



Article

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Identity of *Salix chilensis* Molina (Salicaceae)George W. Argus,¹ Irina V. Belyaeva,^{2,3*} and Kanchi N. Gandhi⁴¹Canadian Museum of Nature, Ottawa, Ontario, Canada.Email: argusmary@gmail.com²Royal Botanic Gardens, Kew, Richmond, TW9 3AE, UK³Russian Academy of Sciences, Ural Branch: Institute Botanical Garden, 8 Marta, 202A, Yekaterinburg, 620144, Russia⁴Harvard University Herbaria, 22 Divinity Ave. Cambridge, Massachusetts 02138, USEmail: gandhi@oeb.harvard.edu*Corresponding author. Email: i.belyaeva@kew.org, willow.belyaeva2017@yandex.com

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Abstract

The problem with the current use of two names, *Salix chilensis* Molina and *S. humboldtiana* Willd., for the same taxon is presented. The identity of *S. chilensis* based on historical facts is discussed. As the continued use of two names for a single taxon is a source of taxonomic confusion, formal rejection of the name, *S. chilensis*, is suggested and the name *S. humboldtiana* is accepted here for current use. The typification of two homotypic names, *S. humboldtiana* and *Pleiarina humboldtiana*, is made.

Keywords: historical collections, nomenclature, *Salix*, Salicaceae, *Salix humboldtiana*, taxonomy, typification

Introduction

There is only one native species of *Salix* in South America but there are two names for that taxon in current use, *Salix chilensis* Molina and *S. humboldtiana* Willd. Since the first published references to *Salix* in South America both names have been used, *S. humboldtiana* being favoured (Schneider, 1918; Standley and Caldéron, 1925; Uphof, 1947; Ragonese and Alberti, 1958 a, b; Hunziker, 1958, 1962; Seymour, 1980; Cowan, 1983; Breedlove, 1986; Balik *et al.*, 1992; Brako and Zarucchi, 1993; Salas Estrada, 1993; López, 1993; Kiesling, 1994; Hoffman, 1995; Argus, 1997; Jørgensen and León-Yánes, 1999; Zuloaga and Morrone, 1999; Garguillo, 2008; Parker, 2008; Zmarzty and Argus, 2008; Argus, 2010; Dorn, 2010; Jørgensen *et al.*, 2013; Lægaard and Balslev, 2014; Berendson *et al.*, 2016; Bernal *et al.*, 2016; Villaseñor Rios, 2016; Zuloaga, and Belgrano, 2017; Ulloa *et al.*, 2017; 2018; Marchelli *et al.*, 2020; Belyaeva and Govaerts, 2021; *Plants of the World Online* (POWO, 2021), *Tropicos* (2021) and *Catalogue of Life* (CoL, 2016–) but some authors and indices use both names (Newsholme, 1992) or use the name *S. chilensis* as an earlier published name (Macbride, 1937; Caldéron and Standley, 1941; Standley and Steyermark, 1952; Gunckel Lüer, 1972; Meikle, 1989; Barrera and Meza, 1997; Acevedo-Rodríguez and Strong, 2012).

Few authors attempted to explain why they selected one name over the other but those who have studied the problem thoroughly conclude that the name *Salix chilensis* remains an enigma. Some advocate its acceptance as an earlier, validly published name but others do not use this name on the grounds that the identity of the taxon is ambiguous. The continued use of two names for a single taxon is a source of taxonomic confusion, thus the purpose of this paper is to reconsider the currently available evidence and suggest possible solutions.

Material and methods

The specimens of the discussed willows were studied at A, **ASU**, B, BAF, BAS, BM, BOCH, BR, **COL**, **DES**, DR, E, F, FI, FR, **FRP**, G, GH, **GENT**, H, JBRJ, K, L, LE, LINN, MA, MHA, MO, MW, NY, **P**, RB, **RSA**, S, U, UPS, **US**, W, **WAG**, WU by visiting the herbaria or using online virtual herbaria (in bold) available via *JSTOR Global plants* (JSTOR, 2021), Virtual Herbaria (2011–) and *Global Biodiversity Information Facility* (GBIF, 2021). Herbarium codes are given as in Thiers (2021). Taxonomic opinions provided in the current literature and taxonomic databases such as *The World Checklist of Vascular Plants* (WCVP, 2021), *Catalogue of Life* (CoL, 2016–), Plants of the World Online (POWO, 2021) and *Tropicos* (2021) were analysed, and references are given accordingly. Abbreviations of authors' names and publications are cited as in the nomenclatural database *International Plant Names Index* (IPNI, 2021). For providing distribution data *The World Geographical Scheme for Recording Plant Distribution* (Brummitt, 1992) and further updates on the website of the *Taxonomic Database Working Group* (TDWG, 2021) were used. Distribution data from the available literature and current versions of WCVP (Govaerts, 2021), CoL (2016–), (POWO, 2021), Tropicos (2021) and GBIF (2021) were carefully analysed and referred to.

