



# **Bulletin** of the *Cupressus* **Conservation Project**

**No 21**

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Volume 9 Number 1

## Taxonomy of the cypresses of Sichuan and Gansu ..... 3

D. Maerki & J. Hoch

**Abstract** : Based on new morphological and molecular data, *Cupressus chengiana* is maintained to S.Y.Hu's original description and circumscription, and two well geographically separated new species are distinguished: *Cupressus gansuensis* Maerki & J.Hoch and an emended *Cupressus fallax* Franco.

## New taxonomic treatments appearing in this issue

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**Cover photo:** *Cupressus gansuensis*, cult. in France from wild, Gansu. Top: 2020-04-23.

Bottom: 2017-07-03. Same tree with seed cones in Spring and in Summer. © CCP.

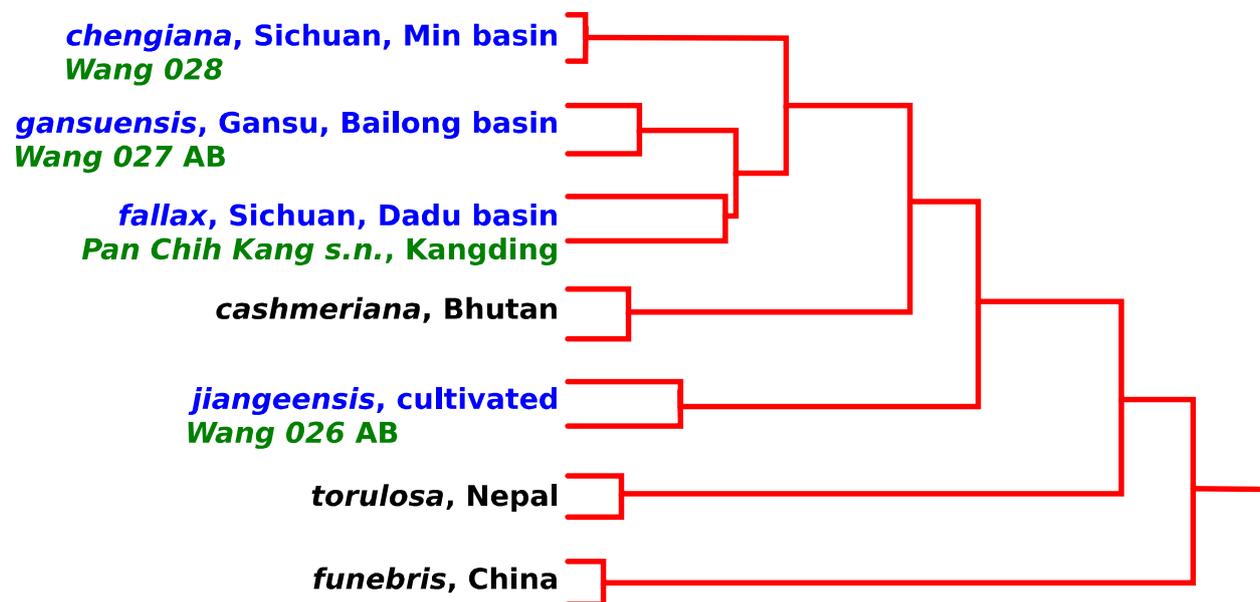
## Taxonomy of the cypresses of Sichuan and Gansu.

Following recent studies with results in morphological statistics and molecular analyses, it is possible to split the Chinese endemic cypresses described so far under *Cupressus chengiana* into three well defined species occupying three separated drainage basins.

Xu *et al.* (2010) analyzed the cpDNA and demonstrated that the haplotypes of the cypresses from Gansu are completely different from the ones of Sichuan. The main characteristic of these haplotypes is their diversity and variability:

- 9 different haplotype for the Sichuan (designated from H2 to H11);
- 9 different haplotype for the Gansu and none in common with those of Sichuan (labelled from H12 to H20).

Rushforth *et al.* (2003: 20, Fig. 1), using RAPDs, showed the following cladogram (here limited to the Asiatic species and completed):



**Fig. 1:** Minimum spanning network, 329 RAPD bands. In green: origin of the material; in blue: species updated according the present study. (*C. cashmeriana* = *C. tortulosa*.)

The interesting information is that the cypresses from the three different drainages appear well separated and discrete; the Dadu River<sup>1</sup> drainage cypress is sister to the Gansu cypress while *C. chengiana* from the Min River<sup>2</sup> is more distantly related.

