

ment, and especially voluntarily by the private sector. The need to save good-quality existing trees sympathetically in building-plans, town-plans and open spaces should be more strongly emphasized, if not made mandatory.

### Literature Cited

1. Bernatzky, A. 1978. *Tree Ecology and Preservation*. Elsevier, Amsterdam.
2. Craul, P.J. (ed.) 1982. *Urban Forest Soils: a Reference Workbook* SUNY College of Environmental Science and Forestry, Syracuse, NY.
3. Harris, R.W. 1983. *Arboriculture: Care of Trees, Shrubs, and Vines in the Landscape*. Prentice-Hall, Englewood Cliffs, New Jersey.
4. Hicks, P. 1976. *The care of trees on development sites*. Arboricultural Association of Great Britain, Advisory leaflet no. 3, Stansted, England.
5. Hill, D.S. 1967. *Figs of Hong Kong*. Hong Kong University Press, Hong Kong.
6. Jim, C.Y. 1986. *Street trees in high-density urban Hong Kong*. *J. Arboric.*, 12:257-263.
7. Jim, C.Y. 1987. *The status and prospects of urban trees in Hong Kong*. *Landscape and Urban Planning*, 14(1): 1-20.
8. McCullen, J. and Webb, R. 1982. *A Manual on Urban Trees*. An Foras Forbartha, Dublin.
9. Oxley, D.H. (ed.) 1980. *Victoria Barracks 1842-1979*. Headquarters British Forces, Hong Kong.
10. Perry, T.O. 1982. *Ecology of tree roots and the practical significance thereof*. *J. Arboric.*, 8:197-211.

Lecturer in Biogeography  
Department of Geography and Geology  
University of Hong Kong  
Pokfulam Road  
Hong Kong

## Cultivars of *Salix babylonica* and other Weeping Willows

by Frank S. Santamour, Jr. and Alice Jacot McArdle

**Abstract.** *Salix babylonica*, the classical "weeping willow" from China, is now regarded as including *S. matsudana*. The species is represented by several valid cultivars, including 'Babylon', which is proposed here for the first time for the female clone upon which the original species description may have been based. Since 'Babylon' is not cold hardy in many areas of the United States, the most commonly planted "weeping" willows are actually hybrids between 'Babylon' and *S. alba* or *S. fragilis*. Unfortunately, many of these hybrids suffer from cold-related twig dieback, their nomenclature is hopelessly confused, and several different clones may be growing under the same cultivar name. It is proposed that most of the older names used to denote cultivars and selections be abandoned and new names, based on plants propagated from living, documented specimens, be used in the future.

**Résumé.** *Salix babylonica*, le saule pleureur classique de Chine, est maintenant considéré comme incluant *S.*

*matsudana*. L'espèce est représentée par plusieurs cultivars valides, incluant "Babylon", qui est proposé ici pour la première fois comme le clone femelle sur lequel la description première de l'espèce fut basée. Étant donné que la variété 'Babylon' n'est pas rustique dans plusieurs régions des États-Unis, les saules pleureurs les plus communément plantés sont des hybrides entre "Babylon" et *S. alba* ou *S. fragilis*. Malheureusement, plusieurs de ces hybrides souffrent d'un dépérissement causé par le froid, leur nomenclature est très confuse, et plusieurs clones différents croissent sous le même nom de cultivar. Il est proposé que la plupart des vieux noms utilisés pour dénoter les cultivars et les variétés soient abandonnés et que des noms nouveaux, basés sur les plants propagés par voie végétative, des spécimens bien identifiés, soient utilisés dans le futur.

*By the waters of Babylon, there we sat down and wept, when we remembered Zion. On the willows there we hung up our lyres.*

Psalms 137

This particular translation of Psalm 137, cited by Zohary (6), is ample evidence that confusion with regard to weeping willows is not a recent phenomenon. The "willows" of the Psalm were really poplars (*Populus euphratica* Oliv.) and the "weeping" willow (*Salix babylonica* L.) is probably native to China.

