

General knowledge of Chinese woody plant introduction in the Arboretum Mlyňany SAS

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Abstract

The contribution sums up the original results of Chinese woody plants introduction into the conditions of the Arboretum Mlyňany SAS. There is detailed analysis of the primary conception of the founder with the evergreen woody plants introduction and further results of East-Asian woody plants introduction directed scientifically. The very important point was the collecting expedition to China in 1960. The seed collections from regions of Hang-tschou, Quilin, Wuhan and Nanking, and foremost from the area of Tien Mu were the basis of new East-Asian dendroflora exposition and also experimental area of Chinese dendroflora. The contribution evaluates also the whole acclimatization process and recent survival of these woody taxa in collections. The most important results of scientific research obtained during the woody plant introduction in the Arboretum Mlyňany SAS are also referred to.

Introduction

Complex, scientifically controlled introduction of woody plants began at the end of the 19th century. The results are sites that have maintained their national or Central-European significance, such as Arboretum Mlyňany SAS. The founder of the Arboretum Mlyňany, Dr. Stefan Ambrozy-Migazzi, is considered as a pioneer of decorative evergreens' introduction into the continental conditions of Central Europe. The scientific research plan of the Institute of Dendrobiology of the Slovak Academy of Sciences was later developed on the basis of the Arboretum Mlyňany. Predominant among the many research projects was the experiment with Chinese woody plants introduction into the conditions of Arboretum Mlyňany SAS.

Material and methods

The plant material investigated was Chinese woody plant species growing in the Ambrozy's Park and East Asian Area of Arboretum Mlyňany and also in the Phenological section (called also experimental area of Chinese dendroflora).

The study of Chinese woody plants increases was based on:

- original records of Ambrozy-Migazzi and Misak.
- The Book of Seeds (volumes from 1959).
- inventories made at Arboretum Mlyňany SAS.

Other subjects evaluated were:

- 60 processes and horticultural methods used in propagating and growing the plants that were collected in China.
- harsh winters and their impact on Chinese woody plants species
- overview of the most important scientific works of the Institute of Dendrobiology

Results and Discussion

Beginning of the Chinese woody plants introduction in Arboretum Mlyňany

The founder, Dr. Ambrozy-Migazzi, was impressed with evergreen mediterranean dendroflora and wanted to create an evergreen park. He took into consideration

- the continental climate impact in Mlyňany with summer droughts and hard frosts in winters (Ambrozy-Migazzi 1921),
- the stepwise introduction theory,
- contacts with Camillo Schneider and Arnost Silva-Tarouca and many other botanists and dendrologists,
- knowledge about the plant material of the nurseries of Hesse, Späth, Simon Louis, Seidel, Böhlje a many others,

By the end of 1914 hundreds of woody plants were planted in the park. Except for dominant woody plants as *Ilex aquifolium* (this woody plants is in the sign of institution) many others,

In 1914, with the outbreak of World War I. and the departure of Dr. Ambrozy-Migazzi, the decrease of woody plants planted began, but by 1925 there were almost 250 evergreen woody plants taxa in the area of 40 ha park.

Number of Species	Origin (China)	Origin Asia	Origin Europe	Origin America	Other Areas
247	98 (62)		79	54	16
100 %	40 % (25 %)		32 %	22 %	6 %

Table 1. Overview of the evergreen woody plants introduction in Arboretum Mlyňany - 1894-1925.

Between the world wars there was a considerable decrease in the number of cultivated taxa in Arboretum Mlyňany.

Expedition to China and study of Chinese woody plants acclimatization

On 1. January, 1953, Arboretum Mlyňany was included in the institution of Slovak Academy of Sciences. The phenological observations and seed collecting for *Index seminum* began.

The researchers of Dendrobiology Institute have:

- summed up results achieved in the woody plants introduction to Czechoslovakia (Benčat' 1959),

- elaborated new targets of East Asian woody plants introduction as the main priority (Benčať 1961),
- created the new areas in the park for planting of new introduced material according the phytogeographical principle (Tomaško 1963).

