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Selection and breeding of stress-tolerant woody ornamentals for urban plantings

Gábor Schmidt

Department of Floriculture and Dendrology, Faculty of Horticultural Science, Corvinus University of Budapest, 1118 Budapest, Villányi út 29-43, Hungary
e-mail: gabor.schmidt@uni-corvinus.hu

Abstract

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Because of this geographic position, climate and soils, Hungary lends itself for selection of woody plants which tolerate environmental stresses. Selection and breeding of the woody ornamentals for extreme urban conditions started in the early 1950s at the former University of Horticulture and Food Industry (at present: the Faculty of Horticulture of Corvinus University), Budapest. The first results were 8 *Sorbus*, 3 *Tilia* and 2 other cultivars, and selected clones from *Fraxinus, Cornus*, *Juniperu*s and others. In the recent 20 years, many new hardy cultivars and named clones are brought up, the most important of which are as follows: *Ailanthus altissima* (Mill.) Swingle cv. Purple Dragon, *Acer campestre* L. cv. Zentai Upright`, *Celtis occidentalis* L. cv. Straight Stem, *Crataegus pinnatifida* Bunge cv. Tahi, *Hedera helix* L. 9 cultivars, *Platanus* × *hispanica* Münchh. cv. Budapest, *Prunus padus* L. cv. Aurora, *Prunus* × *davidopersica* cv. Rubin (*P*. L. cv. Piroschka), *Prunus tenella* Batsch. cv. Pink Carpet, *Pyrus nivalis* Jascq. cv. Kartália, *Salix matsudana* Koidz. cv. Golden Spiral, *Syringa josikaea* J. Jacq. ex Rchb. cv. Smaragd, *Tilia tomentosa* Moench. cv. Zenta Silver, *Tilia* × *euchlora* K. Koch. cv. Saint Stephan.

Keywords

Ailanthus, new cultivars, *Prunus,* stress-tolerance, *Tilia,* urban trees

Introduction

Because of this geographic position, Hungary lends itself for selection of woody plants which tolerate environmental stresses: the summer is warm with temperatures reaching a maximum of 30–35 °C, and the winter is cold and irregular with temperatures falling sometimes –26–30 °C. These extremities are multiplied by the poor sandy and salinity soils of the Great Hungarian Plains, the dry limestones and dolomites of low hills and by the dry warm and polluted atmosphere of cities and towns. Selection of woody ornamentals for such conditions started in the early 1950s by the Department of Horticulture and Dendrology of the former University of Horticulture and Food Industry (at present: the Faculty of Horticulture of Corvinus University, Budapest). The first results were 8 *Sorbus*, 3 *Tilia* and 2 other cultivars, and selected clones from *Fraxinus, Cornus*, *Juniperu*s and others (Sipos, 1964; Read and Schmidt, 1987).

In the recent 20 years, many new hardy cultivars and named clones are brought up (Lukács et al., 2009; Orlóci et al., 2009; Schmidt and Sütöriné, 2011).

The aim of the present paper is to give a short description of (and experiences with) the new selections of this period.

Material and methods

The breeding work was carried out in two basic ways: 1. on-site selection of adult specimens in urban or roadside plantings; 2. selection of young seedlings from mass-propagation in the nursery.

In the case of on-site selection of adults specimens in urban or roadside plantings, expeditions were organized to the larger cities and towns for the search of such adult specimens which in the given urban environment showed higher tolerance towards urban injuries than the other ones (their neighbours standing in the same alley or group) and also showed some increased ornamental or technological value, like better crown shape, shiny and healthy or colourful leaves, good structure of branch system, etc.

In the case of selection of young seedlings from mass-propagation in the nursery, this sort of breeding started with mass-propagation by seed of such species or individuals which were known as genetically stress-tolerant in Hungary (and having sometimes also additional values like red leaves, or disease – resistance etc.) Later from the seedling lot (minimum 400 liners, but usually much more) those were picked out, which showed better qualities than the other ones.