Historical background

The protologue for *Salix chilensis* (Molina, 1782: 169, 355) consists of a description, discussion, and its placement in the Linnaean system. The Latin description appeared as a footnote on page 169: “*Salix* fol. integerrimis glabris lanceolatis acuminatis” and then on page 355: “*Salix Chilensis* fol. Integerrimis, glabris, lanceolatis, acuminatis”. The discussion in the original (Molina, 1782: 169) reads: “Il Salce, *Salix Chilensis* che gl' Indiani chiamano *Thiege*, non differisce dall' Europeo, che nelle foglie, le quali sono intiere, sottili, e di un verde gialligno: questo albero produce una gran quantiti di manna tutti gli anni. I contadini bevono con buon successo l'infusione della sua scorza nelle febbri ardenti.”

Soon after the publication of Molina's *Saggio sulla storia naturale del Chili*, translated versions appeared in German, Spanish, French, and English. The discussion in the English version (1808: 117) reads as follows: "The theige (*Salix Chilensis*) differs from the European willow in its leaves, which are entire, slender, and of a yellowish green. This tree yields annually a great quantity of manna, the country people also make use of the bark which they believe possesses a highly febrifugal quality."

In addition, Molina (1782: 355) placed *Salix chilensis* within the Linnaean system into Class Dioecia, Order Diandria indicating that the flowers are unisexual with two stamens.

Before considering the protologue and the identity of Molina's species a brief review of the circumstances surrounding Molina's publication are pertinent. The following information is based on the biography by Ronan (2000).

Juan (later Giovanni) Ignacio Molina was born in 1740 near the present-day city of Villa Alegre (vicinity of Talca), Chile. His father, an enthusiastic naturalist, instilled in him a love of natural history and, at every opportunity, he studied the natural world of his native Chile, mainly in the region from Talca to Santiago. At 17 years old he took Holy vows but soon was caught up in the expulsion of the Jesuits from the Spanish empire in 1767. Before he left Chile in 1768, never to return, he was regarded to be a knowledgeable student of natural history. As he boarded the ship to sail for Spain his notes and research materials on the flora, fauna, and history of Chile were either confiscated or stolen under unclear circumstances which was a severe blow to his hopes for publication. In 1769 he arrived in Bologna, Italy, where he received Holy Orders, and served as a teacher and scholar. At that time Chile was virtually unknown in Europe and misconceptions about this country were common. This strengthened Molina's resolve to make Chile known to his new countrymen. So even without access to his notes and other sources he wrote, anonymously, the first work on Chile to be published in Europe (Molina, 1776). At around the same time his notes, somewhat damaged, were recovered and he also secured access to contemporary scholarly works and to European scientists. This made it possible for him to write a more complete, scholarly work. His *Saggio sulla storia naturale del Chili* (Molina, 1782) was published in Italian and soon translated into other major European languages. It appeared in two volumes, the first dealing with the natural history of Chile and the second its civil history (Molina, 1808). In 1810 he published a second edition of his *Saggio sulla storia naturale del Chili* (Molina, 1810) to present new information and correct errors. These works were remarkable for their time and contributed to his stature as an eminent and respected naturalist. Although his two editions of the *Saggio sulla storia naturale del Chili* are replete with errors and inaccuracies, considering the time and conditions under which he

worked, that he wrote largely from memory and that he did not return to Chile after he left there at the age of 28, his contribution to the natural and cultural history of Chile are significant.

The points in this historical review most pertinent to a consideration of the name *Salix chilensis* are: (1) Molina lived and botanised in a part of Chile where species of *Salix* occur today, and he could have known this common riparian tree species. (2) His account was written largely from memory and contained many serious errors but nevertheless, many species described by him have been typified by later authors. (3) Under the circumstances of his expulsion from Chile he was unable to bring his collected specimens with him. Thus, the absence of his botanical specimens in the herbarium at Bologna (BOLO, Annalisa Managlia, pers. comm.) is not surprising. Therefore, any decisions about *Salix chilensis* must rely on circumstantial evidence.

