

## SEARCHING FOR POTENTIALLY INVASIVE MAPLES (*ACER* SP.) IN SLOVAK CITIES

### IDENTIFIKÁCIA POTENCIÁLNE INVÁZNYCH DRUHOV JAVOROV (*ACER* sp.) V SLOVENSKÝCH MESTÁCH

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FERUS, P. 2018. Searching for potentially invasive maples (*Acer* sp.) in Slovak cities. In Zborník referátov z vedeckej konferencie: "Dendrologické dni v Arboréte Mlyňany 2018", 11.10.2018. Vieska nad Žitavou: Arboretum Mlyňany ÚEL SAV, s.32-38. ISBN 978-80-89408-33-7

#### Abstract

Non-native maples (*Acer* sp.), as fecund and vigorous trees, have potential to become invasive. In this work, we analysed the foreign maple species structure and abundance in city parks, residential areas and private gardens in Bratislava, Nitra and Zlaté Moravce with the focus on individuals escaped from culture. Silver maple (*Acer saccharinum* L.) was the most frequently planted maple species in parks and older residential areas. However, in private gardens dominated palm maple (*Acer palmatum* Thunb.). In new residences architects relied almost exclusively on native species. The only one maple species, in which escape was observed, was the silver maple. Putting together with the typical attributes of plant species invasiveness, we think that this is a good candidate for future invasive species.

**Key words:** non-native maples (*Acer* sp.), cultivation, escape, traits of potential invasiveness

#### INTRODUCTION

Maples (*Acer* sp.) are trees/shrubs of high ornamental value attracting human's attention with interesting habitus, bark, leaves as well as fruits. Despite general distribution of maple species in temperate zone of the northern hemisphere, among the most decorative belong those from China and Japan (VAN GELDEREN et al. 2010; GREGORY AND VERTREES, 2010). In the Slovak flora, four native maple species occur – field maple (*Acer campestre* L.), Norway maple (*Acer platanoides* L.), sycamore maple (*Acer pseudoplatanus* L.) and Tatarian maple (*Acer tataricum* L.) (ZAHRADNÍKOVÁ, 1984). However, our climate enables successful cultivation of many foreign species, as well. First of them were introduced to the region of present Slovakia centuries ago, during the so called phase of park introduction (BENČAĎ, 1982). From decades ago till now, most of the non-native maple species can be found in botanical gardens and arboretums. For instance, 43 maple species, cultivars and forms grew in the Mlyňany Arboretum in 1967 (BENČAĎ, 1967) and the last living collections inventory in 2012 revealed increase to 80 (Hořka and Barta 2012). In the socialistic period, besides native species, plantations of two American maple species – box elder (*Acer negundo* L.) and silver maple (*Acer saccharinum* L.) – were very common (SUPUKA et al., 1991). However, today new attractive botanical maple species and particularly palm maple (*Acer palmatum* Thunb.) cultivars satisfy the human's demand on special garden plant material. Anyway, these vigorous fruitful woody plants can represent a risk of future invasion (THEOHARIDES AND DUKES, 2007). Therefore, in this work we analyse present state in the maple species spectrum and abundance in different urban zones of three cities with the focus on their escape.

**Tab. 1** Maple genotypes offer in the largest transnational garden centres in spring 2018. Abbreviations: NEG – box elder (*Acer negundo* L.), PAL – palm maple (*Acer palmatum* Thunb.), PLA – Norway maple (*Acer platanoides* L.).

Garden centre	Species	Genotype
<i>OBI Nitra</i>	PAL	‘Bloodgood’, ‘Little Princess’, ‘Osakazuki’
<i>Mercury Market Nitra</i>	-	-
<i>Hornbach Bratislava</i>	PAL	‘Atropurpureum’, ‘Bloodgood’, ‘Dissectum Garnet’, ‘Dissectum Viridis’, ‘Tamukeyama’
	NEG	‘Flamingo’
	PLA	‘Drummondii’
<i>Bauhaus Bratislava</i>	PAL	‘Dissectum’, ‘Burgundy Lace’, ‘Inaba-Shidare’, ‘Katsura’, ‘Orangeola’, ‘Osakazuki’
	NEG	‘Flamingo’