In both cases, at the first step minimum 10–12 specimens were selected (picked out) and propagated vegetatively (by budding or by cuttings) in an amount of minimum 50 cuttings or grafts per clone. The second step was the nursery trial of the clones (speed of growth, healthiness of leaves, straightness of stem of trees or bushiness of shrubs) and, of course, repeated bonitations were made on their ornamental value. The third step was to plant and try them out in urban conditions, usually in Budapest. Finally, those clones which proved to be the best both in the nursery and in urban plantings were propagated again in the nursery. They were given cultivar names and submitted to official cultivar – recognition to the respective Institution and Community for testing and approval (see later at chapter New cultivars for urban planting.)

Results

Description of the recent cultivars and selections

New cultivars in Hungary are inspected and tried for several years by the National Institute for Agricultural Quality Control. If they meet the necessary criteria, including the DUS-requirements, an official recognition and certificate is awarded by the Hungarian Cultivar Qualification Council (HCQC).

In the recent 20 years, many new hardy cultivars and named clones are brought up and recognized by HCQC, the most important of which are as follows:

***Ailanthus altissima* (Mill.) Swingle cv. Purple Dragon.** The heaven tree, *Ailanthus altissima* (Mill.) Swingle, tolerates drought and bad soils extremely well in Hungary and grows like weed in polluted urban environment. The cultivar Purple Dragon is a female form found in Budapest. It has a straight leader, fast growth and a regular rounded crown becoming flattened with aging. The dark purple winged fruits are born in abundant clusters and retain their intensive colour from July through August and early September. Foliage is shiny green with red petioles and leaflet nerves, the shoots are purplish brown. (Breeder: G. Schmidt, 1996.)

***Celtis occidentalis* L. cv. Straight Stem.** The Hackberry Tree *Celtis occidentalis* L. is perhaps the hardiest urban tree in Hungary, which equally tolerates the poor urban soils, polluted atmosphere and also the negative effects of human vandalism like heavy injuries of the trunk, cutting the branches and the roots, etc. The only (but great) disadvantage of the traditionally used type is the irregular growth (curved trunk) and the overhanging branches which create problems both in the nursery and in the street plantings. The new cultivar Straight Stem has the high tolerance of the traditional species without its disadvantage in habit and growth: The stem of this cultivar is growing straight (and fast) in the nursery so (in contrast to the "traditional" type) it does not need staking (Fig. 1); later (on the final place) along urban streets. The crown becomes upright oval. The branches are not overganging at all, so they do not disturb the traffic. (Breeder: G. Schmidt 2006.)

Fig. 1. *Celtis occidentalis* L. cv. Straight Stem.

***Hedera helix* L. Hungarian cultivars.** The English Ivy *Hedera helix* L. is native to practically all woodlands in Hungary (Bényei-Himmer, 1994a). It is a multifunctional plant in landscaping. The juvenile form

is suitable for a groundcover (both in shadow and on the sunshine), for covering walls of the buildings and fences and climbs easily on pergolas or on trunk of trees as well. The adult form makes a fine and hardy rounded bush, or, if pruned, can be planted as a low evergreen semi-low hedge.

The cultivars of the Faculty of Horticultural Sciences originate from different parts of Hungary and fall into two groups: 1. the spreading climbing (juvenile) cultivars, and 2. the bushy (adult) ivies. They were bred by Mrs Bényei-Himmer M. at the Department of Botany (Bényei-Himmer, 1994b).

Spreading – climbing (juvenile) cultivars are:

***H. helix* L. cv. Börzsöny.** A fast spreading cultivar, with thick growth. Leaves are elongated triangular in form (f. *sagittifolia*), the leaf blade leader them, dark green with well marked nerves (Fig. 2). Makes an excellent groundcover. (Breeder: Bényei-Himmer M. 2000).

Fig. 2. *Hedera helix* L. cv. Börzsöny.

***H. helix* L. cv. Zebegény.** Middle-strong growth, very good tendency for branching. Leaves are markedly five-lobed (f. *pedata*) with vivid green colour and silvery leaf-nerves. Suitable as a ground-cover (especially in small gardens) or for balcony-boxes. (Breeder: Bényei-Himmer M. 2000).