The fact is that most of the "weeping" willows presently cultivated in the United States are *not* *S. babylonica*. Furthermore, if these weeping trees are known by any other name, that name is also probably incorrect. It has been well documented in the literature (1) and confirmed by our study that several different clones, even of different sexes, may be growing under the same name. Since there are more individual genotypes (clones) of weeping willows than there are names (cultivar names or otherwise), it may be best to discard most of the earlier names and start over. There is no reason to allow the present nomenclatural confusion to continue, or increase, when we have the means at our disposal to bring some order out of chaos.

The present study is a combination of literature research on plant nomenclature and experimental and observational research on plant biology. Its purposes are to justify a realistic appraisal of the cultivated weeping willows and offer solutions that will allow a more efficient and intelligent use of the germplasm available.

### Nomenclature

Much of the historical and anecdotal information given below has been taken from Bean (1). Although this work contains an abundance of observations, no attempt was made to integrate disparate views. All of the plants presently cultivated in Europe and the United States under the epithet "*Salix babylonica* L." are female, and probably are genetically identical members of the same clone. In the listing that follows, we have proposed 'Babylon' as a cultivar name for this clone. According to Bean (1), Linnaeus first saw this weeping willow in the Clifford garden at Hartecamp in the Netherlands and described it in

Hortus Cliffortinaus in 1738. Although the plant had not flowered, Bean (1) stated "there seems to be little doubt that Clifford's willow was the common female clone". However, when Linnaeus published the name "*Salix babylonica*" in Species Plantarum in 1753, his herbarium contained four specimens, presumably from different sources, purported to be this species. All of these specimens were of vegetative shoots, with no male or female catkins. The word "China" is written on one of these herbarium sheets. Thus, it cannot be proved that Linnaeus' description was based on only one clone or that the choice of the specific name "babylonica" was made without knowledge of the Asiatic origin of the species.

It is, however, likely that the *S. babylonica* cultivated in the West (the female clone 'Babylon') was a highly atypical selection (from an Asiatic species) that had been introduced at various points along the ancient trade route through southwest Asia, to the Near East, and in ca. 1730 to Europe. The non-weeping taxon from China described by Koidzumi in 1915 as *S. matsudana* is probably more typical of the majority of wild *S. babylonica*. Rehder (2) and others placed certain non-weeping (or less-weeping) selections from China as *formae* under *S. matsudana*. Before 1915, it was probably thought reasonable to include both weeping and non-weeping trees under *S. babylonica*. Following the lead of Skvortsov (5), it is again fashionable, and probably biologically sensible, to consider *S. babylonica* as including *S. matsudana*.

In the listing that follows, we have attempted to include, and explain, most of the names that have been applied to *S. babylonica* or its "weeping" derivatives. As in previous checklists, **VALID CULTIVARS** are given in boldface capitals and **INVALID** names in lightface capitals.

**ANNULARIS**—based on *S. babylonica* f. *annularis* by Ascherson in 1864. Should be considered as synonymous with *S. babylonica* **CRISPA**.

**BABYLON**—This cultivar name is here proposed for the female clone that is widely grown in Europe and eastern United States as *S. babylonica*. Tree to 30 ft, with long pendulous branches; branchlets brown (not yellowish), glabrous; leaves lanceolate to linear lanceolate, 8-16 cm long, long acuminate, with cuneate base and serrulate margin; female catkins curved, to 2 cm long. We consider our trees (NA 44011) at the U.S. National Arboretum to be typical for this cultivar.

