

Two distinct Himalayan cypress species *Cupressus tortulosa* and *Cupressus cashmeriana* with additional comparison to *Cupressus torulosa*

In a previous article (Maerki 2013b), the trees grown in France, Italy and Switzerland under the label *Cupressus cashmeriana* Carrière were investigated. It was discovered that the cypresses grown in France are different from those cultivated in Italy, which better match the material collected by Griffith in Bhutan and described by him under the name *Cupressus tortulosa*. A summary of the main differences has been proposed (Maerki, 2013b: 49-50) together with analysis of Carrière's protologue (1867) and discussion of the correct origin of the French plants in "Tibet" (now Arunachal Pradesh in India). The scope of the present article is to detail these differences with new observations and statistical data.

Cupressus torulosa D.Don, *Cupressus tortulosa* and *Cupressus cashmeriana* are all growing west to east on the southern slopes of the Himalaya in well separated distribution ranges¹; west Nepal, and Himachal Pradesh and Uttarakhand in India, for *C. torulosa*, Bhutan for *C. tortulosa* and Arunachal Pradesh (India) for *C. cashmeriana*. All populations of each species are scattered in different valleys. It is quite likely that the compartmentalisation of these populations over several millions years allowed speciation processes from a common ancestor. There are also lots of planted trees near temples, monasteries and fortresses whose origins are not recorded. Several wild stands are very difficult to access, sometimes almost impossible above high cliffs, and are still in need of investigation; further taxa could possibly yet be discovered. So far only the three above mentioned species were already described in the 19th century. Unfortunately the exact origins of the material introduced in that century and currently still cultivated in Europe are poorly recorded, and the different names brought a lot of confusion until quite recently. New well documented introductions from western Bhutan, but from cultivated trees, occurred only in 1975 by Grierson and Long, by Ern in 1982 and by Keith Rushforth in 1985. Rushforth also introduced *Cupressus tortulosa* from the wild trees growing on the western side of the Pele La below Norbding in May 1987. In 2006 and 2008 he was the only author also to visit the wild stands of cypress in Arunachal Pradesh.

The statistical data and observations on different trees cultivated in France, Switzerland and Italy belonging to the three southern slope Himalayan species are summarised in tables 3 to 5 (pages 103 and 104). One specimen of *Cupressus torulosa* more than a century old was studied for comparison.

Morphology : statistical data

Cone size : although there is much variability, an obvious difference between *Cupressus cashmeriana* and the two other species exists. The Arunachal Pradesh species has the longest cones, to more than 30 mm, and the average length is more or less equivalent to the maximum length of the other taxa. Moreover the smaller cones of *Cupressus cashmeriana* have a clear majority of aborted seeds. Inside the trees attributed to *Cupressus tortulosa*, the variability between the different trees is important with the smallest cones belonging to the 150 years old Isola Madre tree². The index $\frac{\text{length} \times \text{max. width} \times \text{min. width}}{1000}$ gives the volume of the orthogonal parallelepiped in which the cone is included. The volume thus defined shows an obvious difference between *Cupressus cashmeriana* and the other two species.

Cone shape : the shape of the cones show meaningful differences. An index³ enables one to put into evidence these differences. It is calculated using three measurements: length of the cone, maximum width and minimum width. The ratio $\frac{\text{length}}{\text{max. width}}$ gives information on the cone shape with elongated: >1.10 ; ovoid: between 1.10 and 1.07 ; subglobose: between 1.06 and 1.03 ; globose between 1.02 and 0.98 ; flattened: <0.98. The ratio $\frac{\text{max. width}}{\text{min. width}}$, always equal to or above 1.00, shows the regularity (close to 1.00, rounded in section) or the irregularity of the cone diameter (away from

¹ The gap between *C. torulosa* and *C. tortulosa* is ~600 km, between the latter and *C. cashmeriana* at least 60 km. More investigation of the wild trees in eastern Bhutan is necessary. Shorter distances between other *Cupressus* species are known, e.g. between *C. macrocarpa* and *C. goveniana* (< 3 km) or between *C. stephensonii* and *C. forbesii* (< 10 km).

² Worth noting that the cones were collected on the lowest branches, with several containing mostly aborted seeds. The seed cones observed in September 2014 at 15 m high look bigger. See fig. 3.

³ Meaning of index: a number derived from a formula, used to characterise a set of data.

1.00, ellipsoid or flattened in section). Combined these two ratios allow a meaningful comparison between the cones of different species on a statistical basis and add information to the absolute size of the cones. *Cupressus cashmeriana* has the most elongated cones, often quadrangular in section, instead of rounded.