Nomenclature and taxonomy

The description of *Salix chilensis*, as given in Molina's protologue (1782), is very brief. The native Chilean *Salix* has narrow leaves but they are more linear than lanceolate and the margins are distinctly toothed not entire ([Schneider, 1918: 6](#)), the plants are dioecious but stamen number is 4–9 not two as placement in Linnaeus' Dioecia, Diandra would imply, unless Molina had seen only plants with pistillate flowers or plants in a vegetative state. The febrifugal qualities of *Salix* are well documented (Lewis and Elvin-Lewis, 1977) but the reference to its producing copious manna does not fit any *Salix*. Finally, the Indian common name "theige," cited by Molina, is not a name applied to willow but to laurel (Gay, 1851–1852). The protologue, therefore, does not correspond completely to the native *Salix*.

Several botanists have grappled with the problem of the identity of *Salix chilensis*. Opinions range from Hauman (1923) who proposed the rejection of Molina's names as "nomina nuda" to Johnston (1924) who advocated the acceptance of Molina's names (but not specifically *Salix chilensis*) if they could be satisfactorily identified, if only by the common name or the folk uses.

Andersson ([1868: 199](#)) cited *Salix chilensis* as a synonym of *S. humboldtiana* Willd. without explanation. However, the editor, Alfonse de Candolle (Andersson, [1868: 199](#)), added a footnote: "Nomen Chilensis Molinae vetustius, ideo admittendum", to point out that the synonym was an earlier name. Later, in the same volume, under Addenda et Corrigenda, De Candolle (Andersson, [1868: 684](#)) added without further explanation, "Nomen vetustius *S. Chilensis* Molinae merito relinquendum est, quia planta in Chili non spontanea, quod cl. auctor non dixerat (Alph. DC)." thereby excluding *S. chilensis* from the Prodrumus because it was

not native. No additional information was discovered in the correspondence between N. J. Andersson and A. P. De Candolle by one of the authors of the current paper either in Stockholm University Archive, Sweden, or in Geneva Botanical Garden Library Archive, Switzerland.

Both, Schneider (1918) and Hauman (1923), expressed the view that Molina was not referring to a *Salix* at all. Hauman argued that the Indian common name “theige” refers to laurel not to willow. He finally decided, however, to treat *Salix chilensis* as a name “restés tout à fait mystérieux.” However, other botanists such as Gunckel Lür (1972) accepted *Salix chilensis* as the correct name. Although most botanists use the name *S. humboldtiana*, Newsholme (1992: 65, 85) recognized both species and others recognize *S. chilensis* as the correct one (Barrera and Meza, 1997; Acevedo-Rodríguez and Strong, 2012).

In regard to the use of the “gl’ Indian” common name “theige”, Molina (1782) recognized no laurel in this edition of *Saggio sulla storia naturale del Chili*, but in the second edition (Molina, 1810), in which he deliberately excluded *Salix*, he described the laurel, *Thiga chilensis*, which Philippi (1864: 23) treated as a synonym of *Laurelia aromatica* Spreng. (now *L. sempervirens* (Ruiz & Pav.) Tul.). This suggests that Molina may have thought that *S. chilensis* was a laurel, but *Laurelia* does not fit Molina’s protologue of *Salix chilensis* in any way except that its flowers produce copious quantities of an oily substance that could be described as manna. It is unlikely to have been confused with *Salix*. It is more likely that the name was a misspelling of “tihue” or “trihue” the common names used by the Mapuche Indians for *Laurelia sempervirens*.

Philippi (1864) in his thorough study of Molina’s names, was able to clarify the identity of many of Molina’s poorly described taxa. He did not, however, accept *Salix chilensis* but treated it as a synonym of *S. humboldtiana*. Andersson (1868) may have been following Philippi’s lead in his treatment. According to Philippi (1864), Molina, in preparing the 1810 revision, relied on floras published since his *Saggio sulla storia naturale del Chili* (Molina, 1782) including, Feuillée (1714–1715, 1756) and Feuillée and Huth (1766), Cavanilles (1791–1801), Ruiz and Pavón (1789) and Willdenow (1806).