- BLANDA**—as *S. x blanda* by Andersson (1867) to denote a hybrid between *S. babylonica* and *S. fragilis* growing in Germany. Bean (1) considered this somewhat pendulous female clone as a cultivar, but we have seen several clones grown under this name. Even the putative parentage of the plant, judged only on herbarium specimens, is in doubt. Bean noted that the male parent may have been *S. x rubens* Shrank (*S. alba* x *S. fragilis*) or *S. pentandra* L. The name "blanda" should probably be used only as a hybrid specific epithet (*S. x blanda*) to denote putative hybrids between *S. babylonica* and *S. fragilis*.
- CHRYSOCOMA**—considered a cultivar by Bean, (1) listed under *S. x sepulcralis* Simonkai. Based on *S. x chrysocoma* Dode (1908), with *S. vitellina pendula nova* Spath, *S. alba* var. *vitellina* (Spath) Rehder, *S. babylonica ramulis aureis* Hort., and *S. alba* 'Tristis' Hort. in synonymy. Put into commerce by Spath (Berlin) in 1888. Origin unrecorded, and Bean expressed doubts as to its hybridity, but we believe it to be a hybrid between *S. babylonica* and *S. alba*. It is probable that many, if not most, of the "golden weeping willows" grown in the United States under the name 'Tristis' are this clone. However, until a type specimen is established and nursery propagation is standardized, we consider the use of this name to be of doubtful utility.
- COCKSCREW**—a common name for *S. babylonica* **TORTUOSA**.
- CONTORTED** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 574)—as a clone (*tortuosa*) of *S. matsudana*. = *S. babylonica* **TORTUOSA**.
- CRISPA**—based on *S. babylonica* f. *crispa* (Loudon) Rehder (1949), originally considered a variety of *S. babylonica* by Loudon (1838). Branches pendulous and leaves twisted or spirally curved. According to H.J. Elwes and A. Henry, The trees of Great Britain and Ireland, 1913, Vol. VII, this is a female clone. A valid cultivar of *S. babylonica*.
- DOLOROSA**—a name used variously as *S. dolorosa* Hort., in synonymy with *S. babylonica* or as a variety of *S. babylonica*, as *S. babylonica dolorosa* Hort. A. Rehder, Bibliography of cultivated trees and shrubs, 1949, p. 76, placed *S. babylonica* var. *dolorosa* Rowen ex Rowlee in the synonymy of *S. x blanda*. Name probably not valid at any level.
- DRAGON'S CLAW**—mentioned by Bean (1) as a common name for *S. matsudana* 'Tortuosa' = *S. babylonica* **TORTUOSA**.
- ELEGANTISSIMA**—as *S. x elegantissima* K. Koch (1871) to denote a hybrid between *S. babylonica* x *S. fragilis*. Excellent discussion of this name and its problems in Bean (1). Not a cultivar, best considered as a synonym for *S. x blanda* Andersson.
- GOLDEN** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 573)—as a horticultural variety (*ramulis aureis*) of *S. babylonica*. Not a valid cultivar name.
- GOLDEN CURLS** (Girard Nurs., Geneva, Ohio, Cat. 1976, p. 29)—as *S. tortuosa aurea pendula*, a new golden-leaved willow "introduced by Charles Beardsley for first time this year". Had only been grown for four years prior to this date.
- LAVALLEI**—considered a valid cultivar of *S. babylonica* by Bean (1). A male clone, less pendulous than the female *S. babylonica* (**BABYLON**). May be the same as the male clone known in Japan as *S. babylonica* var. *lavallei* f. *seiko* Kimura. No plants listed under this name in American arboreta.
- MATSUDANA**—as *S. matsudana* Koidz. in 1915. Considered synonymous with *S. babylonica*.
- NAPOLEON**—according to Bean (1) plants of the true *S. babylonica* (**BABYLON**) were planted at the gravesite of Napoleon on St. Helena after his death in 1921. Whether the "Salix Napoleonis" sold by several nurserymen were of this clone or others is unknown. Not a valid cultivar name.
- NIOBE**—a common name of unknown origin and no particular botanical status, similar in its application to WISCONSIN (A. Rehder, Manual of cultivated trees and shrubs, 1940) as referring to a hybrid between *S. babylonica* and *S. fragilis* (*S. x blanda* Andersson). Name derived from tragic heroine in Greek mythology who wept for her murdered children. Not a valid cultivar name.
- PENDULA**—the name "pendula" has been applied to so many weeping or semi-weeping willows that it has lost any significance. Bean (1) considered **PENDULA** as a valid cultivar of *S. matsudana*, based on the female clone grown in Great Britain. However, a pendulous male clone sent to the Arnold Arboretum (U.S.) in 1908 is also mentioned. Might be considered as a valid name for the female clone if its identity can be verified.
- PETZOLDI**—as *S. petzoldi* Hort. and *S. petzoldi pendula* Hort. in synonymy of *S. blanda* (A. Rehder, Bibliography of cultivated trees and shrubs, 1949). Not a valid name at any level.
- RAMULIS AUREIS**—as *S. babylonica ramulis aureis* Hort., placed in synonymy of **CHRYSOCOMA** by Bean (1).
- RINGLEAF** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 573)—as a common name for *S. babylonica annularis* and *S. babylonica crispa*. = *S. babylonica* **CRISPA**.
- SACRAMENTO**—as a cultivar of *S. babylonica* in G. Krussmann, Manual of cultivated broad-leaved trees and shrubs (Vol. III, p. 280), English translation published by Timber Press, Portland, Oregon in 1986. Tree less weeping, crown open, large leaved. Strangely, not found in G. Krussmann, Hanbuch der Laubgehölze (1978), on which the English translation was based. The herbarium of the U.S. National Arboretum contains a specimen collected in 1955 in Argentina from a plant (female) labeled *S. babylonica* var. *sacramenta* which had been received under that name from Switzerland. It is therefore not possible to validate either *sacramenta* or 'Sacramento', but any connection of the name with Sacramento, California can be ruled out.
- SALAMONII**—considered a cultivar by Bean (1) as synonymous with "Sepulcralis", under *S. x sepulcralis* Simonkai (*S. x salamonii* Carr. ex Henry), a group of hybrids between *S. alba* and *S. babylonica*. First appeared on the property of Baron de Salomon before 1864 and was put into commerce by Simon-Louis Freres, Metz, France, in 1869. According to H.J. Elwes and A. Henry, the Trees of Great Britain and Ireland, 1913, Vol. VII, the young plants develop a handsome pyramidal crown, and only the tips of the branches are pendulous; only female trees known. Several trees with this growth habit have been observed in the Washington, DC area. Probably a valid cultivar name, but verified material should be introduced from Europe.
- SEPULCRALIS**—as *S. x sepulcralis* Simonkai (Oesterr. Bot. Zeitschr. 40:424.1890), *S. babylonica* x *S. alba*, a valid botanical epithet under which all hybrids between these two species must be placed. Not a cultivar.