Cone scales : the number of scales – although not as reliable as the previous characters – allows the use of statistical analysis to distinguish between the different species. *Cupressus cashmeriana* has 10 to 14 scales (see fig. 23 & 26 for cones with 14 scales), with a majority of cones with 12 scales. The average number of scales per cone for trees of this species is always above 11. Based on the oldest specimens (trees #5 and #7) and on the one with a recorded origin (tree #8), the average number of scales/cone for *Cupressus tortulosa* is below 11, with a range of 8 to 12 scales per cone and a majority of cones with 10 scales (with only one exception, tree #6). The data for the young specimens are less homogenous, but in a similar range. *Cupressus torulosa* has a more important percentage of its cones with 10 scales/cone.

Seeds per cone : the statistical data allow to distinguish clearly between *Cupressus cashmeriana* and the two other species. The lower number of seeds is found in *Cupressus torulosa* with less than 100 seeds per cone. *Cupressus tortulosa* shows a wide range of variability between 72⁴ to 120 seeds per cone on average, while *Cupressus cashmeriana* has on average always more than 150 seeds per cone. Raddi *et al.* (2013) confirm the present observations on *Cupressus tortulosa*. They found 110 seeds per cone on average with a sample of 100 cones.

Cotyledon size : the data on the length of the cotyledons appear in table 1. Cotyledons of *Cupressus cashmeriana* are smaller than those of *Cupressus tortulosa*.

Table 1 : Length of Cotyledons	Sample size	Length		
		Average	Max.	Min.
		Mm		
<i>Cupressus tortulosa</i>	33	12.1	14.9	10.0
<i>Cupressus cashmeriana</i>	16	7.4	9.4	4.6

Cotyledon number : see table 2. The result of cotyledon observations from cultivated trees is rather confusing. In *Cupressus torulosa*, wild origin seeds (Kalamuni, Uttarakhand, India) give 100% of seedlings with 2 cotyledons, while seeds of cultivated origin (England and Italy) give a small amount of seedlings with 3 cotyledons (fig. 44). As already noted by Silba (2013), the data mentioned by Farjon (2005, 2010, 2013) of (2-)3-4 cotyledons are erroneous, as they are mainly based on Hill and De Fraigne (1908: sample of 12 seedlings, nine with 3 cotyledons, two with 4 and one with 5), cited by Camus (1914). They clearly belong to *Cupressus lusitanica*, a species widely cultivated on the lower hills of the Himalaya, and an invasive species in India, several times confused with *Cupressus torulosa* (see Maerki 2013b, fig. 1 and Farjon 2013). All references give only 2 cotyledons for *Cupressus cashmeriana*⁵. The problem is that no source is ever cited, for instance no mention is made if the origin of the seeds is wild or cultivated, from trees grown in Europe or in Asia. More disturbing is the fact that the statistics are not constant when collecting seeds in different years, suggesting cotyledon number could be affected by environmental conditions. Until verification can be done with seeds of wild origins, the data presented here is the best available. A further hypothesis is that the *Cupressus torulosa* grown in Europe has an origin other than Kalamuni and represent a variety of it or a new taxon.

Table 2 : number of cotyledons	<i>torulosa</i>			<i>tortulosa</i>		<i>Cashmeriana</i>			
	wild	cultivated tree #4		cultivated tree #3		cultivated tree #7			cultivated tree #8
Number of cotyledons	2	2	3	2	3	2	3	4	2 3
number of seedlings	120	84	12	54	15	92	18	4	76 6
percent	100%	87.5%	12.5%	78.3%	21.7%	80.7%	15.8%	3.5%	92.7% 7.3%
sample size	120	96		69		114			82

⁴ The lowest numbers belong to trees of completely unknown origin, except tree #6 (Hillier nursery, but source?).

⁵ In previous works (e.g. Eckenwalder 2009, Farjon 2005, 2010, DP.Little 2005), with a few exceptions (e.g. Rushforth 1987), *Cupressus cashmeriana* was understood as including both *Cupressus cashmeriana* and *Cupressus tortulosa*.

Morphology : other observations

Foliage : the foliage is quite often deceptive when it comes to distinguish between different cypress species, because it is a very variable and highly adaptative character depending on the climatic conditions. Here all three taxa have their ultimate shoots disposed in flat sprays (fig. 16). *Cupressus torulosa* has the most distinguishable foliage as it is the only one with monomorphic appressed green adult leaves. *Cupressus tortulosa* commonly has dark green foliage with appressed needles. The strong glaucous and thinner leaves of the Isola Madre tree belong to a cultivar⁶ rarely found in the wild populations, whereas glaucous foliage is a common feature in *Cupressus cashmeriana*. This shared⁷ leaf character of a free apex is at the origin of the confusion between the two species of the eastern part of southern Himalaya.