## MATERIAL AND METHODS

### *Present market survey*

In April 2018, the spring collections of maple (*Acer* sp.) genotypes were investigated in the most famous transnational garden centres in the regional city Nitra (OBI Slovakia s.r.o. and Mercury Market Slovakia s.r.o.) and the capital city Bratislava (Hornbach – Baumarkt SK s.r.o. and Bauhaus Slovensko s.r.o.), as well as the offer of the large national ornamental woody plant internet sellers (Lesy SR š.p. – OZ Semenoles, Liptovský Hrádok; Plantago s.r.o., Bratislava; Stromčeky s.r.o., Nesvady; Weigela s.r.o., Vieska nad Žitavou).

### *Field research*

In summer 2018, field research on preferences in maple species/cultivar plantations was carried out in the capital Bratislava, the regional city Nitra and the county town Zlaté Moravce. We expected that the species composition in the public spaces and private gardens could be influenced by the Mlyňany Arboretum vicinity (ca. 10.5 km). First we analysed the city park together with the small Janko Král park, of area 5.5984 ha. Then we moved to the residential area, which was established in the socialistic era (1960-1989), of area 33.7694 ha. And finally, focus was given to gardens in front of the private houses (328 houses), located in the north-western part of the town. In this area we found also new (started in 2012) residential area Ďateliniská of 0.7856 ha. In Nitra, the city park (20.8039 ha), older residential areas Klokočina and Diely built from 1975 till now (168.7313 ha), new (started in 1993) residential area Martinák (7.1732 ha) and private houses in the city part Čermáň (416 houses), were surveyed. From Bratislava the Park of Janko Král (24.0736 ha), central part of the city part Petržalka built in period 1973-1989, bordered by Rusovská and Panónska road, Pajštúnska, then Kutlíkova and Starohájska street (161.7495 ha), new (started in 2011) residential area Slnčnice (9.4653 ha) and private houses in the Kalvária

area in old Bratislava city (352 houses), were selected. Area of parks and residential areas as well as number of investigated houses were determined in the Mapy.sk web environment.

**Tab. 2** Internet market with maple genotypes in spring 2018. Abbreviations: GIN – Amur maple (*Acer ginnala* Maxim.), GRI – paper bark maple (*Acer griseum* (Franch.) Pax.), NEG – box elder (*Acer negundo* L.), PAL – palm maple (*Acer palmatum* Thunb.), RUB – red maple (*Acer rubrum* L.), SAC – silver maple (*Acer saccharinum* L.).

Internet store	Species	Genotype
<i>Lesy SR – Semenoles, Liptovský Hrádok</i>	PAL	botanic, 'Atropurpureum', 'Bloodgood', 'Dissectum Garnet', 'Dissectum Inaba-Shidare',
	NEG	'Flamingo'
<i>Stromčeky, Nesvady</i>	-	-
<i>Plantago, Bratislava</i>	GIN	botanic
	RUB	botanic, 'October Glory', 'Scanlon'
	SAC	'Laciniatum Wieri', 'Pyramidale'
<i>Weigela, Vieska nad Žitavou</i>	GRI	botanic
	PAL	'Atropurpureum', 'Dissectum Garnet', 'Dissectum Inaba-Shidare'

#### Database data

Year of the first report of cultivation of the most frequently found non-native maples in the area of present Slovakia was taken from the Benčať's Atlas of the foreign woody plant species cultivation in Slovakia (BENČAŤ, 1982). As the reference for maple species frost tolerance we took the USDA hardiness ranking ([www.usda.gov](http://www.usda.gov)): 3 – from -40 to -34.4, 4 – from -34.4 to -28.9, 5 – from -28.9 to -23.3, 6 – from -23.3 to -17.8, 7 – from -17.8 to -12.2, 8 – from -12.2 to -6.7, 9 – from -6.7 to -1.1 °C. Drought tolerance level of these species was adopted from the work of NIINEMETS AND VALLADARES (2006), where 1 – very intolerant, 2 – intolerant, 3 – moderately tolerant, 4 – tolerant, 5 – very tolerant.