Molina does not seem to have been aware of *S. humboldtiana*, published by Willdenow (1806: 657) or that it may have been the same as his *S. chilensis*. Among the other floras, only Ruiz and Pavón in *Sistema vegetabulum florum peruvianae et chilensis* (1789), which ceased publication before the volume including *Salix* was published, could have been useful to Molina. It is of interest that, although they did recognize some of Molina’s names in their published volumes, they did not propose to use the name *Salix chilensis*. In their unpublished *Salix* treatment (information was kindly provided by Dr. Paloma Blanco, University of Madrid) they

recognized *Salix pyramidata* and *S. heptandra*. Both have serrate leaves and 7 or 8 stamens and thus do not fit Molina's description of *S. chilensis* but they do fit *S. humboldtiana*. The name *S. pyramidata* fits *S. humboldtiana* var. *fastigata* André and *S. heptandra* fits *S. humboldtiana* var. *humboldtiana* (with more or less pendulous branches). The unpublished journals of Ruiz and Pavón (1777–1788, pers. comm. by G.W.A. with Paloma Blanco) could have been helpful to Molina because they reported seeing *S. hermaphroditica* (this name is unpublished but many specimens of *S. humboldtiana* are hermaphroditic), *Salix helix* L. (possibly introduced European *S. purpurea*), and *S. pyramidata*, noted above. Other floras of the region, published at that time, would not have been useful because none of them included *Salix*.

The question of whether or not *Salix chilensis* could have been an introduced *Salix* (Andersson in De Candolle 1868) or a hybrid involving one is not easily answered.

Schneider (1918) did not believe that *Salix babylonica* L., one of the most commonly grown introduced species in Chile, was introduced at the time Molina described his new species. We can find no information on when *Salix* was first introduced aside from the journal kept by Lady Callcott (Callcott, 1824). She reported seeing three willows in Chile in 1822–1823, “one like that of Europe; another called Simaroon; and a third Mimbre.” The name “simaroon” or “cimaroon” is sometimes applied to *S. humboldtiana* (Abalos, 2002) and the name “mimbre” is applied to *S. viminalis* L. (López, 1993). The latter with its narrow, entire leaves and two stamens best fits the protologue of *S. chilensis*. The possibility that *S. viminalis* had been introduced into Chile 50 years before it was seen by Lady Callcott, is not unreasonable, and corroborates the claim by De Candolle (see Andersson, 1868) that *S. chilensis* was an introduction. The only question that could be raised is that Molina did not note the presence of the characteristic densely silky indumentum on the abaxial leaf surface of *S. viminalis*, although it should be remembered that he wrote his description from memory. Reports by both, Callcott (1824) and by Ruiz and Pavón (1789), used only the common name, which may have been incorrectly applied, and *S. viminalis* was not included by Ruiz and Pavón in their unpublished manuscript.

Newsholme (1992), who recognized both species, *Salix chilensis* and *S. humboldtiana*, described *S. chilensis* as having leaf margins “regularly serrate” but made no mention of stamen number. He believed it to be a hybrid between *S. humboldtiana* and *S. alba* L. because it has “a preponderance of *S. alba* characteristics,” but did not say what these characteristics were or make reference to the entire leaves and two stamens mentioned in the protologue of *S. chilensis*. In support of his hybrid-hypothesis he noted that *S. alba* was imported from Europe early in

the 20th Century. His ‘evidence’ is irrelevant to the question of hybridization because Molina described *S. chilensis* over 100 years earlier and there is no evidence that *S. alba* was introduced at that time. The two ‘species’ Newsholme recognized probably are the fastigate and pendulous variations of *S. humboldtiana* mentioned above rather than support for the recognition of *S. chilensis* as an accepted name.

We considered four possible hypotheses for the identity of *Salix chilensis*: (1) it was a species of *Salix* native to Chile, (2) it was a hybrid, (3) it was an introduced species or (4) it was not a *Salix* at all.

(1). The possibility that it is a native species of *Salix* was not supported by the protologue or by Molina's removal of the species from his *Saggio sulla storia naturale del Chili* (Molina, 1810). (2). There is no evidence to support the hybrid hypothesis. (3). Evidence that *Salix chilensis* may be the introduced *S. viminalis* is based on its reported occurrence in Chile (Callcott, 1824) and its uncanny fit with the protologue. However, to conclude that *S. chilensis* is a synonym of *S. viminalis* would be based on insufficient evidence. (4). The most likely explanation is that *S. chilensis* was not a *Salix* at all. This was indirectly suggested by Molina's removal of the name in 1810 (Molina, 1810). It is possible that in this revision of his *Saggio sulla storia naturale del Chili* (Molina, 1810) he was uncertain about the identity of his *S. chilensis* and because of his distance from Chile and the lack of specimens he would have been unable to solve the problem. His reliance on published floras in solving the problem would not have helped as, up to that time, no one except Willdenow (1806), mentioned *Salix* for that region. It is not possible to assume that Molina knew of Willdenow's *S. humboldtiana* or if he recognized that it may be his *S. chilensis*. If he did, the question remains why he removed it from his *Saggio sulla storia naturale del Chili* (Molina, 1810) and did not replace it with *S. humboldtiana*. These questions cannot be answered. The later opinions by Gay (1851–1852), Schneider (1918), and Hauman (1923) are all assertions based on circumstantial evidence and do not constitute a proof one way or another. At one point in our study, we were inclined to accept Molina's name and to typify it as the native *Salix* he could have known in Chile but were dissuaded by Molina's own ‘rejection’ of the name in 1810. At that time, he not only removed the description and discussion but also removed the Linnaean order and class in which he previously placed *S. chilensis*. We agree with the many others who have considered the problem that the identity of *Salix chilensis* remains a mystery. It is reasonable, therefore, to formally reject *S. chilensis* as a name unsupported by original material and so impossible to positively identify because the protologue contains characters of more than one taxon, and