Seedlings : (photos, p. 110) the seedlings show well marked differences, both in growth rate and shape of the leaves at different times. *Cupressus torulosa* has the slowest growth and displays very early (already after one growing season) intermediate foliage with flattened dimorphic leaves. Adult foliage appears when the plant is between 40 and 60 cm high. *Cupressus tortulosa* displays intermediate growth rate, and *Cupressus cashmeriana* has the fastest growth rate. *Cupressus cashmeriana* keeps juvenile foliage for a longer period than *Cupressus tortulosa* which presents intermediate foliage with flattened shoots during the second growing season, similar to the intermediate foliage of *Cupressus torulosa*. This observation could explain the reduction by Carrière (1867) of *Cupressus corneyana* Carrière (1855 – a synonym of *Cupressus tortulosa*) to a variety of *Cupressus torulosa*. He could observe the development of the foliage of young trees and confusion is possible at some different stages when considering only this character.

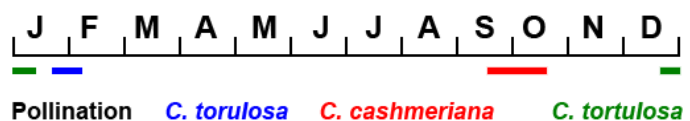
Physiology

Serotiny : while both *Cupressus torulosa* and *tortulosa* open their cones soon after maturity, the seed cones of *Cupressus cashmeriana* remain closed as long as they are vascularised⁸. Exceptional weather conditions like a drought or a hard frost stressing the tree can trigger the opening of the cones and seeds release. In northern Italy, cone opening on *Cupressus tortulosa* happens in January exactly two years after pollination. In the same conditions the seed cones of *Cupressus torulosa* open in late summer.

Hardiness : the hardiness of these species decreases from west to east, *Cupressus torulosa* being hardier than *C. tortulosa*, and *C. tortulosa* being hardier than *C. cashmeriana*. The mature specimen growing in Geneva suffered from the two weeks cold wave of February 2012 (low to -12°C with no temperature above freezing during this period), and lost its leader while most of the cones opened.

Phenology

Pollination : *Cupressus tortulosa* sheds its pollen at the end of December to the start of January. Pollen cones observed in September are only in their initialisation



phase (see fig. 5, 9 & 10), when *Cupressus cashmeriana* begins to release its pollen (in September-October – see fig. 27 & 28). No difference was observed in either Paris or Geneva or in the south of France⁹. As well no difference was observed on the different specimens of *Cupressus tortulosa* growing in Italy or Switzerland. In the Arboretum de Chèvreloup, France, *Cupressus torulosa* was observed releasing its pollen at the end of January.

Molecular analysis

To this date, only one series of genetic analysis has been conducted on French specimens of *Cupressus cashmeriana* using amplified fragment length polymorphism (AFLP). Material of several trees from

⁶ In fact this cultivar is retaining its intermediary foliage when adult.

⁷ Between a species and the cultivar of another species.

⁸ Like many other *Cupressus* species, e.g. *C. sempervirens*, *C. bakeri*, *C. macnabiana*, *C. stephensonii*, etc.

⁹ By comparison, *Cupressus sempervirens* pollination dates between Morocco (Aboulaïch 2008), Spain (Hidalgo 2003, 2010), France and Switzerland (pers. obs.) do not vary significantly, occurring in February. Data about pollination periods are scarce in the literature, except for the most common species.

Italy, France and Switzerland was sent in June 2011 to Dr. R.Adams for analysis. Results are still pending.

AFLP: for his thesis, Bachelier (2003) collected material of all three species from botanical gardens and arboreta in southern France. *Cupressus tortulosa* was represented under the label of *Cupressus torulosa* var. *corneyana*¹⁰, Ern collection from 1982.

Bachelier concluded from these AFLP tests: “Les taxons de l’Ancien Continent, par contre, sont très bien hiérarchisés. A l’intérieur de ce groupe se rencontrent successivement, de manière distincte, les sous-groupes suivants :

- *Cupressus funebris*,
- *Cupressus duclouxiana*,
- *Cupressus gigantea* et *Cupressus chengiana*,
- *Cupressus torulosa* var. *corneyana*,
- *Cupressus torulosa* avec inclus distinctement *Cupressus cashmeriana*,
- le sous-groupe méditerranéen, très bien isolé [...]”¹¹, but not reproduced here.

The result shows that *Cupressus cashmeriana* is closer to *Cupressus torulosa* than to *Cupressus tortulosa* and also that there could be more than just one species of cypress currently under the labels *Cupressus torulosa* and *Cupressus tortulosa*¹².

Conclusion

From these observations on living plants, taking into account morphology with statistical data, physiology, phenology, biogeography and molecular analysis, there is enough evidence, despite the extreme variability of some characters, to justify the treatment proposed here, that is to distinguish at least three cypress species along the southern slopes of the Himalayan range: *Cupressus torulosa*, *Cupressus tortulosa* and *Cupressus cashmeriana*.

