

Nomenclature and Taxonomic Notes on *Cupressus gigantea* Cheng & Fu

From material collected in Adelaide, Australia, labelled *Cupressus torulosa* D.Don var. *majestica* Carrière, sent to China by Mao & Liu for molecular analysis, Silba (2012) got the interesting result that this variety matches the species *Cupressus gigantea* described by Cheng & Fu in 1975. This taxon was first described by Carrière in his *Traité Général des Conifères* (1855) from a material earlier listed in the catalogue of the Knight & Perry nursery in United Kingdom (1850).

If this taxon is considered as a variety of *Cupressus torulosa*, the correct name is therefore *Cupressus torulosa* var. *majestica* Carrière, and the combination *Cupressus torulosa* var. *gigantea* (Cheng & Fu) Farjon (2005) becomes superfluous. However, from morphological, physiological, molecular, ecological and geographical data, there is no justification to treat *Cupressus gigantea* as a variety of *Cupressus torulosa* D.Don. The two taxa are easily distinguished from one other.

Morphology

Leaves : Farjon discusses mainly shoot morphology, yet foliage in this genus is rarely easy to distinguish between the different species, with only very few exceptions such as *Cupressus macnabiana* A.Murray bis or *Cupressus funebris* Endlicher (adult foliage). Despite this, *Cupressus gigantea* can show white resin dots on adult leaves, while this has not been observed on *C. torulosa*. Foliage on saplings of *Cupressus gigantea* is typically glaucous, on *C. torulosa* green. **Seed cones** : they are easily distinguishable. *C. gigantea* cones display typical recurved umboes on the distal scales (see fig. 1), absent in *C. torulosa* (see fig. 4) ; young seed cones of *C. gigantea* close to pollination time and soon after are black (see fig. 3), the ones of *C. torulosa* are blue (see fig. 6 and 7). One year old cones of *C. torulosa* often have a whitish wax coating (see fig. 13). **Bark** : on old trees, bark of *C. gigantea* is brown or grey, with stripes usually parallel, of *C. torulosa* grey and the stripes are intertwined (compare figures 8 and 12). **Crown shape** : *C. gigantea* has a typical columnar crown shape, while *C. torulosa* has a conical one (see figures 9 and 11). From a morphology point of view, Cheng and Fu rightfully observed that *C. gigantea* is closer to *Cupressus chengiana* (“Species affinis”).

Fig. 1 : Mature cone of *Cupressus gigantea*, 17.2.2013.



Physiology

Cupressus gigantea is hardier than *Cupressus torulosa*. Following the cold frost wave of the first two weeks of February 2012 in Western Europe¹, young plants of *Cupressus gigantea* were completely undamaged, even ones in containers when it is a well known fact that roots are less hardy than foliage. Seedlings of *Cupressus torulosa* on the other hand suffered in the nursery and several were killed in the same conditions.

¹ The cold wave to which the plants discussed here were subjected lasted two weeks with temperatures remaining below 0°C during the whole period, and with several lows below -10°C and a record measured at -12.6° ; moreover the damaging effects were reinforced by a strong desiccating wind and direct sunlight.

Phenology

At maturity, *C. torulosa* cones open and release their seeds 18 months after pollination, while *C. gigantea* cones remain green and closed for more than 24 months (see fig. 1, 2, 4 & 5).

Molecular data

Several studies are available. Although their results may appear contradictory, none is showing a close relationship between *Cupressus torulosa* and *C. gigantea*.

Rushforth & al. (2003 : fig. 1, p. 20) using RAPDs propose a cladogram where the closest species to *Cupressus gigantea* are *Cupressus austrotibetica* Silba and *C. duclouxiana* Hickel in Camus.

Conversely, *C. torulosa* is in another clade together with *Cupressus funebris*, *C. tortulosa* Griffith [under the name *C. cashmeriana* Carrière] and *C. chengiana* S.Y.Hu.