especially because the author himself intentionally omitted this name from a later edition of *Saggio sulla storia naturale del Chili* (Molina, 1810).

As mentioned in the Introduction, *Salix humboldtiana* is accepted in most recent taxonomic treatments in American Floras and Checklists, as well as in modern taxonomic databases. For current synonymy for this species see the *World Checklist of Salicaceae sensu stricto* (Belyaeva and Govaerts, 2021).

Salix humboldtiana Willd., [Sp. Pl., ed. 4 \(C.L. Willdenow\) 4\(2\): 657. 1806.](#) ≡ *Pleiarina humboldtiana* (Willd.) Raf., [Alsogr. Amer.: 15. 1838.](#)

Type: Ecuador, A. J. A. Bonpland & F. W. H. A. v. Humboldt 3398, ♀ ([B-W-18108020!](#) – lectotype, **designated here** by I. V. Belyaeva); syntype: Venezuela: in cultis Caracas, A. J. A. Bonpland & F. W. H. A. v. Humboldt 1095, veg. ([B-W-18108-010!](#))

Protologue citation: “Habitat in Peru, et culta in America calidiori. Humboldt et Bonpland. (v. J. ♀).”

Note: Four specimens in the Willdenow herbarium at B that belong to *Salix humboldtiana* were studied: [B-W-18108-010!](#) (as *S. humboldtiana*); [B-W-18108-020!](#) (as *S. humboldtiana*) [B-W-18109-010!](#) (as *S. falcata*) [B-W-18110-010!](#) (as *S. acuta*). The first two of them, named by Willdenow as *S. humboldtiana*, correspond to the protologue and belong to the original material. The herbarium specimen B-W-18108020 with leaves and catkins with pistillate flowers is selected here as the lectotype.

Etymology: *Salix humboldtiana* was named after the German naturalist, Friedrich Wilhelm Heinrich Alexander von Humboldt, who was one of its collectors.

Distribution: Native range is Mexico to S. South America ([Salix humboldtiana Willd., POWO, 2021](#)).

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Author's contributions

George W. Argus (GWA) together with KNG initiated the project, investigated the historical, nomenclatural and taxonomic background of the problem, participated in discussion of nomenclature and taxonomy and prepared the first draft of the manuscript.

Irina V. Belyaeva (IVB) discussed with GWA and KNG nomenclatural and taxonomic aspects, studied correspondence of A.P. de Candolle and N.J. Andersson and herbarium specimens of *Salix humboldtiana* at G, S and in C. L. Willdenow's collection at B, made corrections and additions to the original draft, prepared the final version of the manuscript and together with KNG coordinated the last stage of the project.

Kanchi N. Gandhi (KNG) together with GWA initiated the project, discussed nomenclatural and taxonomic aspects of the research, made corrections and additions to the original draft and together with IVB coordinated the last stage of the project.

References

- Abalos Romero, M.I. (Ed.)** 2002. Silviculture y producción sauce-mimbres *Salix* spp. Santiago, Chile: FONDEF/FDI/INFOR/CORFO.
- Acevedo-Rodríguez, P. and Strong, M.T.** 2012. Catalogue of seed plants of the West Indies. *Smithsonian Contr. Bot.* 98: 1–1192.
- Andersson, N.J.** 1868. Salicineae: *Salix* L. In: [De Candolle, A.P. Prodrômus systematis naturalis regni vegetabilis 16\(2\). Parisii: Sumptibus Victoris Masson et Filii: 190–323.](#)
- Argus, G.W.** 1997. Infrageneric classification of *Salix* (Salicaceae) in the New World. *Syst. Bot. Monogr.* 52: 1–121.
- Argus, G.W.** 2010. *Salix* L. In: Flora of North America Editorial Committee (Eds.) *Flora of North America*, vol. 7. New York: Oxford University Press: 23–162.
- Balik, M.J., Nee, M.H. and Atha, D.E.** 2000. Checklist of the Vascular Plants of Belize. *Memoirs of the New York Botanical Garden* 85: The New York Botanical Garden Press: 76.
- Barrera, E. and Meza, P.I.** 1997. Características de la epidermis foliar de árboles Chilenos. III. Subclase Dilleniidae. [Bol. Mus. Nac. Hist. Nat. Santiago de Chile 46: 33–43.](#)
- Belyaeva, I.V. and Govaerts, R.H.A.** 2021. Genera *Populus* L. and *Salix* L. In: Govaerts, R.H.A. (Ed.) *The World Checklist of Vascular Plants (WCVP)*, <https://wcvp.science.kew.org/> (Accessed 28 February 2021).