As all these results were obtained from cultivated trees in Europe¹³, several with an unrecorded source, more investigations are needed with material collected in the wild populations to understand the origins of these specimens. For instance it is likely that most introductions from Bhutan were also from cultivated trees growing around fortresses or monasteries, and the wild origin of these plants is still not known with certainty. It is even possible that some of them are hybrids.

Statistical data and analyses will be needed to match the current described species with the wild populations growing in Bhutan, India and Nepal and to understand if there are more taxa than the currently accepted ones.

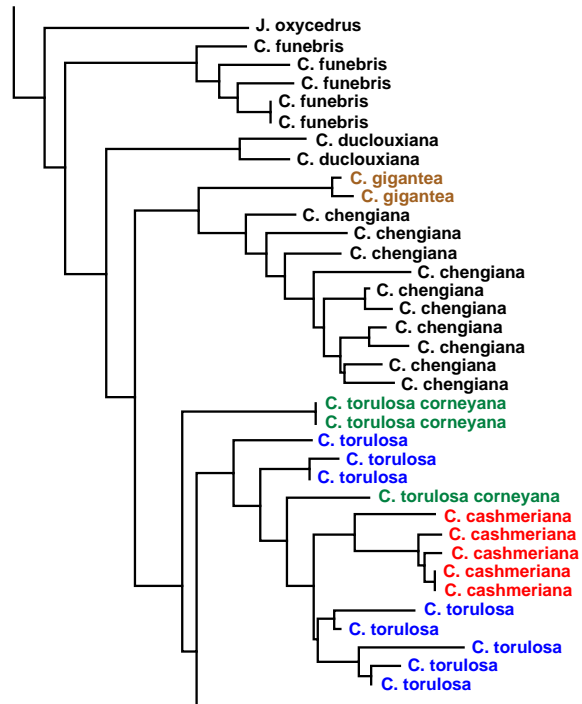


Fig. 1 : Bachelier (2003: fig. 36 in part), with colour additions.

¹⁰ As stated above, a later synonym by Carrière (1867) of his *Cupressus corneyana*.

¹¹ “The old world taxa, on the other hand, are very well hierarchised. Inside this group the following subgroups are distinctly met : * *Cupressus funebris*, * *Cupressus duclouxiana*, * *Cupressus gigantea* and *Cupressus chengiana*, * *Cupressus torulosa* var. *corneyana*, * *Cupressus torulosa* including distinctly *Cupressus cashmeriana*, * the Mediterranean subgroup, very well isolated [...]”

Note that *Cupressus gigantea* does not cluster with *Cupressus torulosa*, but with *Cupressus chengiana* and thus the merging of this species into a variety of *Cupressus torulosa* by Farjon (2005, 2010) is not justified (see Maerki 2013a).

¹² Unfortunately there is no record of the wild origins of these “*Cupressus torulosa*” and of several of the *Cupressus tortulosa*.

¹³ Several of these species were first described (D.Don, Carrière) from introduced plants, so that it was a necessity to start this study on the southern Himalayan cypresses with that cultivated material (trees #2, 5, 7 & 8 are more than one century old).

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Table 3
Statistical data

		Tsenden	Cupressus cashmeriana			
		Farjon 2005 as <i>C. "cashmeriana"</i>	Paris #1	Nice Oldest tree #2	Antibes #3	Geneva #4
Cones	Shape	(sub)globose to ovoid	1.10-1.06	1.09-1.06	1.08-1.08	1.08-1.09
	Length	(10-)12-21 mm	12.9-26.4 mm	11.7-28.6 mm	13.7-26.3 mm	13.7-31.8 mm
	Average	?	20.1 mm	21.7	23.0 mm	22.1 mm
	Width	10-19 mm	11.2-23.3 mm	11.1-23.9 mm	15.3-24.7 mm	11.5-27.2 mm
	Average	?	17.8 mm	19.4 mm	20.5 mm	20.6 mm
Scales #	%	8-10	10-12	10-12-14	10-12	10-12-14
	Average	?	40%-60%	35.4%-63.1%-1.5%	32.7%-67.3%	44.8%-52.8%-2.4%
		?	11.20	11.18	11.22	11.07
			10 (39.8%) - 12 (58.6%) - 14 (1.5%)			
Index	Serotiny	?	6.36	8.14	9.65	8.68
		parting scales	Serotinous			
Sample #		?	20	65	49	127
Seeds/cone (avg.)		?	176	183	185	168
min.-max.			113-218	133-232	126-231	106-216
Seeds/scale (avg.)		?	15.6	16.5	16.2	15.5
min.-max.			11.2-18.8	11.9-21.2	12.6-21.0	12.1-18.2
Sample #		?	14	62	21	40
Foliage	Colour		Glaucous-grey			
Pollen release		?	Before December			September-October