## RESULTS AND DISCUSSION

In spring 2018, all analysed garden centres offered particularly a large scale of palm maple (*Acer palmatum* Thunb.) cultivars (Table 1). Most of them (6) were found in Hornbach Bratislava and Bauhaus Bratislava. To the most popularly sold cultivars belong 'Bloodgood', 'Dissectum Viridis' and 'Osakazuki'. What is interesting, despite invasive, box elder (*Acer negundo* L.) cv. 'Flamingo' was still on market. From native species, only Norway maple (*Acer platanoides* L.) cv. 'Drummondii' was found.

**Tab. 3** Non-native maple species presently (in summer 2018) planted in parks, residential areas and private gardens of Bratislava, Nitra and Zlaté Moravce. Abbreviations: CAM – field maple (*Acer campestre* L.), CIS – vineleaf maple (*Acer cissifolium* Siebold et Zucc.), GRO – Grosser's maple (*Acer davidii* var. *grosseri* Pax.), NEG – box elder (*Acer negundo* L.), PAL – palm maple (*Acer palmatum* Thunb.), PLA – Norway maple (*Acer platanoides* L.), PSE – sycamore maple (*Acer pseudoplatanus* L.), RUB – red maple (*Acer rubrum* L.), SAC – silver maple (*Acer saccharinum* L.), TAT – Tatarian maple (*Acer tataricum* L.).

City	Locality	Native/invasive species	Non-inv. species	Planted (pcs./ha or pcs./house)	Escaped (pcs./ha or pcs./house)
Bratislava	Janko Kráľ park	PSE, PLA, NEG, CAM	SAC	0.166	0
	Petržalka	NEG, PLA, PSE, CAM, TAT	SAC PAL	0.130 0.043	0 0
	Slnčnice	CAM, PLA	PAL	0.106	0
	Kalvária	PLA, CAM, NEG, TAT	PAL SAC	0.048 0.003	0 0
Nitra	City park	PLA, PSE, CAM, TAT	SAC	1.057	0
	Klokočina	PLA, PSE, NEG, CAM, TAT	SAC	0.682	0.030
			CIS	0.006	0
			GRO RUB	0.006 0.006	0 0
Martinák	PSE, PLA, NEG	SAC PAL	0.697 0.697	0.139 0	
Čermáň	PLA, NEG	PAL	0.118	0	
Zlaté Moravce	Parks	PLA, PSE, CAM	SAC	3.215	0.893
	Residential area	PLA, PSE, NEG, CAM	SAC	1.569	0.030
	Ďateľiniská	-	-	-	-
	Private houses area	PLA, NEG	PAL	0.058	0

On the other hand, internet market was richer on species but poorer on cultivars (Table 2). Among sold species, the 'old-fashioned' silver maple (*Acer saccharinum* L.), but also trendy red maple (*Acer rubrum* L.) and jewel botanical paper bark maple (*Acer griseum* (Franch.) Pax.) and Amur maple (*Acer ginnala* Maxim.), were identified. From the palm maple cultivars, usually the most common were offered.

Our field research on the non-native maple species occurrence in parks, older and new residential areas as well as in private gardens of Bratislava, Nitra and Zlaté Moravce revealed massive plantations of silver maple and palm maple (Table 3). Silver maple dominated in parks and older residential areas of all cities.

In opposite, palm maple cultivars were observed exclusively in gardens of all analysed private residential areas. Presently, general preference of green-leaved or coloured palm maple cultivars with non-dissect palm leaves, was observed (Figure 1). The only one exception was the case of Petržalka, where it was also planted in small gardens in front of blocks of flats. In the new residential areas native maple species were preferred but palm maples also can occur. Since larger time span of the construction works, in Martinák residential area (Nitra) silver maple plantation could also be seen. The only one maple species escaping from culture – older residential areas in Nitra and Zlaté Moravce as well as the Janko Kráľ park of Zlaté Moravce, was the silver maple.

**Tab. 4** Residential time and ecological plasticity (USDA frost hardiness and drought tolerance) of Norway maple (*Acer platanoides* L., PLA), box elder (*Acer negundo* L., NEG), palm maple (*Acer palmatum* Thunb., PAL) and silver maple (*Acer saccharinum* L., SAC).