***H. helix* L. cv. Krokó.** A slow to medium-strong growing spreading form, with slightly lobed and widely silvery-nerved leaves which give the plant a spectacular ("crocodile-like" appearance, Fig. 3). Excellent as a grand cover for small gardens or in balcony-boxes. (Breeder: Bényei-Himmer M., G. Botlik 2004).

***H. helix* L. cv. Negro.** A medium-strong growing spreading form, whose leaves are very dark green (almost black). An interesting ground cover, makes a good contrast if planted in one group with silvery or with golden-coloured cultivars. (Breeder: Bényei-Himmer M. 2004).

Fig. 3. *Hedera helix* L. cv. Krokó.

Bushy (adult) cultivars are:

***H. helix* L. cv. Soroksár.** A wide-rounded low or medium-sized bush, with vivid green shiny leaves. Black fruits from February till the end of March. (Breeder: Bényei-Himmer M. 2000).

***H. helix* L. cv. Blue Star.** A medium-sized bush, with shape and size like that of the former cultivar, but the fruits are shiny blue, appearing in abundant loose cymes. (Breeder: Bényei-Himmer M. 2000).

***H. helix* L. cv. Marble.** An upright bush of smaller (later medium) size. Dark green leaves with undulate margins and marked light-green veins are giving a marbled effect. It has abundance of yellowish flowers in September–October and black fruits (in compact cymes) during winter. (Breeder: Bényei-Himmer M. 2000).

***H. helix* L. cv. Csocsoszan.** A rounded bush whose leaves are not lanceolate but wide obovate with crenate leaf-margins resembling a Japanese fan. Not so winter-hardy as the former cultivars. (Breeder: Bényei-Himmer M. 2004).

***Prunus* × *davidiopersica* cv. Rubin (*P.* × *d.* cv. Piroschka).** A small tree with flattened crown. Ultimate height is 4–5 m, diameter 6–8 m. Leaves are dark ruby-red during the intensive shoot growth and are turning dull greenish red when the growth stops. This change of

colour (with new and new flushes of growth) is repeating 2–3 times in one vegetation. Large white flowers with a small pink eye bloom in late March–early April immediately after bud-brake. The cultivars are resistant to mildew and to *Taphrina deformans* (Berk.) Tul. Tolerant to drought and early frost. (Breeders: G. Schmidt and F. Incze. 1996).

***Prunus padus* L. cv. Aurora.** The "Bird Cherry" *Prunus padus* L. is a medium-sized bushy tree widely distributed on the Northern Hemisphere including Hungary. The first red-leaved *Prunus padus* cultivar Coloratus was introduced to Hungary some 30 years ago. This cultivar did not distribute in Hungary because of its poor tolerance to continental climate and the limy soils (the cultivar was selected in Sweden, under the humid climate of Scandinavia). The Hungarian cultivar Aurora is developing leaves which are much darker red under our conditions, than those of cv. Coloratus and, in contrast to the mentioned Scandinavian cultivar do not burn neither become necrotic (yellow) in the hot summer. It brings abundance of dark pink flowers (Fig. 4) blooming in upright panicles during mid- or late April. (Breeder: G. Schmidt, 2005, further selected clones still in process of trials).

Fig. 4. *Prunus padus* L. cv. Aurora.

***Pyrus nivalis* Jacq. cv. Kartália.** A 4–6 m high, slow growing small tree with wide columnar form. Side shoots are short, squat and grow horizontally when young. Later the side-shoots turn upright and are only slightly thorny. Flowers are white, blooms 2 weeks later than *Pyrus communis* L. The fruit is a 3 cm wide, yellowish green pear. No pests. Suitable in parks, small streets. Drought tolerant. (Breeders: I. Tóth, and A. Terpó 1995).

***Salix matsudana* Koidz. cv. Golden Spiral.** A fast growing corkscrew-willow, probably a spontaneous hybrid between *S. matsudana* Koidz. *'Tortuosa'* and *S. alba* L. *'Tristis'*. It was found as a chance seedling near Velencei lake. Shoots, twigs and branches are much contorted, light yellow in the summer turning rich golden orange in the winter (Fig. 5) (Breeder: G. Schmidt. 1993).