**SEPULCRALIS**—*S. x sepulcralis* Simonkai (Oesterr. Bot. Zeitschr. 40:424.1890), *S. babylonica* x *S. alba*, a valid botanical epithet under which all hybrids between these two species must be placed. Not a cultivar.

**SOLOMON** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 575)—as a common name for *S. x sepulcralis*, with *S. salamoni* in synonymy, and noted as *S. alba* x *S. babylonica*. Not a valid cultivar name.

**THURLOW**—a common name of unknown origin often applied to plants known as *S. x elegantissima* K. Koch (A. Rehder, Manual of cultivated trees and shrubs, 1940). Apparently a female clone with longer branches than the plant known as "blanda". The plant should probably be considered as *S. x blanda* (*S. alba* x *S. fragilis*) but the name should not be used to denote a valid cultivar.

**TORTUOSA** (A. Rehder, J. Arnold Arb. 6:201-208, 1925)—as *S. matsudana* f. *tortuosa*. Based on *S. matsudana* var. *tortuosa* of Vilmorin (1924) and then in cultivation at Vilmorin's nursery near Paris. Upright growing, with tortuous and twisted branches. A female clone.

**TRISTIS**—as *S. alba* 'Tristis' Hort., placed in the synonymy of **CHRYSOCOMA** by Bean (1). This is not to be confused with *S. alba* var. *tristis* (Seringe) K. Koch, which is a form of *S. alba* with weeping branches. Plants grown in the United States under the name 'Tristis' are hybrids between *S. babylonica* and *S. alba* (*S. x sepulcralis* Simonkai) but the name cannot be unequivocally assigned to any particular clone.