Mu & al. (2006 : fig. 1, p. 351) using cpDNA (the *petG-trnP* sequence) came to the conclusion that *Cupressus gigantea* is closest to *Cupressus chengiana*, while another cluster is formed by the other analysed *Cupressus* species : *Cupressus torulosa*, *Cupressus nootkatensis* D.Don [under *Chamaecyparus nootkatensis*], *Cupressus funebris* and *Cupressus duclouxiana*.

Xu & al. (2010) analysed the cpDNA of several Asiatic cypress species. Their results show that *C. torulosa* is much closer to *C. tortulosa* [under the name *C. cashmeriana*] and to *C. austrotibetica* than to *C. gigantea*. Whichever the molecular analysis, by placing this later taxon under *C. torulosa*, the species so constituted (Farjon, 2005, 2010) is paraphyletic.

Ecology

Cupressus gigantea grows in riparian habitats, north of the main Himalayan range and thus protected from the monsoon which develops its full effect on the southern slopes of the Himalaya. The average rainfall is below 800 mm/year (Zhang, 2006). It is true that a few *Cupressus torulosa* stands are facing very dry conditions, but these populations above 3000 m show no regeneration at all and look like relict groves (Karnali valley at 3400 m altitude, above Marpha). Most localities are below 3000 m (Gharwal 1600 to 2800 m, Mugu 2300 m, Nainital to 2400 m, Simla 2200 m, rainfall above 1300 mm/y). *Cupressus gigantea* grows between 3000 and 3400 m (Zhang, 2006).

Geography

Cupressus gigantea grows in southern Tibet along the Yarlung Tsangpo and its tributaries at an altitude higher than 3000 meters with a very restricted distribution range, so restricted that it is considered endangered (and even as critically endangered from one report). This region is

Fig.2: *C.gigantea* 18 months after pollination.20.6.2012.



Fig. 3 : *C.gigantea*, young cones, 19.2.2011.



separated from the distribution range of *Cupressus torulosa* by the Himalayan highest summits. In a west to east direction, the distance is at least equal to 900 km in a straight line from central Nepal to the Yarlung Tsangpo shores (Nang Xian). The geographical separation of these two species is so important that inbreeding became impossible quite soon after the beginning of the Himalayan orogeny. Considering that the collision between the Indian and Asiatic tectonic plates began some 50 millions years ago (Mascle & al., 1990), and even if accepting more than half of that figure for an effective separation, there is a span of time big enough for a complete speciation process to occur. Xu & al. (Additional File 4-fig. 2), building a phylogenetic diagram based on a molecular clock, propose a separation occurring some 20 millions years ago². *Cupressus torulosa* appears in rather small isolated stands exclusively south of the Himalayan range from central Nepal to north-west India (Uttarakhand and Himachal Pradesh).

