



## *Salix* × *meyeriana* (= *Salix pentandra* × *S. euxina*)—a forgotten willow in Eastern North America

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*Salix pentandra* L. is a boreal species native to Europe and western Siberia. In North America it is considered to have been introduced to about half of the US states (Argus 2007, 2010). In Massachusetts it is reported from nine of the fourteen counties (Sorrie & Somers 1999). Even though this plant may have been introduced to the US and Canada, its naturalization in North America appears to be quite improbable. Unlike willows from the related section *Salix*, in *S. pentandra* twigs are not easily broken off and their ability to root is very low, 0–15% (Belyaeva *et al.* 2006). It is possible to propagate *S. pentandra* from softwood cuttings (Belyaeva *et al.* 2006) and it can be cultivated in botanical gardens, however, vegetative reproduction of this species by natural means seems less likely. In North America this willow is known only by female (pistillate) plants (Argus 2010), so for this species, although setting fruit, sexual reproduction should be excluded. It is difficult to imagine that, under these circumstances, it could escape from cultivation. Therefore, most of the records for this willow in North America should be considered as collections from cultivated plants or misidentifications (Zinovjev 2008–2010).

*Salix pentandra* is known to hybridize with willows of the related section *Salix*. The differences between them were shown, e.g., by Bean (1980), Berg and Christensen (2000). In Europe, this section includes native *S. alba* L., another species introduced from Asia Minor and its hybrids (Skvortsov 1968, 1973). For a long time, the name *S. fragilis* has been applied either to some of these hybrids or to a species from Asia Minor. According to recent decision of the Nomenclature Committee for Vascular Plants, these hybrids should be named *S. × fragilis* L., while plants native to Turkey and the Caucasus region have been described as *S. euxina* I.V. Belyaeva (Brummit 2009: 280, Belyaeva 2009, Argus 2010).

Examination of herbarium samples from the herbaria A, GH, NEBC, MASS, US, College of the Holy Cross (Worcester, Massachusetts), led to the conclusion that the main cause for misinterpretation of this willow in North America was the presence of cultivated hybrids of *S. pentandra* with *S. euxina*, known as *S. × meyeriana* Rostk. ex Willd. (Willdenow 1811). Such a hybrid would have been favored for cultivation as it is easily propagated vegetatively. It is particularly noteworthy that some old herbarium samples of Nearctic *S. pentandra* were initially treated as hybrids (labeled *S. pentandra* × *S. fragilis*), e.g., Washington, D.C., Corcoran St., between 18th & 19th St., June 21, 1905, G.B. Sudworth (US 1584807 and US 1584808). However, such hybrids are not mentioned in recent American literature, with the exception of a horticultural manual (Rehder 1954). These hybrids have only been seen by the author in the European section of Harvard University Herbaria. Perhaps some of them are real hybrids, and one of these samples is of special interest, proving that this hybrid was cultivated in the US: it bears the label "*S. fragilis* × *pentandra* ... Received from Kew. Grown at Fountaindale, Illinois: 1880. leg. M.S. Bebb" (GH).

*Salix pentandra* belongs to section *Salicaster* Dumort. All species of this section differ from those in section *Salix* (as defined by Skvortsov 1968) by having multistaminate male flowers. All of its species have strongly lustrous leaves, producing odorous resin, as some poplars do, when young. As has been shown by Skvortsov (1960) this section is further separated into two distinct groups: the Holarctic *pentandra*-group (with five species) and the Nearctic *lucida*-group (with two or three species).

All species of the *S. pentandra*-group are separated from other willows by their phenology. Their seeds ripen much later than those of any other willows, in late summer (see links to photographs in Zinovjev 2008–2010); they are dispersed during the winter and germinate in the following spring; catkins remain hanging on the tree during the entire winter and often remain during the next year. In American literature this feature is known for *S. serissima* Fernald that is called 'autumn willow' but which is seldom associated with New World '*S. pentandra*'. This fact alone suggests that the name '*S. pentandra*' is misinterpreted in North America. Morphologically, late seed formation is correlated with thick stout catkins, with mature capsules that are unusually large and thick-walled (Skvortsov 1960, 1968). However, in the keys for Nearctic willows (e.g., Fernald 1950, Seymour 1969, Magee & Ahles 1999) large capsules are only mentioned for *S. serissima* (7–10 mm long) but not for '*S. pentandra*' (5–6 mm long). Herbarium samples identified as '*S. pentandra*' in North America frequently have long, loose and narrow catkins with smaller capsules. Ecologically, species of the *S. pentandra*-group also differ from related willows: they are nearly obligatory wetland species. *Salix pentandra* itself usually grows in graminoid forest fens dominated by *Carex* L. and *Calamagrostis* Adans. The ease of rooting of the brittle twigs of *S. euxina* and its hybrids seems to be correlated with the alluvial habit of these taxa, which is not the case for *S. pentandra* and its relatives of the *S. pentandra*-group.

