* Vieska nad Žitavou: Arborétum Mlyňany SAV, p. 60–65.

Hoťka, P., Fogadová, K. 2008. Výsledky a zhodnotenie expedície do Číny realizovanej pracovníkmi Arboréta Mlyňany SAV v roku 1960 [Evaluation of the results of an expedition to China, organised by researchers from the Arboretum Mlyňany SAS in year 1960]. In Barta, M., Hoťka, P., Vozáriková, M., Šusták, R. (eds). *Dendrologické dni v Arboréte Mlyňany SAV 2008. Autochtónne a alochtónne dreviny v zmenených podmienkach prostredia. Zborník abstraktov z vedeckej konferencie. Arborétum Mlyňany SAV, 15. – 16. október 2008.* Vieska nad Žitavou: Arborétum Mlyňany SAV, p. 44–56.

Krüssmann, G. 1976. *Handbuch der Laubgehölze. Band I., A–D*. Berlin: Paul Parey. 486 p.

Krüssmann, G. 1977. *Handbuch der Laubgehölze. Band II., E–Pro*. Berlin: Parey. 466 p.

Krüssmann, G. 1978. *Handbuch der Laubgehölze. Band III., Pru–Z*. Berlin: Parey. 494 p.

Krüssmann, G. 1983. *Handbuch der Nadelgehölze*. Berlin: Parey. 396 p.

Mulligan, O.B. (ed.). 1977. *Woody plants in the University of Washington Arboretum*, *Washington Park*. Seattle: University of Washington, College of Forest Resources. 183 p.

Náběleк, F. 1985. Květena Arboreta Mlyňany. In Benčať, F. (ed.). *Prírodné podmienky Arboréta Mlyňany* [Natural conditions in the Arboretum Mlyňany]. Bratislava: Vydavateľstvo Slovenskej akadémie vied, p. 9–77.

Rehder, F. 1990. *Manual of cultivated trees and shrubs hardy in North America*. Portland, Oregon: Dioscorides Press. 996 p.

Tábor, I., Tomaško, I. 1992. *Genofond a dendroexpozície Arboréta Mlyňany* [Gene pool and dendroexposition of the Arboretum Mlyňany]. Arborétum Mlyňany – Ústav dendrobiológie SAV. 118 p.

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