Table 4
Statistical data

Table 4 Statistical data		Tsenden - <i>C.tortulosa</i>				
		Farjon 2005 as <i>C."cashmeriana"</i>	Italy			France
	Isola Madre #5		Young tree #6	Old tree #7	Young tree #8	
Cones	Shape		0.97-1.11	1.07-1.07	0.99-1.07	1.05-1.05
		(sub)globose to ovoid	globose to slightly subglobose			
	Length	(10-)12-21 mm	8.8-15.6 mm	10.6-18.9 mm	15.2-22.6 mm	12.5-16.7 mm
	Average	?	13.0 mm	14.7 mm	18.6 mm	14.7 mm
	Width	10-19 mm	8.3-15.5 mm	6.2-14.7 mm	14.1-22.7 mm	11.1-16.1 mm
	Average	?	12.8 mm	17.2 mm	18.3 mm	13.7 mm
Scales #		8-10	8-10-12	10-12	8-10-12	10-12
		?	6.5%-71%-22.6%	25.5%-74.5%	5%-74.3-20.7%	51.2%-48.8%
	Average	?	10.26	11.26	10.05	10.79
			8 (2.3%) - 10 (50.3%) - 12 (47.4%)			
	Index	?	2.11	2.61	6.24	2.75
Serotiny		parting scales	not serotinous			
Sample #		?	31	141	101	43
Seeds/cone (avg.)		?	119		104	120
	min.-max.		107-131		50-141	72-159
	Seeds/scale (avg.)	?	9.9		10.3	11.2
	min.-max.		8.9-10.9		5.0-13.8	7.2-15.5
	Sample #	?	2		118	43
Foliage	Colour		Glaucous-blue	Glaucous-green	Glaucous-green	Green
Pollen release		?			January	
Origin		?	W.B. Pentland	Hillier nursery	W.B. Pentland	H. Ern

Table 5
Statistical data

Table 5 Statistical data		Tsenden - <i>C.tortulosa</i>				<i>C.torulosa</i>
		Farjon 2005 as <i>C."</i> cashmeriana"	Italy		Switzerland	Italy
			Young tree #9	Young tree #10	Young tree #11	Old tree #12
Cones	Shape		0.96-1.05	1.02-1.05	1.03-1.07	1.0-1.06
		(sub)globose to ovoid	globose to slightly subglobose			regular, globose
	Length	(10-)12-21 mm	10.6-17.0 mm	13.3-19.8 mm	10.3-20.8 mm	12.7-20.9 mm
	Average	?	12.8 mm	16.7 mm	16.6 mm	18.0 mm
	Width	10-19 mm	11.2-16.8 mm	12.3-18.8 mm	11.2-20.0 mm	12.8-20.8 mm
	Average	?	13.0 mm	15.9 mm	15.6 mm	17.5 mm
	Scales #	8-10	8-10-12	8-10-12	8-10-12	8-10-12
		?	16.7%-62.5%-20.8%	1.9%-48.1%-50%	3.8%-71.2-25%	5.1%-81.8%-13.1%
	Average	?	10.08	10.77	10.54	9.99
			8 (5.5%) - 10 (60.1%) - 12 (34.4%)			
	Index	?	2.17	4.24	4.04	5.52
	Serotiny	parting scales	not serotinous			not serotinous
Sample #		?	24	52	52	99
Seeds/cone (avg.)		?			72	69
min.-max.					50-89	47-96
Seeds/scale (avg.)		?			6.8	7.0
min.-max.					5.0-8.7	4.7-9.6
Sample #		?			26	64
Foliage	Colour		Glaucous-blue	Glaucous-green	Glaucous-green	Green
Pollen release		?				January (France)
Origin		?	(Isola Madre ?)	unknown	unknown	unknown

Appendix : photos

Cover page : *Cupressus tortulosa*, Isola Madre, tree #5 (the # refers to the trees of tables 3-5, statistical data), foliage and cones close to the top. Note the yearly cones still green, the open cones pollinated in January 2012 and the greener than glaucous foliage colour. – 28.5.2014.

Fig. 2 : *Cupressus tortulosa*, Isola Madre, tree #5. – 28.5.2014.

The seed which gave rise to this famous tree was received in 1862 by the Borromeo family, owners of the islands of the same name on Lago Maggiore, in northern Italy. This tree was first struck by a lightning which cut its leader. Before this happened, the cypress had a conical shape. From that day it developed a broad rounded crown, with numerous lower branches taking the aspect and size of real trunks. The fate of this beautiful tree was almost sealed when on the night of the 26 June 2006, a most powerful “tromba di aria” (tornado) uprooted this almost 150 years old tree. Several other trees on the island were uprooted or their trunks broken. It was decided to rescue this almost unique monument in western Europe. Lead by GianCarlo Giustina and by a company specialising in tree care, the cypress was hauled up back into place and secured with cables. Eight years later, the tree is recovering and producing lot of cones, the foliage slowly filling the gaps left by the broken branches. The photo shows the side with the most damage, the tree having fallen in the direction of the photographer. Two saplings raised from cuttings are planted at its base.