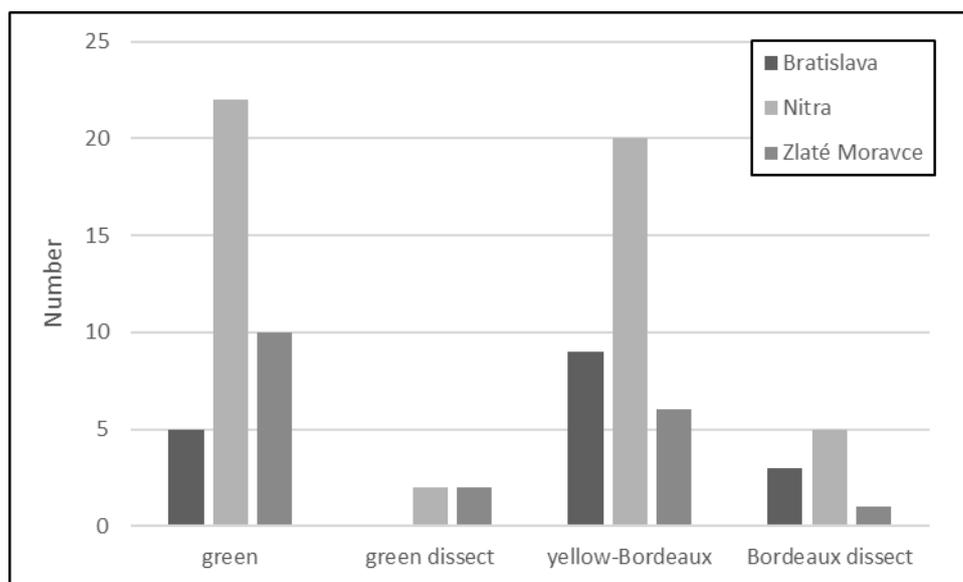
Species	Introduced in	Hardiness	Drought tolerance
PLA	-	3-7	2.76
NEG	1794	3-8	3.03
PAL	after 1900	6-8	2-3?
SAC	1820	3-9	2.88

The world literature survey revealed just a few maple species of invasive status other than the box elder. In the North America, there is strong evidence on the impact of Norway maple on the natural ecosystems (e.g. LAPOINTE AND BRISSON 2012; GALBRAITH-KENT AND HANDEL 2008; REINHART et al. 2006). In two of the analysed Slovak cities (Nitra and Zlaté Moravce), silver maple individuals escaping from the culture, were observed. Since this species was widely planted in parks, along roads as well as in the newly built residential areas of larger cities in the socialistic era (SUPUKA et al. 1991), and despite of the city management, we found some niches, where it could establish – abandoned areas and hardly accessible locations. In some cases, situations when seedlings were let grow, were also observed. On the other hand, despite the palm maple became highly popular among people in the past two decades, we did not see any escape of this species into nature. Mostly young trees, which still do not form thousands of viable seeds and much more precise management in private gardens could be explanations for our observation.

As indicated by PYŠEK et al. (2009), probability of alien woody plant species increases with the residence time in the country, planting density (propagule pressure) and low temperature tolerance. In contrary, based on similar parameters (residence time, propagule

pressure, invasiveness elsewhere and climate change hardiness), DEHNEN-SCHMUTZ (2011) determined green list of non-invasive ornamental plants. Following these traits, silver maple is much more similar to the invasive box elder in respect of the residence time, frost hardiness and drought tolerance than the palm maple. Because of older, already fruiting trees of relatively high planting frequency, silver maple fits better with the propagule pressure requirement, as well. However, in some decades the palm maple can also appear as potentially dangerous invasive species. The large genetic diversity (numerous cultivars on the market) can contribute to this switch.

**Fig. 1** Human preferences in palm maple (*Acer palmatum* Thunb.) cultivars in Bratislava (Kalvária), Nitra (Čermáň) and Zlaté Moravce (private houses area).



## ACKNOWLEDGEMENT

This work was supported by project of the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic (Vega 2/0058/18).

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