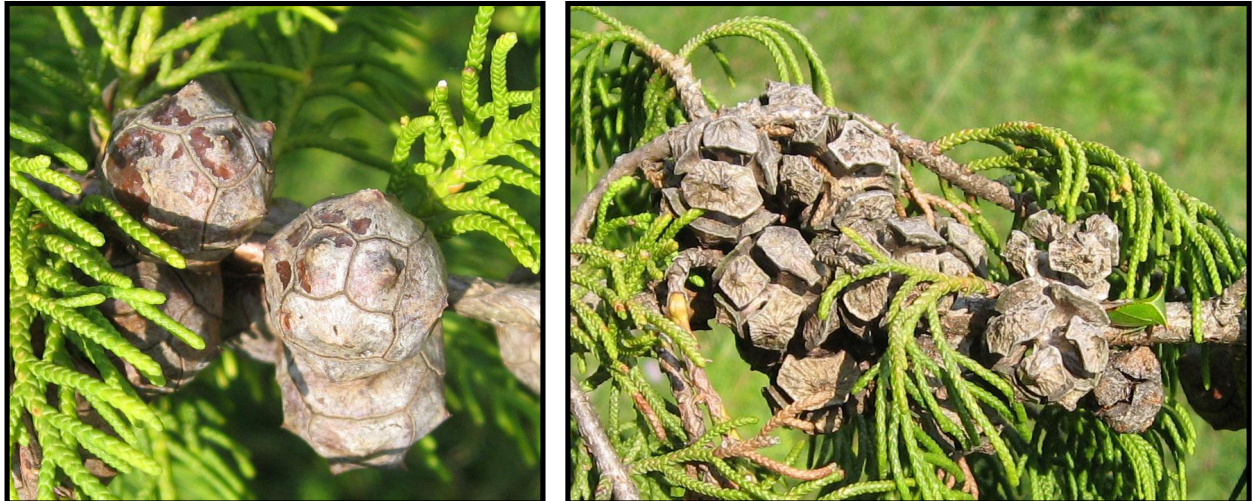


Fig. 4 & 5 : *Cupressus torulosa* cones before maturity and after seeds have been released. 10.9.2009

Taxonomy summary

Based on the observations summarised here, it is easy to distinguish both species by their morphology, physiology, phenology, DNA, ecology and geography. Given the cited molecular analysis, as already noted, if *Cupressus gigantea* is placed as variety of *Cupressus torulosa*, the group is paraphyletic, when other *Cupressus* taxa south of the Himalayan range are considered as valid species and are closer to *Cupressus torulosa*³ than to *Cupressus gigantea*.

Cupressus gigantea W.C.Cheng & L.K.Fu, *Acta Phytotax. Sin.* 13 (4): 85 (1975).

Synonyms :

- ≡ *Cupressus torulosa* var. *majestica* Carrière, *Traité Général des Conifères*: 118 (1855).
- ≡ *Cupressus majestica* Knight & Perry, *Synopsis of the Coniferous Plants sold by Knight and Perry, Exotic Nursery, King's Road, Chelsea* : 19 (1850) [*nom. nudum*].
- ≡ *Cupressus torulosa* var. *gigantea* (W.C.Cheng & L.K.Fu) Farjon, *A Monograph of Cupressaceae and of Sciadopitys* : 224 (2005) [*nom. superfl.*].

Holotype and Paratypes : see Fiche Jean Hoch, page 22.

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² Additional File 4-figure 1 proposes a cladogram where the old world and new world *Cupressus* species form a monophyletic group, separated from the Junipers.

³ Farjon (2005, 2010) treats *Cupressus austrotibetica* Silba as synonym of *Cupressus torulosa* D.Don when – according to the results of the cpDNA analysis (Xu & al., 2010) – the former shows no difference in the nucleotide chain with *Cupressus tortulosa* Griffith [treated as *Cupressus cashmeriana* by Xu & al. and by Farjon], while there is one difference in the nucleotide chain between *Cupressus austrotibetica/tortulosa* and *Cupressus torulosa*. Again the populations placed by Farjon under *Cupressus torulosa* form a paraphyletic group.

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Fig. 6 & 7 : *Cupressus torulosa*, seed cones two months and a half after pollination time (left : Chèvreloup 13.4.2011), and 3 to 4 months old seed cones (centre : Villa Thuret 29.4.2009). The blue colour of the young cones remains clearly visible several months after the pollination. Fig. 8 : Bark of *C.torulosa*