Fig. 3 : Detail of cover photo.

Fig. 4 & 5 : *C. tortulosa*, Isola Madre, tree #5. – 11.9.2014.

Fig. 5 (below) shows pollen cone initialisation. Phenophase 1.

Fig. 6 : *C. tortulosa*, tree #7, 10.9.2014. Note the similarities between the two trees.





Fig. 7 : *Cupressus tortulosa*, tree #7. – 6.9.2012. Note the 8 months old green cones. The cones of the previous year – light brown – are still closed, while the older cones are all open. Compare with cover photo.

Fig. 8 : *Cupressus tortulosa*, tree #10. 10.9.2009.



Fig. 9 : *Cupressus tortulosa*, tree #9. 11.9.2011. Note the pollen cones in their initialisation phase.





Fig. 10 : *Cupressus tortulosa*, seed and pollen cones. Tree #10. The pollen cones are in phenophase 2c. 4.11.2007.

Fig. 11 : *Cupressus tortulosa*, mature seed cones. Tree #10. The seed cones older than 2 years are all open and their seeds have been released. Compare with fig. 13 and 25. 6.9.2012.



Fig. 12 : *Cupressus tortulosa*, foliage with immature seed cones. Tree #11. 12.4.2008.

Fig. 13 : *Cupressus cashmeriana*, foliage with mature seed cones all closed. Tree #2. 6.8.2013.





Fig. 14 : *Cupressus tortulosa*. Tree #10. Note the less appressed leaves, contrary to the cultivar tree of Isola Madre. 4.11.2007.

Fig. 15 : *Cupressus tortulosa*. Tree #7. Note the pollen cones still in their initialisation phase (phenophase 1b), while at this date (4.11.2007) *Cupressus cashmeriana* has already released its pollen.



Scale given by the millimetre paper.

Fig. 16 : Comparison of foliage between *Cupressus torulosa* and *Cupressus tortulosa*. 10.2010. From left to right : 1) *Cupressus torulosa*, note the monomorphic green leaves closely appressed on the shoot (#12). – 2) *Cupressus tortulosa*, tree #7. – 3) *Cupressus tortulosa* (no statistical data). Note the dimorphic leaves more or less appressed on the shoot. – 4) *Cupressus tortulosa*, tree #5, Isola Madre. Dimorphic leaves with a free apex, glaucous cultivar form.





Fig. 17 : *Cupressus tortulosa* seedling. – 8.9.2012. **Fig. 18 :** *Cupressus cashmeriana* seedling. – 8.9.2012. Both seedlings are during their second year of growth. The seeds germinated at the same time. Note the differences between the size and the length of the juvenile needles. The tubes give the scale : their diameter at the top is 6.7 cm. (From seeds of trees #7 & #3.)

Fig. 19 : Side by side *Cupressus tortulosa* and *torulosa* of same height, but not same age (*torulosa* is older). Note the differences of the juvenile and intermediate foliage with *torulosa* almost entirely with intermediate foliage. (#7 & #12.)

Fig. 20 : Side by side *Cupressus tortulosa* and *cashmeriana* of about same height, but not same age (*tortulosa* is older). Note the differences in the foliage with only juvenile foliage on *cashmeriana*. (#7 & #3.)



Fig. 21 : Older *Cupressus cashmeriana* seedling still with juvenile foliage. (#3.)





Fig. 22 : *Cupressus cashmeriana*. Tree #3. Young seed cone 5 to 6 months after pollination. 24.3.2011.

(top right) **Fig. 23a, b & c :** *Cupressus cashmeriana*. Pollen cone. Tree #4. Bigger cone (> 3cm) found with 14 scales.

(right) **Fig. 24 :** *C. cashmeriana*. Pollen cones with 12 scales. #4.

Fig. 25 : *Cupressus cashmeriana*, mature seed cones. Only when they are not vascularised do the scales open.



Fig. 26 : *Cupressus cashmeriana*. Seed cone with 14 scales. Tree #4.