The expedition to China in 1960:

- took place in September and October of 1960 by the former director Benčať and the chief gardener Kovalovský,
- the journey was from Irkutsk to Charbin and to Beijing and further to Wuhan and to Cheng-Jang. From Cheng-Jang journeys were made to Kanton, Quilin and Nanking. From Cheng-Jang to Hangtschou with the stop in the nature reserve Tien Mu and next from Shang-hai to Su-tschou and Beijing. From Beijing to Ulanbatar and Irkutsk.
- By 1961 seed material begun to arrive from original Chinese areas. The peak of introduction was reached in 1964.

Year	1961	1962	1963	1964	1965	1966
No. of Species	295	145	345	347	125	143

Table 2. Number of chinese woody species introduced to Arboretum Mlyňany - 1961-1966

The seed material was registered in the Book of seeds and it got an evidentiary number.

Area	Peking	Wuhan	Quilin	Lushan	Nanking	Hangtschou	Kanton	AM
No. of Taxa	408	34	65	162	241	30	7	453

Table 3. Number of Chinese woody taxa with respect to place of collection - 1961-1966

The young specimen were planted in:

- Ambrozy's Park (40 ha),
- East Asian Area according to phytogeographical principle by the project of Tomaško (14 ha),
- Phenological Section (0,5 ha).

In 1965 the results of inventory were published but without the taxa growing on East Asian Area and on Phenological Section.

No. of Species	Origin (China)	Origin Europe	Origin America	Other Areas
1245	549 (341)	140	251	305
100 %	44,1 % (27,4 %)	11,2 %	20,2 %	24,5 %

Table 4. Woody plants species represented according to phytogeographical areas in Arboretum Mlyňany in 1965

The 341 Chinese woody species represented 19 species of conifer, 85 of evergreen or semi-evergreen species and 237 deciduous species (without number of subspecies, varieties, forms and cultivars).

Propagating and growing plants collected in China

After the expedition to China the 3rd phase of younger introduction began. The aim was to study the plasticity of climatic-ecologically amplitude of Chinese woody plants due to the transfer of seed material. Most of the previous knowledge about the ecological response of Chinese woody plants in our conditions was obtained from the plant material study of unknown origin (Benčat' 1973).

The plant collections of Tien Mu preserve was selected on the basis of the survey in China in 1960 and also atheoretical analysis of reciprocal potential and plant collections introduced previously into the conditions of basic dendrological institutions in former Czechoslovakia (Pruhonice, Kysihybel, Arboretum Mlyňany) The comparison of local conditions in Tien Mu and in Arboretum Mlyňany can be seen in Table 5.

Site	Latitude	Elevation	Tmean	T(I.)	Tmin.	T (VII.)	Tmax.
Tien Mu	31° 10'	550-1 400	14 °C	2 to -4 °C	-5 °C to -15 °C	20 to 28 °C	35 to 38 °C
Mlyňany	48° 19'	159-217	9 °C	-1,8 °C	-2 °C to -32 °C	18,7 °C	35 to 37 °C

Table 5. Comparison of the Latitude, Elevation, annual mean temperature (Tmean), Mean temperatures in January and July, and recorded highest maximum and lowest minimum temperatures in Tien Mu and Arboretum Mlyňany (long-term means)

Seeds were sown according to certain or supposed resistance levels either:

- directly on the field,
- in coldframes,
- in hotbeds,
- in greenhouses.

The temperature was controlled carefully. The hardening-off of seedlings was made in the way of a new conditions moderation according the ecological requirement in the original area during the first winters. Also winter shelter was made for the seedlings on the field.

After the valuable seed material from previous introduced taxa was obtained there begun the selection of the seedlings from the more resistant population.

In the autumn of 1965 a new classification of young plant material was carried out as follows:

- species suitable to plant without winter shelter
- species suitable to plant with only with winter shelter
- species which should be overwintered in the coldframes
- species which should be overwintered in the hotbeds (temperature higher than -3 °C)
- species which should be overwintered in greenhouses (temperature higher than 0 °C)

The purpose was the preservation of each species so that selected seedlings were growing in the conditions of more moderate conditions in the case of loss of other seedlings.

The evaluation of the seedlings overwintered was done usually in each Spring with application of the Nine Frost Damage Characteristic Scale used usually in the former research works of the Soviet researchers.