Fig. 9 : *C.gigantea* grove, Xizang, China

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 Fig. 9, 10 & 12 :
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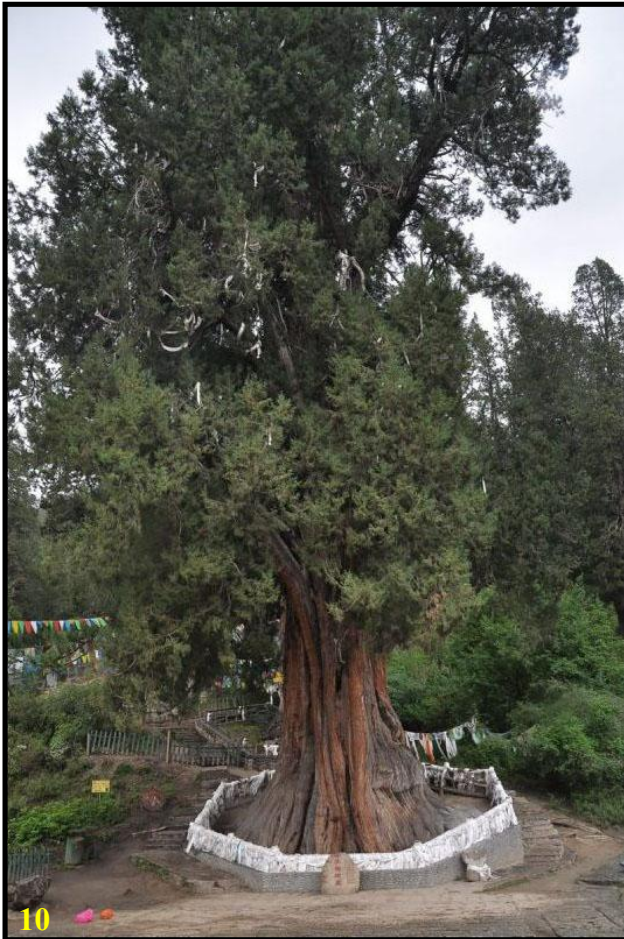
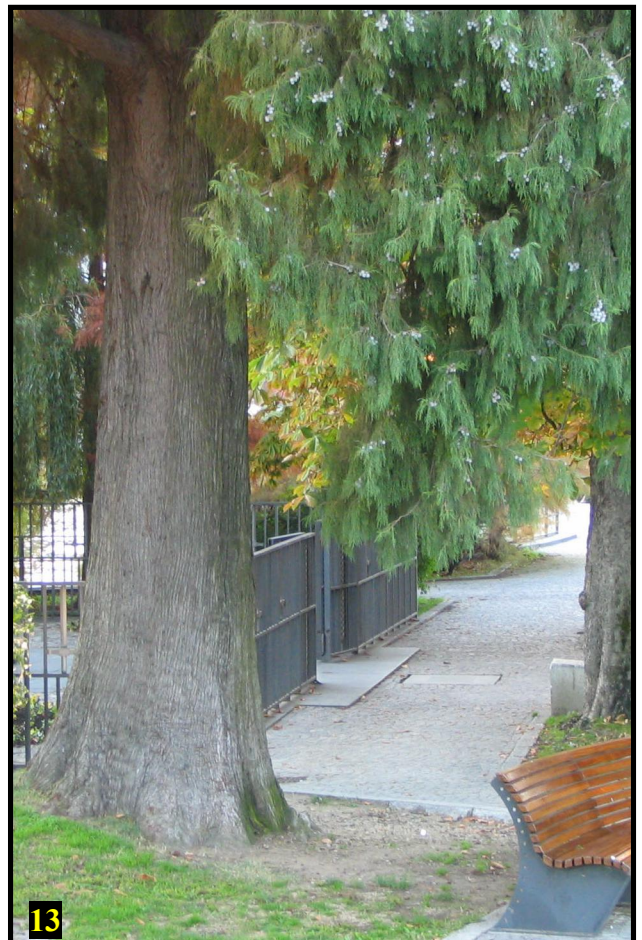
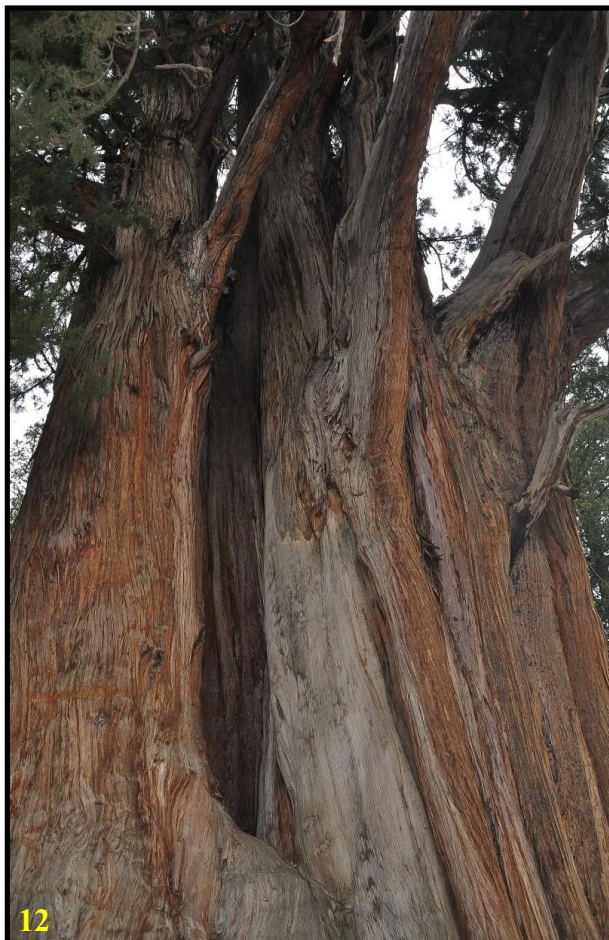