**UMBRACULIFERA** (A. Rehder, J. Arnold Arb. 6:201-208, 1925)—as *S. matsudana* f. *umbraculifera*. Based on a 1906 USDA introduction by F.N. Meyer as *Salix* sp., Pl. 17737. Plants growing at Chico, California had developed dense subglobose crowns (20 ft tall, 30 ft crown spread) in 6 years. Called "bread willow" by Chinese because crown resembled a loaf of bread. Sex not noted in 1925, but a specimen in the herbarium of the U.S. National Arboretum, grown from cuttings of the original introduction, is female.

**UMBRELLA** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 574)—as a clone (*umbraculifera*) of *S. matsudana*. = *S. babylonica* **UMBRACULIFERA**.

**VITELLINA**—as *S. alba* var. *vitellina* (L.) Stokes in Bean (1), with *S. vitellina* L. in synonymy. The variety *vitellina* is a group of clones, some male and some female, having yellow twigs. Not a valid cultivar name under *S. alba*.

**VITELLINA PENDULA**—as *S. alba* var. *vitellina pendula* (Spath) Rehder, placed in synonymy under **CHRYSOCOMA** by Bean (1). This is the same clone described as *S. x chrysocoma* by Dode in 1908.

**VITELLINA PENDULA NOVA**—as *S. vitellina pendula nova* Spath, placed in the synonymy of **CHRYSOCOMA** by Bean (1). Plant put into commerce by Spath Nurs., Berlin, in 1888, but this clone was re-named *S. x chrysocoma* by Dode in 1908.

**VITELLINA TRISTIS**—considered a cultivar of *S. alba* by Bean (1). A semi-pendulous form of *S. alba* var. *vitellina* (L.) Stokes "received by the botanist Seringe from Baumann's nursery in Alsace a few years before 1815. Probably a valid cultivar of *S. alba*; but not of *S. babylonica* or its hybrid derivatives.

**WEeping** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 574)—as a clone (*pendula*) of *S. matsudana*. Not a valid cultivar name.

**WEepingGOLD** (H.P. Kelsey and W.A. Dayton, Standardized Plant Names, 1942, p. 573)—as a clone of *S. alba*, with *S.*

*alba tristis* and *S. (alba) vitellina pendula* as synonyms. Not a valid cultivar name.

**WISCONSIN**—a common name of unknown origin and no particular botanical status, usually used in the phrase "Wisconsin weeping willow" to refer to a taxon known botanically as *S. x blanda* Andersson (*S. babylonica* x *S. fragilis*), which may encompass several clones. The type for *S. x blanda* grew in Hessen, Germany and the only possible reason for the appellation "Wisconsin" might have been that a plant of this putative parentage was cold hardy somewhere in that state. Not a valid cultivar name.

### Isozyme Studies

In January, 1983, we solicited dormant cuttings of willows from: the Arnold Arboretum, Jamaica Plain, Massachusetts; the Morton Arboretum, Lisle, Illinois; and the University of Minnesota Landscape Arboretum, Chanhassen, Minnesota. Our request was based on the plants listed in the 1979 microfiche edition of the Master Inventory of Botanical Taxa published by the Plant Sciences Data Center of the American Horticultural Society. We asked for cuttings of each and every entry, by accession number, of plants bearing the epithets "babylonica", "blanda", "elegantissima", "matsudana", "sepulcralis", or "tristis". These plants were propagated, along with similar plants from the collections of the U.S. National Arboretum, by sticking six to ten untreated dormant cuttings directly into a soil mix contained in large wire baskets.

In 1984, we analyzed the leaves and cambial tissue of each clone for isozyme variability (peroxidase, alcohol dehydrogenase), using established techniques of starch-gel electrophoresis (3, 4). First of all, it was apparent that all 10 taxa identified as "tristis" were hybrids between *S. babylonica* and *S. alba*. This relationship could be determined by comparing their banding patterns with our specimen of 'Babylon' (NA 44011) and a clone of *S. alba* (NA 44016). Secondly, the 10 "tristis" (or "chrysocoma") taxa could actually be identified as four distinct clones! Interestingly, when we made the original requests for plant material, we had not realized that the four "tristis" accessions obtained from the Morton Arboretum represented only two clones. Our isozyme results did show this to be true, but also showed that these two "tristis" taxa were not identical.