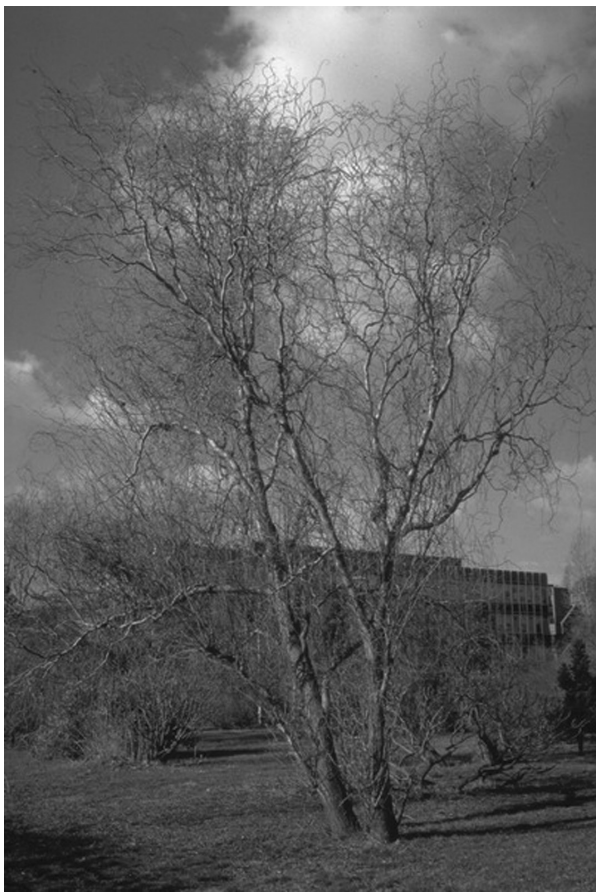

Fig. 5. *Salix matsudana* Koidz. cv. Golden Spiral.

***Syringa josikaea* J. Jacq. ex Rchb. cv. Smaragd**. A 2–3 m high, strong growing, compact shrub with stiff, upright branches. Leaves are 6–10 cm wide, elliptic, dark emerald green, leathery through the whole summer. Dark lilac-coloured flowers, bloom in upright compact panicles, in mid- or late May (2 weeks after the common lilac (*S. vulgaris* L. cultivars). Cv. Smaragd is not susceptible to mites, and tolerates half-shade. Use: alone or in groups in parks and in home gardens. (Breeder: G. Schmidt. 1993).

Tilia tomentosa **Moench. cv. Zenta Silver**. A strongly upright-growing tree, making a straight leader in the nursery and reaching an ultimate height of 15–20 m in parks. The crown is wide columnar when young, becoming compact conical with aging. Branches are upright. Shoots are greyish green, downy. New leaves are light dull green above, strongly silvery tomentose beneath. Highly scented flowers bloom in late June-early July. Grows fast in the nursery and tolerates urban climate well. Suitable for streets and parks. (Breeders: B. Nagy and G. Schmidt. 1996).

Tilia* × *euchlora **K. Koch. cv. Saint Stephan.** A strongly growing tree, making a straight stem and continuous leader in the nursery and reaching an ultimate height of 15–20 m. Crown is narrow-ovate, with pointed top (Fig. 6). Branches are upright. Shoots are brownish-green, glabrous. Leaves are leathery, shiny green above, dull green and glabrous beneath. Slightly fragrant flowers bloom in early July and almost no fruits later. Tolerates urban climate well. (Breeders: E. Jámbor-Benczúr, Z. Ifjú., I. Tóth and G. Schmidt 2000).

Fig. 6. *Tilia* × *euchlora* K. Koch. cv. Saint Stephan.

Conclusion

In the recent 20 years 11 new urban trees and shrubs have been bred at the Department of Floriculture and Dendrology and 8 *Hedera helix* L. cultivars at the Department of Botany of the Faculty of Horticulture, Corvinus University, Budapest. All of them are available in the leading Hungarian tree nurseries, registered at the Central Agricultural Office and also are kept records by the civil organization "Commission for Hungarian Ornamental Cultivars". The home page of this organization (http://www.magyarfajtak.hu) contains a more detailed description of the above-listed cultivars too, illustrated by digital photos.

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