- Berendson, W.G., Gruber, A.K., Rodríguez Delcid, D. and Olmedo Galán, P.** 2016. Nova Silva Cuscatlantica 3: Angiospermae – Familias R a Z y Gymnospermae. Englera 29(3): 1: 356.
- Bernal, R., Gradstein, R.S. and Celis, M. (Eds.)** 2016. Catálogo de plantas y líquenes de Colombia 1-2. Libro Impreso: 1-3068.
- Brako, L. and Zarucchi, J.L.** 1993. Catalogue of the Flowering Plants and Gymnosperms of Peru. Monogr. Syst. Bot. Missouri Bot. Gard. 45: 1–1296.
- Breedlove, D.E.** 1986. Flora de Chiapas. Listados Florist. México 4: i–v, 1–246.
- Brummitt, R.K.** 1992. World Geographical Scheme for Recording Plant Distributions, ed. 2. Pittsburgh: Hunt Institute for Botanical Documentation Carnegie Mellon University. TDWG – <https://www.tdwg.org>, <https://www.tdwg.org/standards/wgsrpd/> (Accessed 28 February 2021).
- Caldéron, S. and Standley, P.C.** 1941. Flora Salvadoreña. Lista preliminar de plantas de El Salvador, 2nd ed. San Salvador: Imprenta Nacional: 85.
- Callcott, Maria, Lady.** 1824. [Journal of a residence in Chile, during the year 1822; and a voyage from Chile to Brazil in 1823](#). London: Printed for Lungman, Hurst, Rees, Orme, Brown, and Green, Paternoster Row; and John Murrey, Albemarle-Street.
- Catalogue of Life (CoL).** 2016–. <https://www.catalogueoflife.org/col/> (Accessed 28 February 2021).
- Cavanilles, A.J.** 1791–1801. Icones et descriptions plantarum. Madrid: Typographia regia.
- Cowan, C.P.** 1983. Flora de Tabasco. Listados Florist. México 1: 1–123.
- Dorn, R.D.** 2010. Willows of North America. Lulu Publisher.
- Feuillée, L.** 1714–1715. Histoire des plantes médicinales.
- Feuillée, L.** 1756. [Beschreiben zur Arzeney dienlicher Pflanzen](#). Nürnberg: Johan Michael Seligmann.
- Feuillée, L. and Huth, D.G.L.** 1766. Beschreiben zur Arzeney dienlicher Pflanzen. Nürnberg: Seligmannischen Erben.
- Garguillo, M.B.** 2008. A Field guide to plants of Costa Rica. Oxford: University press: 72–73.
- Gay, C.** 1851–1852. Historia física y política de Chile. Botanica. 5(3): 384. Paris.
- Global Biodiversity Information Facility (GBIF).** 2021. www.gbif.org (Accessed 28 February 2021).
- Gunckel Lüer, H.** 1972. Plantas chilenas descritas como nuevos por Juan Ignacio Molina y sus concordancias con la nomenclatura botánica actual. [Not. Mens. Mus. Nac. Hist. Nat. 17\(197\): 3 – 11](#).