Isozyme data also showed a remarkable similarity among an "elegantissima" from the Arnold Arboretum, a "sepulcralis" from the Morton Ar-

boretum, and a "babylonica" from the University of Minnesota. None of the "babylonicas" from the Morton Arboretum or the University of Minnesota was identical to the supposedly correct specimen of 'Babylon' (NA 44011) at the National Arboretum. Taxa designated as "blanda" could likewise be identified as four distinct clones.

Using only two isozyme systems, we could not "fingerprint" the various clones as accurately as one might wish, but this was not our intention. We only wished to examine genetic variability. Which specimen was, indeed, the *true* "tristis", or the *true* "Niobe"? Who can say? What we have shown is that many of the various names (species, hybrids, cultivars) under which weeping willows are presently cultivated in our major arboreta are virtually meaningless.

#### Disease Observations

The wire baskets containing the rooted willow clones were mulched in and overwintered in a coldframe in the National Arboretum lath house. During the spring of 1985, we noted a major "disease" outbreak on many of these plants. Black, sunken areas appeared on many of the stems and the portion of the stem distal to the "canker" died. The causal organism was cultured and identified as *Botryosphaeria dothidea* by Dr. R. Jay Stipes (VPI & SU, Blacksburg, VA). This condition was observed on National Arboretum specimen trees of 'Babylon' (NA 44011), 'Tortuosa' (NA 44014) and "tristis" (NA 8929, NA 43995) as well as plants of 'Crispa' and 'Pendula' from the Arnold Arboretum. At least one plant of every name was infected but at least one plant of every name seemed to be resistant. It was noteworthy that only one of eight clones from the Arnold Arboretum was resistant while eight of nine from the Morton Arboretum had no infection. These apparently resistant Morton trees included both clones of "tristis", neither of which agreed isozymically with the National Arboretum trees under the same name. As a matter of interest, we attempted artificial inoculation of *B. dothidea* into stems of 1-year-old rooted cuttings in the greenhouse, but no symptoms developed. Apparently, cold weather or other stresses are necessary for symptom development on plants

with a certain proportion of germplasm from *S. babylonica*. In 1986, we established a permanent field test plot for all of the clones included in this study.

#### Conclusions and Recommendations

It may be that a weeping willow, by any name, should be suspect. However, we think that agreement can be reached on establishing and maintaining the identities for the the various valid cultivars of *S. babylonica* and others recognized above. The various hybrid "weepers" are another matter. It may not, or, more likely, will never be possible to find, identify, or verify a clone to fit each name. There may be more clones than names, or more names than clones. Whatever the case, we recommend that the use of most, if not all cultivar names considered invalid in this paper be abandoned by the nursery trade. There is no need to continue the confusion already rampant.

There may, indeed, be some weeping willows in our arboreta and nurseries that are superior to most of the others. If so, we should be propagating them, naming, and using them. If nothing else, we should know what to expect when we purchase and plant a tree of a particular cultivar.

#### Literature Cited

1. Bean, W.J. 1980. Trees and shrubs hardy in the British Isles, Ed. 8, Vol. IV.
2. Rehder, A. 1925. *New species, varieties, and combinations from the herbarium and collections of the Arnold Arboretum*. J. Arnold Arb. 6:201-208.
3. Santamour, F.S., Jr. 1982. *Cambial peroxidase isoenzymes in relation to systematics of Acer*. Bull. Torrey Bot. Club 109:152-161.
4. Santamour, F.S., Jr. and P. Demuth. 1980. *Identification of Callery pear cultivars by peroxidase isozyme patterns*. J. Hered. 71:447-449.
5. Skvortsov, A.K. 1968. Willows of the USSR. (In Russian, with English summary) Nauka, Moscow.
6. Zohary, M. 1982. *Plants of the Bible*. Cambridge Univ. Press, 223 p.

*Research Geneticist and Horticulturist,  
respectively*

*U.S. National Arboretum  
Agricultural Research Service  
U.S. Department of Agriculture  
Washington, DC 20002*