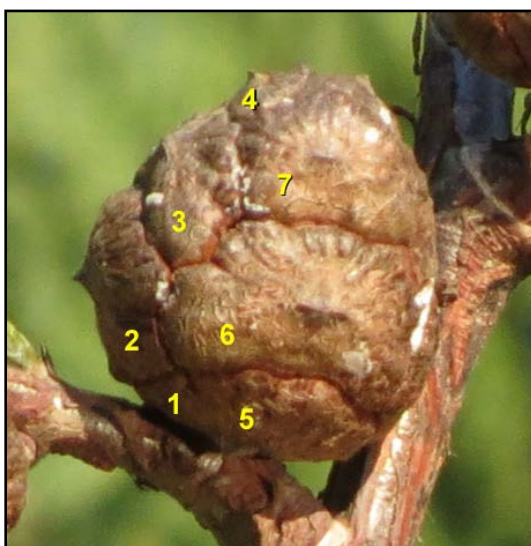




Fig. 27 : *Cupressus cashmeriana*, seed cone. Tree #4. Note the droplet on one of the ovules. 18.10.2011.

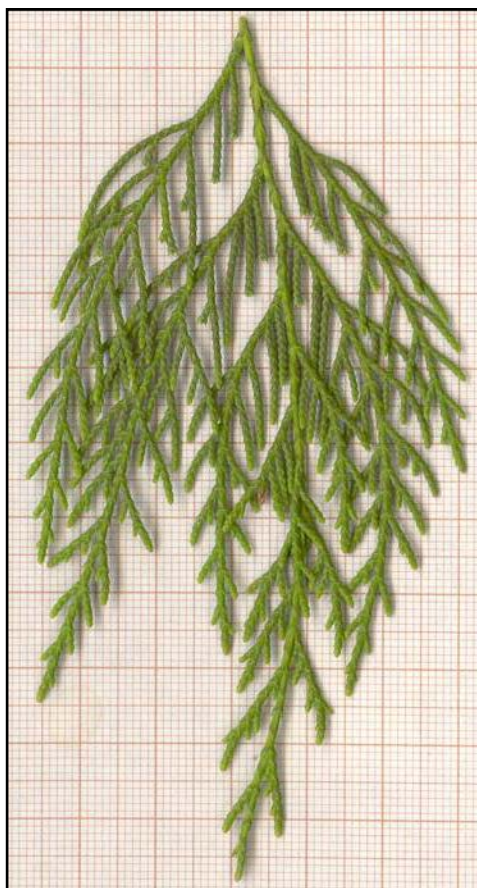
Fig. 28 : *Cupressus cashmeriana*, (left) pollen cones. Tree #4. Almost all cones have already released their pollen. 18.10.2011.

Fig. 29 & 30 : *Cupressus cashmeriana*, seed cones. Tree #4. After pollination. 29.11.2011.



Fig. 31 : *Cupressus cashmeriana*, mature seed cones. Tree #2.





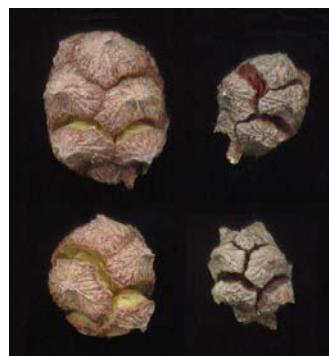
(left) **Fig. 32** : *Cupressus tortulosa*, flattened shoot with green leaves. Tree #11. 13.4.2008. On the branchlets of the upper part of the shoot, note that the pollen cones already have fallen.

(centre) **Fig. 33** : *Cupressus tortulosa*, leaves, detail. Tree #11. 13.4.2008.

Fig. 34 : *Cupressus tortulosa*, seed cones, before and after maturity. Tree #11. 13.4.2008.



(right) **Fig. 35** : *Cupressus tortulosa*, seed cones, Isola Madre. Tree #5. Note the similarities with the cones of tree #11. The smaller cones have mainly aborted seeds. Scale 1:1. Compare with fig. 23 & 24.



(below) **Fig. 36** : *Cupressus tortulosa*, pollen cones. Tree #7. Phenophase 3f, near to flowering. 22.12.2012. © Francesco.



Fig. 37 : *Cupressus tortulosa*, seed cones. Tree #7. 23.4.2012. Compare with fig. 22 – taken one month earlier. *C. tortulosa* is about 2 months late in the cone development. © Francesco.



Fig. 38 : *C.tortulosa*,
Isola Madre. Tree #5.

Fig. 39 : *C.cashmeriana*.
Tree #2.

Fig. 40 : *C.tortulosa*.
Tree #11.