- Hauenstein, E., Peña-Cortés, F., González, M. and Schlatter, R.** 2005. New distribution range limits of *Salix humboldtiana* Willd., Salicaceae, in Chile. [Gayana Bot. 62: 44–46.](#)
- Hauman, L.** 1923. Notes sur le saule sud-américain et sur la valeur des espèces botaniques de Molina. Physis (Buenos Aires) 7(24): 67–81.
- Hoffman, A.J.** 1995. Flora Silvestre de Chile. Zona central, 3rd. ed. Santiago: “El Mercurio,” Santa Maria 5542.
- Hunziker, J.H.** 1958. Estudios citogeneticos en *Salix humboldtiana* y en sauces hybridos triploides cultivados en la Argentina. Revista Invest. Agrícolas 12: 155–171.
- Hunziker, J.H.** 1962. The origin of the hybrid triploid willows cultivated in Argentina. Silvae Genet. 151–153.
- International Plant Names Index (IPNI).** 2021. <https://beta.ipni.org/> (Accessed 28 February 2021).
- Johnston, I.M.** 1924. On the validity of Molina’s scientific names. [Contr. Gray Herb. 70: 90–92.](#)
- Jørgensen, P.M., and León-Yánes, S. (Eds.)** 1999. Catalogue of the Vascular Plants of Ecuador. Monogr. Syst. Bot. Missouri Bot. Gard. 75: 1–1181.
- Jørgensen, P.M., Nee, M.H. and Beck, S.G. (Eds.)** 2013. Catálogo de la plantas vasculares de Bolivia. Monogr. Syst. Bot. Missouri Bot. Gard. 127: 1–1741.
- JSTOR Global Plants (JSTOR).** 2021. <https://plants.jstor.org/> (Accessed 28 February 2021).
- Kiesling, R.** 1994. Salicaceae. In: Kiesling, R., Múlgura, M.M. and Múlgura, E.A. (Eds.), Flora of San Juan 1: 40–43.
- Lægaard, S. and Balslev, H.** 2014. 24. Salicaceae. In: Persson, C. H. and B. Ståhl (Eds.). Fl. Ecuador 91(24): 28.
- Lewis, W.H. and Elvin-Lewis, M.P.** 1977. Medical Botany: Plants affecting man’s health. New York: John Willey & Sons.
- López R.P.** 1993. Salicaceae. In: Killeen, T.J., Garcia, E. and Beck, S.G. (Eds.). Guía de árboles de Bolivia. La Paz, Bolivia: Herbario Nacional de Bolivia, Missouri Botanical Garden: 717–718.
- Macbride, J.F.** 1937. Salicaceae. In: Flora of Peru. [Publ. Field Mus. Nat. Hist., Bot. Ser. 13\(2, 2\): 260–261.](#)
- Marchelli, P., Sanguinetti, J., Izquierdo, F., Ziegenhagen, B., Martin, A., Mattioni, C., Gallo, L.A., Amico, I., Bozzi, J., Cedres Gazo, M., Cerillo, T., Datri, L., Hansen, M., Leyer, I., López, H., Martinez, A., Pablo Micuk, J., Orellana, I., Pomponio, F., Puntieri, J., Salgado, M., Torales, S. and Vincon, S.** 2020. *Araucaria araucana* and *Salix*

- humboldtiana*: two species highly appreciated by the society with domestication potential. In: Pastorino, M.J. and Marchelli, P. (Eds.). Low intensity breeding of native forest trees in Argentina. Springer: 175–216.
- Meikle, R.D.** 1989. *Salix*. In: Cullen, J., Knees, S.G. and Cubey, H.S. (Eds.). The European Garden Flora III. Cambridge: Cambridge University Press: 21–42.
- Molina, G.I.** 1776. Compendio della storia geografica, naturale, e civile del Regno del Chile. Bologna: Stamperia di S. Tommaso d'Aquino.
- Molina, G.I.** 1782. [Saggio sulla storia naturale del Chili](#). Bologna: Nella Stamperia di S. Tomaso d'Aquino: 169, 355.
- Molina, G.I.** 1808. [The geographical, natural and civil history of Chili](#) 2. Middletown, (CONN.): Printed for I. Riley.
- Molina, G.I.** 1810. [Saggio sulla storia naturale del Chili](#). Bologna: Tipografia de' Fratelli Masi e Comp.
- Newsholme, C.** 1992. Willows. The genus *Salix* L. London: Timber Press.
- Parker, T.** 2008. Salicaceae. In: Trees of Guatemala. Austin: The Tree Press: 823–825.
- Philippi, R.A.** 1864. Commentar zu den Molina beschriebenen chilenischen Pflanzen. [Bot. Zeitung \(Berlin\) 22: 1–24](#).
- Plants of the World Online (POWO).** 2021. <http://plantsoftheworldonline.org/> (Accessed 28 February 2021).
- Ragonese, A.F. and Alberti, F.R.** 1958a. Sauces híbridos originados naturalmente en la Rep. Argentina. Revista Invest. Agric. 12: 11–153.
- Ragonese, A.F. and Alberti, F.R.** 1958b. Mejoramiento de sauces en la República Argentina. Revista Invest. Agric. 12: 225–246.
- Ronan, C.E.,** 2000. Juan Ignacio Molina. The World's Window on Chile. American University Studies.
- Ruiz, H. and Pavón, J.** 1777–1778. Unpublished journals. *Salix* L. from Archive at the Madrid University. Pers. Communication G. W. Argus with Paloma Blanco.
- Ruiz, H. and Pavón, J.** 1789. Sistema vegetabilium florum peruvianae et chilensis. Madrid: Typis Gabrielis de Sanca.
- Salas Estrada, J.B.** 1993. Salicaceae. In: Árboles de Nicaragua. Managua, Nicaragua: Instituto Nicaraguense de Recursos Naturales y del Ambiente: 280–281.
- Schneider, C.** 1918. A conspectus of Mexican, West Indian, Central and South American species and varieties of *Salix*. [Bot. Gaz. 65\(1\): 1–41](#).