This cladogram and its interpretation are confirmed partially by Terry *et al.* (2018) using nDNA. Unfortunately if that research included *C. gansuensis*, there is no information on the material used as *C. chengiana*, either that species from the Min River or *C. fallax* from the Dadu He drainage. Here too, the Sichuan and the Gansu Cypresses appear as sister taxa. As usual when dealing with the genus *Cupressus*, the molecular analyses and their syntheses confirm the biogeographical distances.

Those molecular analyses could already bring enough arguments to propose a different species for each drainage basin in Sichuan and Gansu. But there is more than that.

Thanks to Feng *et al.*, detailed morphological characters<sup>3</sup> were studied in depth and made available in 2017. The statistics thus established (with meaningful sample sizes from every county

<sup>1</sup> Dadu River or Dadu He or Tung River.

<sup>2</sup> Min River or Min Jiang.

<sup>3</sup> The list of characters comprises: seed cone length, seed cone width, seed cones ratio length/width, seed cone perimeter, seed cone mass, number of scales/seed cone, seeds/cone, seed mass in one seed cone, seed length, seed width, seed ratio length/width, seed thickness, thousand seed mass. Sample size = 100.

with a *Cupressus* population previously listed as *chengiana*) allow distinguishing the cypresses of the different drainages easily. These morphological differences are emphasised in describing the three taxa as separate species.

***Cupressus gansuensis*** Maerki & J.Hoch, *spec. nov.*

**Morphological diagnosis:** Young seed cones glaucous or blue before maturing in brown after one year. Cones opening at maturity. Shape of lateral scales flat with a depression in the centre, forming thus a  $\pm$  square (not round) section. On average, seed cone mass, 1.89 to 2.27 g; seed cone perimeter, 6.06 to 6.25 cm., seed cone width, 1.54 to 1.57 cm; always smaller and lighter than *C. fallax* and always bigger and heavier than *C. chengiana*. Seed thickness, 1.58 to 1.68 mm, always thicker than *C. fallax* and *C. chengiana*. Pollen release in January.

**Molecular diagnosis:** The chloroplast DNA present 9 different haplotypes shared by no other *Cupressus* species (listed H12 to H20 by Xu *et al.*, 2010).

**Holotype:** *T.P.Wang 14286* (PE; isotypes WUK, HIB); opposite Hanban village, Zhugqu county, Gannan pref., Gansu, 2000 m, 1951-07-11.

**Paratypes:** *T.P.Wang 14304* (PE, WUK);  
*Rock 12073* (E, P, K);  
*Meyer 1981* (K, P, NY);

This species is limited to the Bailong Jiang drainage almost exclusively in the Gansu province in China. It is distinguished from the two Sichuan species by its unique haplotypes, listed by Xu *et al.* (2010) under the numbers from H12 to H20. The results by Feng *et al.* (2017) show that on average the weight of the seeds cones of *C. gansuensis* show no overlap with the seed cones of the cypresses of the Dadu He drainage; they are on average 1 g lighter (Table 1: cone mass, from 1.89 to 2.27 g compared to 2.88 to 3.37 g for *C. fallax*). There is also no overlap either with the seed cones of the Min Jiang drainage; they are on average ca. 0.45 g heavier (from 1.40 to 1.85 g for the Min Jiang cypresses).

This is also the case for the width and the perimeter of the seed cones (Table 1, respective columns).

Other computed data used to compare the sizes (volumes) of the different populations<sup>4</sup> also show no overlap between the three species here acknowledged (Table 1).

On average *C. gansuensis* has ca. 33% fewer seeds per cone than *C. fallax*, which has larger cones with more scales, and also fewer seeds than *C. chengiana*, which has on average smaller cones, but with more scales. An important difference with the Sichuan cypresses<sup>5</sup> resides in the seed volume. Index #3 (Table 1) shows no overlap with the other taxa here acknowledged and described: the seeds in Gansu are larger on average.

During the first year after pollination and before they get weathered, the seed cones of this species have a blue or glaucous colour which allows distinguishing the Gansu populations from the Sichuan ones where the first year seed cones are predominantly green (cf. Figs 15 & 16).

The name *gansuensis* is directly derived from the currently accepted English name of this Chinese province, Gansu. The holotype is chosen from the specimens attributed to W.C. Cheng by C.D. Chu at a species rank on T.P. Wang's herbarium sheet, but unpublished (article in prep.).