Fig. 41 : *C.tortulosa*.
Tree #10. *All scales 1:1*

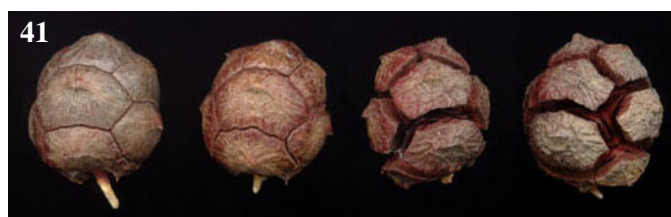
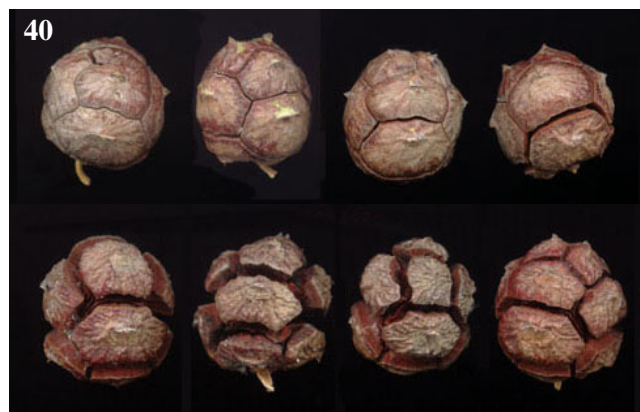


Fig. 42 : *Cupressus torulosa*. Tree #12.
Note the white wax on the seed cones.

Fig. 43 : *Cupressus torulosa*. Tree #12.
Seed cones. – Scale 1:1.

First row up : weathered mature cones.

Second row : mature cones.

Third row : immature cones with wax.

Fig. 44 : *Cupressus torulosa*. Seedlings from
tree #12. A few seedlings display 3 cotyledons.
Note the obtuse apex of the cotyledons.





Fig. 45 : *Cupressus tortulosa*, tree #9. First year cones not yet fully developed. Compare with fig. 3. 28.5.14.

Key to native cypresses of the southern Himalaya.

- 1a. Cones serotinous, often longer than 25 mm, attached to the branches for several years, on average more than 150 seeds/cone *Cupressus cashmeriana*
- 1b. Cones not serotinous, smaller than 25 mm, usually falling in the year following cone opening, less than 150 seeds/cone..... 2
- 2a. Cones often covered with glaucous wax in the first year, always less than 100 seeds/cone, slow growth during the 2 first years, intermediate leaves already the first year, leaves monomorphic *Cupressus torulosa*
- 2b. Cones never covered with wax, from 50 to 150 seeds/cone, quick growth from the start, intermediate leaves only from the second year or later, leaves dimorphic..... *Cupressus tortulosa*

Note on the epitypification of *Cupressus tortulosa* Griff.

D. Maerki

Following the publication of the article : *Typification of Cupressus tortulosa* Griff. [Bull CCP 3 (2) :69-75], Kanchi Gandhi (IPNI & Harvard University Herbaria) courteously drew our attention to a correctable error in the formulation concerning the designation of the epitype. He stated: "Since *Cupressus pendula* Griff. (1848) and *C. tortulosa* Griff. (1854) are nomenclatural synonyms, whatever typification is done to one name automatically applies to the other name." In order to remove any ambiguity in the formulation of the epitypification, the following presentation is added:

Cupressus pendula Griff., Itin. Pl. Khasyah Mts.: 131. 1848 [non Thunb., Fl. Jap.: 265. 1784].

Lectotype: Bhutan: Dewangiri [now Deothang], Samdrup Jongkhar District, 6.I.1838, *Griffith 27* (K! [K000088093]) (designated by Maerki, 2014).

Epitype (hic designatus): s.l., s.d., *Griffith 1001/1* (P! [P06489919]).

The application of the two treated names comes down to the following nomenclatural formulation:

Cupressus tortulosa Griff., Not. Pl. Asiat. 4: 26. 1854.

≡ *Cupressus pendula* Griff., Itin. Pl. Khasyah Mts.: 131. 1848 [non Thunb., Fl. Jap.: 265. 1784].

Lectotype: Bhutan: Dewangiri [now Deothang], Samdrup Jongkhar District, 6.I.1838, *Griffith 27* (K! [K000088093]).

Epitype: s.l., s.d., *Griffith 1001/1* (P! [P06489919]).

Cupressus cashmeriana Neotype 1

Figures 1 to 3 : *Cupressus cashmeriana* Carrière
Neotypus, sheets 1/3, 2/3 and 3/3.

© Herbar MNHN, Paris, France.
Collection : Plantes vasculaires (P).

- 1) P02088769
- 2) P02088792
- 3) P02088793

Collector : Y.Pauthier s.n., 20 December 2011.

Designated by D.Maerki (2013), Which name for the Tsenden? *Bull. CCP* 2 (2): 54.

Notes : on sheet 1/3, the cones are one year and a couple of months old and still immature as the yellow colour inside the cones testifies ; on sheets 2/3 and 3/3 the pollen cones are empty after pollen release in September-October ; on sheet 2/3 small blue seed cones soon after fertilisation are visible attached to the shoots, and the mature small – quite untypical – seed cone detached from the branch contains mainly aborted seeds.

D. Maerki



2



3