Level	Frost Damage Characteristic	Frost Resistance Level
A.	Without Damage	I. Plants totally frost resistant
B.	Leaves or winter-buds frozen	II. Plants partially frost resistant
C.	Ends of one-year old shoots frozen	
D.	One-year old shoots completely frozen	
E.	Two-year old shoots completely frozen	III. Plants with low frost resistance
F.	Three-year old shoots completely frozen	
G.	Plant frozen to the snow surface	IV. Plants with very low frost resistance
H.	Plant frozen to ground but springing up	
I.	Plant completely frozen	V. Frost susceptible plants

Table 6. Frost damage characteristic and frost resistance level of woody plants evaluated in Arboretum Mlyňany

The nine frost damage characteristics served for inclusion of the investigated Chinese woody plants into five frost resistant levels (according to Vasiljev, Sokolov and Gursky).

During this experiment with autochthonous Chinese woody plants 99 woody taxa were introduced into the conditions of former Czechoslovakia for the first time (Benčat' 1973).

Present State and Perspectives of Chinese Woody Plants Introduction

In 1992 Arboretum Mlyňany SAS celebrated its centenary and a broad inventory of plant collections was carried out (Tábor, Tomaško 1992).

No. of Species	Origin (China) Asia	Origin Europe	Origin America	Other Areas
1405	850 (423)	210	272	73
100 %	60,5 % (30,1 %)	14,9 %	19,4 %	5,2 %

Table 7. Woody plants species represented according to phytogeographical areas in Arboretum Mlyňany in 1992

The number of 423 chinese woody species represented 18 species of conifers, 77 species of evergreen or semi-evergreen species and 328 deciduous species (without subspecies, varieties, forms and cultivars).

At present the researchers of the Experimental Dendrology Department of the Arboretum Mlyňany SAS deal with the micropropagation of chosen woody plants. There are very hopeful results with micropropagation of *Magnolia liliiflora* (Kamenická, Kormuťák, Lanáková 2001).

There was the first attempt to evaluate the acclimatization process. Taken into consideration were:

- Growth (Benčat' F. and Benčat' T. 1988; Benčat' et al. 1989),
- Phenology (Hot'ka, 2005),
- Susceptibility to diseases and pests (Juhásová and Hrubík 1984),
- Injury from abiotic factors (Benčat', Hrubík and Tábor 1986),
- Possibility of naturalization.

In autumn 2006 the latest inventory of all woody plant collections in Arboretum Mlynany SAS was carried out. The data are now being processed. The results gained will be used in a complex evaluation of now growing woody taxa of all species. The aim is to appraise the value of each specimen and pay attention to the best management for:

- filling up plant collections,
- treatment of plant collections, and
- presentation of plants collections.

Temperature impact on Chinese woody plants introduction in Arboretum Mlyňany SAS

Low temperature is one of the most important abiotic factors that negatively effects Chinese woody plant introduction. Extremely harsh winters occur periodically in Arboretum Mlyňany (Tábor and Tomaško 1992).

Winter	1928/29	1939/40	1955/56	1967/68	1984/85	1986/87
Tmin.	-32,6	-24,2	-24,0	-25,2	-23,7	-27,2
Month	II.	II.	II.	I.	I.	I.

Table 8. The lowest recorded minimum temperatures (Tmin.) [°C] in Arboretum Mlyňany

The low temperature in winter 1928/29 caused the decrease of many Chinese woody plants. The consequences of winter 1986/87 were very similar. Frost damage and chilling injury of different levels were recorded in 743 taxa.

In recent years damage due to frost and chilling injury have been recorded during the winters in Arboretum Mlyňany (Hrubík, Tomaško, Hoťka and Kuba 2006).

Winter	1992/93	1995/96	1996/97	2002/03	2004/05	2005/06
Tm.min.	-5,5	-4,1	-4,9	-4,4	-3,8	-4,4
Mm	43	95	128	70	168	158

Table 9. Mean minimum temperature (Tm.min) [°C] and precipitation amount [mm] during chosen winters in Arboretum Mlyňany

The frost damage was usually greater in winters with lower precipitations amounts. For Arboretum Mlyňany there is significant long-term water deficit in many years that make overwintering of young specimen of Chinese woody plants more difficult.

Conclusion

The introduction and acclimatization of Chinese woody plants is still considered as one of the most important research tasks in Arboretum Mlyňany SAS. This experiment has taken approximately 46 years and today our efforts are towards complex evaluation of this process. All results of scientific research projects and works will be taken into consideration. Also newly achieved outcomes in phenology and naturalization biology will play an important role in appraisal of this outstanding study.

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