Sometimes *Salix pentandra* could be confused with native *S. lucida* Muhl. However, as was shown by Skvortsov (1960), the latter belongs to the *S. lucida*-group of section *Salicaster*, which is characterized by a different bud structure and elongated cataphylls that correspond to first primordial leaves in the mature buds. In *S. lucida* bud scales do not die off during the winter, their inner membranous layer (second prophyll) is free, its connection to the base of developing shoots is retained by a small ring; it partially embraces and covers developing cataphylls together with tufts of long silvery hairs originating from the base of branchlets and medial parts of cataphylls (see photographs in Zinovjev 2010). However, in all species of the *S. pentandra*-group of section *Salicaster* and willows of section *Salix*, at least the first cataphylls are broad, their length is equal to or smaller than their width; in mature floriferous buds the first primordia are longer than the catkin, the outermost primordial leaf fully embraces the bud contents, so that its margins meet; bud scales die during the winter (at least partially) and are not persistent (hence, are rarely found in herbarium samples); cataphylls are glabrous on both sides but ciliate, with fugacious trichomes at the margin (may not be retained in herbarium material). Furthermore, the young leaves of *S. lucida* are more or less hairy, with some hairs reddish, the stipules are usually well developed. In *S. pentandra* (and native *S. serissima*) even the youngest leaves are totally glabrous; in herbarium samples stipules are absent or rudimentary although they are known to occur in *S. pentandra* but perhaps only on the most vigorous shoots; if present, according to Skvortsov (1960), with glands on the upper surface.

In some vegetative characters, *Salix pentandra* can be similar to *S. euxina*, particularly by having glabrous, lustrous leaves that are sometimes of a similar shape. This makes distinguishing their hybrids particularly difficult when dealing with herbarium samples. In nature, *S. pentandra* looks very distinctive. It usually grows as a small tree with branches flexible at the base, rarely, according to some authors, slightly brittle. Branchlets and young branches are glabrous and shiny, as if varnished, their color ranging from yellowish and yellow-brown to dark red-brown. Buds in winter are positioned at acute angles to branchlets; they die off but never become black. Pistillate catkins are stout with large thick-walled mature capsules (7–11 mm long). The leaves are deep green and lustrous above, pale below but not with glaucous bloom. In *S. euxina* young branches are very brittle at the base, light grayish-yellow (like light-colored wax) and the buds have the same color as the branches but usually become black apically in winter. The first outermost primordium in the bud is sericeous at the margin and the outside is frequently pubescent. Sometimes the young leaves have a few hairs.

In the 1960s, a synthetic hybrid between *S. pentandra* and *S. euxina* (then called '*S. fragilis*') was produced by V. I. Shaburov in Yekaterinburg Botanical Garden. The described cultivar, *Salix* '*Sverdlovskaja blestjaszczaja*' (Belyaeva *et al.* 2000), is a male tree of about 16 m height. Morphologically, it occupies an intermediate position between both parents. Like in *S. euxina*, twigs in this hybrid are brittle and easily rooted (100%). The dark green, broad and highly lustrous leaves resemble those of *S. pentandra*, but the stipules can

persist even on some shorter twigs. The cultivated tree, examined by the author in 2010, looks very similar to the great majority of the herbarium specimens treated here as putative hybrids of *S. pentandra* with *S. euxina*. These specimens frequently have better developed stipules than typical for *S. pentandra* and, if catkins are present, they are usually loose and narrow, sometimes with traces of some abnormalities like incidental male flowers. In rare cases (Massachusetts: Barnstable and Suffolk counties) they bear sawfly galls of the European *Pontania proxima* (Serville). This sawfly is characteristic for *S. euxina*, *S. alba*, and their hybrids (i.e., willows of section *Salix*). Producing such galls on true *S. pentandra* is highly improbable which is additional evidence of the hybrid origin of the so-called American *S. pentandra*.

Therefore, the great majority of herbarium samples from eastern North America previously identified as '*S. pentandra*' are putative hybrids of *S. pentandra* and *S. euxina* or possibly of *S. pentandra* with the fertile hybrid *S. × fragilis*, that approaches *S. euxina* phenetically. Samples most definitely identified as these hybrids were seen from the following states of eastern USA: Illinois, Maine, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, and as undoubtedly cultivated plants from Wisconsin and the vicinity of the District of Columbia. In Massachusetts, they were seen from Berkshire, Hampshire (cultivated), Worcester, Middlesex, Essex, Suffolk (perhaps cultivated), Norfolk, Plymouth (explicitly marked as a cultivated plant), Barnstable, Dukes, and also from Hampden and Nantucket counties (identification less definite). A few of the examined specimens from New England formerly named *S. pentandra* belong to *S. × fragilis*, or maybe even to some kind of hybrids of *S. lucida*. So far I have seen only one living plant from the US. It is cultivated in the Arnold Arboretum of Harvard University under the name *S. pentandra*: accession number 95-1990, an asexual propagation of an older accession 503-33 received as cuttings from the Botanic Garden Berlin-Dahlem. In spite of superficial resemblance to *S. pentandra*, this cultivated plant cannot be pure *S. pentandra* because of its brittle branchlets and easily rooting young branches, hairy second and subsequent primordial leaves of the winter buds, as well as some other differences. A detailed list of examined samples is available at <http://www.salicicola.com/>.

Plants named *Salix pentandra* from the US will still need further investigation, particularly because their fertility remains an unanswered question. I hereby propose to apply the name *S. × meyeriana*, a name traditionally applied to hybrids of *S. pentandra* with *S. euxina* (formerly confused with *S. fragilis*); however, they actually may include hybrids of triple parentage (e.g. *S. pentandra* × *S. euxina* × *S. alba*), and the actual situation may prove to be even more complicated, e.g., we cannot exclude the possibility of back-crossing with parent willows or subsequent hybridization with North American species. Also the possibility that pure *S. pentandra* occurs in North America cannot be excluded completely, however, since even the plants cultivated in arboreta under the name *S. pentandra* appear to be hybrids, for the time being I suggest to place *S. pentandra* in the list of dubious species for North America and remove it from the standard list of New England willows until proven otherwise.

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