Fig. 10 & 12 : *C. gigantea*, near Nyingchi, Xizang, China. Fig. 11 & 13 : *C. torulosa*, cultivated, Italy.



Cupressus gigantea W. C. Cheng & L. K Fu

Acta Phytotax. Sin. 13 (4): 85 (1975)

巨柏 *ju bai*, Cyprès géant, Tibetan Cypress**Tibet (Xizang), Préfecture de Línzhī Di Qu, vallée du Yǎlǔ Zàngbù Jiāng.****District (sous préfecture) de Lǎng Xiàn**

coll. *Qinghai-Xizang Exped. n° 3318* **Holotype**, 21-09-1974, 22 km à l'ouest de Jiǎgé (Mǐlín Xiàn), dans l'est du district de Lǎng Xiàn, 3000 m. Versant sud, sur sol sablonneux, sporadique, arbre de haute futaie. PE00014363, PE00042975, PE00053433

coll. *Guo Benzhaoy & Wang Weiyi, n° 23061*, 21-08-1977, Lǎng Xiàn, 3300 m. HNWP67778, WUK344172

coll. *Qinghai-Xizang Exped. n° 750(7 ou 9)63*, 27-07-1975, Lǎng Xiàn, 3200 m. Bords de rivière, sur sols sablonneux. HNWP96350, HNWP51393

District (sous préfecture) de Línzhī Xiàn (Nyingchi) 林芝

coll. *Zhang Jing Wei & Wang Jin Ting n° 61* **Paratype**, 11-05-1966, Línzhī Xiàn, au nord-est à environ 1 km de Bajié xiang, versant sud-ouest, 3150 m. Hauteur 30 à 45 m. Diam. 0,9 m. survivant, nom local Cyprès rond (Yuan bai). PE00014367, PE00042977

coll. *Ni Zhicheng & Wang Yongze, Ci Duo, Ci Dan, n° 1753*, 20-09-1980, près de Línzhī city, 3100 m. Hauteur 35-45 m. diam. 1,5-3 m. PE00014362, PE00014366, PE00063413

coll. *China coll. n° 15723*, 20-09-1980, Línzhī Xiàn, du canton de Línzhī au canton de Bayi, 3100 m. versant ensoleillé, en petit peuplement. H. 15-20 m. PE00063424, 25, 26, 27, 28, 29, 30.

coll. *Lang Kaiyong & Li Bosheng n° 1520*, 21-05-1986, Línzhī Xiàn, au pont de Zhouga, à mi-monts 3100 m. PE00026744, 46

coll. *Ni Zhicheng, Ci Duo, Ci Dan n° 3211*, 03-09-1982, Línzhī Xiàn, canton de Bayi près de Jinxing, 3100-3300 m. PE00026745.

District (sous préfecture) de Mǐlín Xiàn

coll. *Xizang medicinal plants Team, n° 4314* **Paratype**, 03-08-1972. Mǐlín Xiàn, bourg de Jiǎgé, sur les versants vers le village de Pentoulían, 3000 m. Hauteur 30 m. diam. 1 m. PE00042976, PE00017910, HNWP82790

coll. *Huang Rongfu, n° CG-89-369*, 09-09-1989, Mǐlín Xiàn, domaine forestier de Hongwei, 3100 m. HNWP155888, 89