- Seymour, F.C.** 1980. Salicaceae. In: A checklist of the vascular plants of Nicaragua: based largely on collections in Nicaragua made by the author and companions 1968–1976. Plainfield, N.J.: Harold N. Moldenke: 118.
- Standley, P.C. and Caldéron, S.** 1925. Salicaceae. In: Lista preliminar de las plantas de El Salvador. San Salvador: Tip. La Unión, Dutriz hermanos: 63.
- Standley, P.C. and Steyermark, J.A.** 1952. Salicaceae. In: Flora of Guatemala 3. [Fieldiana, Bot. 24\(3\): 342–348.](#)
- Thiers, B. (Ed.)** 2021. [Continuously updated] Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available from: <http://sweetgum.nybg.org/science/ih/> (Accessed 28 February 2021).
- Tropicos.** 2021. <https://www.tropicos.org/home> (Accessed 1 February 2021).
- Ulloa, C., Acevedo-Rodríguez, P., Beck, S.G., Belgrano, M.J., Bernal, R., Berry, P.E., Brako, L., Celis, M., Davidse, G., Gradstein, S.R., Hockhe, O., León, B., León-Yánes, S., Magill, R.E., Neill, D.A., Nee, M.H., Raven, P.H., Stimmel, H., Strong, M.T., Villaseñor Rios, J.L., Zarucchi, J.L., Zuloaga, F.O. and Jørgensen, P.M.** 2017. An integrated assessment of vascular plant species of the Americas. *Science* 358: 1614–1618.
- Ulloa, C., Acevedo-Rodríguez, P., Beck, S.G., Belgrano, M.J., Bernal, R., Berry, P.E., Brako, L., Celis, M., Davidse, G., Gradstein, S.R., Hockhe, O., León, B., León-Yánes, S., Magill, R.E., Neill, D.A., Nee, M.H., Raven, P.H., Stimmel, H., Strong, M.T., Villaseñor Rios, J.L., Zarucchi, J.L., Zuloaga, F.O. and Jørgensen, P.M.** 2018 (onwards). An integrated assessment of vascular plant species of the Americas ([Online Updates](#)).
- Uphof, J.C.** 1947. The geographical distribution of *Salix humboldtiana* in comparison with other *Salix* species. *Jaarb. Ned. Dendrol. Ver.* 16: 76–82.
- Villaseñor Rios, J.L.** 2016. Checklist of the native vascular plants of Mexico. *Revista Mex. Biodivers.* 87: 559–902.
- Virtual Herbaria.** 2011–. <https://herbarium.univie.ac.at/database/> (Accessed 28 February 2021).
- Willdenow, C.L.** 1806. *Salix* L. In: [Caroli a Linné Species Plantarum 4\(2\)](#). Berlin: 653–710.
- World Checklist of Vascular Plants (WCVP).** 2021. <https://wcvp.science.kew.org/> (Accessed 28 February 2021).
- Zmarzty, S. and Argus, G.W.** 2008. Salicaceae. In: Zuloaga, F.O., Morrone, O. and Belgrano, M.J. (Eds.). *Catálogo de las Plantas Vasculares del Cono Sur*. *Monogr. Syst. Bot. Missouri Bot. Gard.* 107: 2927–2934.

Zuloaga, F. O. and Belgrano, M.J. (Ed.) 2017. Flora Argentina. Flora vascular de la República Argentina 17. INTA. IMBIV & IBODA: 1–434.

Zuloaga, F. O. and Morrone, O. 1999. Catálogo de las plantas vasculares de la República Argentina. Monogr. Syst. Bot. Missouri Bot. Gard. 74(2): 1–1331.