***Cupressus chengiana*** S.Y.Hu (1964).

**Holotype:** *W.C.Cheng 2066* (A; isotypes PE, E, SYS, ISBC, K, US, BM, CAS); N.W. Wenchuan Xian, Sichuan, 1930-11-02.

**Paratypes:** *F.T.Wang 21700* (PE, KUN, NAS, LBG); East of Li-fan Hsien (in temple ground), Sichuan, 1930-07-10.  
*E.H.Wilson 798a* (K); Min River, Wenchuan Xian, 1908-11.  
*E.H.Wilson 2105* (K); Min River, Maowen ["Mao chou"], 1908-05.

<sup>4</sup> Index #1: average seed cone volume: enclosing parallelepiped rectangle; index #2: seed cone volume: spheroid.

<sup>5</sup> Here Sichuan cypresses mean the ones previously listed as *C. chengiana* to the exclusion of *C. funebris* also present in Sichuan.

This species was described and circumscribed by S.Y.Hu in 1964. The distribution range mentioned in the diagnosis is limited to the Min River valley; the holotype and all the paratypes were collected in that drainage. The mentioned small size of the seed cones excludes the populations of the Dadu He drainage from this species<sup>6</sup>. According to Xu *et al.* (2010), *C. chengiana* has two haplotypes in common with the Dadu He populations, viz. H3 and H4<sup>7</sup>, and one unique H6 haplotype in Wenchuan. Two species share the same haplotype: *C. tortulosa* in Bhutan and *C. austrotibetica* in south-east Xizang (Xu *et al.* 2010). There is no doubt that the two taxa *C. fallax* and *C. chengiana* are easily distinguished morphologically as well as by other molecular analyses including other DNA than the chloroplast one. S.Y.Hu insisted on the globose and “unusually small fruits”, which is confirmed statistically in the study by Feng *et al.* (2017).

Franco (1969) described *Cupressus fallax* as followings:

*Cupressus fallax* Franco, nov. sp.

[...]

Arbor erecta, modica (ad 30 m alta), valde ramosa, coma juventate dense fastigiata senectute expansa; cortex brunneo-rubescens; ramuli plus minusve dependentes, ramusculis 1-1,2 mm diam., post folium casum cinereo-brunnescentibus, rugosis; folia squamosa, quadrifariam imbricata, homomorpha, acuta vel obtusiuscula, cinereo-viridia, distincte glandulosa; flores masculi 2-3 x 1,2-1,5 mm, staminibus 8-12, filamentis apice in laminam ovato-rotundatam dilatatis; galbuli 15-25 x 15-20 mm, globosi, juventate glauci maturitate brunneo-cinerascentes, e squamis 8-10 lignosis formati.<sup>8</sup>

Holotypus: valle Tung fluminis, alt. 1300-2600 m, Jun.-Aug. 1908, *Wilson 2106* (BM).

**TIBET austro-orient.:** Kongbo, Nye, in valle Tsangpo, alt. 3000 m, 21 Oct. 1947, *Ludlow, Sherriff & Elliott 13345* (BM).

#### SINA

**Szechuan:** Tatsienlu [K'angting], 2 Nov. 1930: *Cheng 2066* (BM) & *Cheng 2073* (K; P) — valle Tung fluminis: alt. 1300 m, Jul. 1904, *Wilson 3012* (K; BM) & alt. 1300-2600 m, Jun.-Aug. 1908, *Wilson 2106* (K; BM) — prope Wen-chuan hsien, alt. 1600 m, Nov. 1908, *Wilson 798a* (K) — ad austrem Mao-chou, 21 Sept. 1931, *Cheng 3321* (BM; P) — in valle Min, prope Mao-chou, alt. 1800 m, 25 Mai. 1908, *Wilson 2105* (K).

**Kansu:** prope Chu Kun, 18 Oct. 1914, *Meyer 1981* (K) — inter Kaichow (Wutu) et Minchow, ad fluminem Wutu-ho, Apr. 1925, *Rock 12073* (K; P).

This diagnosis is not sufficiently precise to distinguish *C. fallax* from the other taxa of Sichuan and Gansu. It also includes paratypes from the two other drainage basins. It is thus emended here:

*Cupressus fallax* Franco, emended by Maerki & J.Hoch.

**Holotype:** *E.H. Wilson 2106* (BM; isotypes: K, E); valley of Tung River, Dadu He, Sichuan, 1300-2600 m, 1908-07.

**Paratype:** *E.H. Wilson 3012* (K, BM, P); valley of Tung River, Dadu He, Sichuan, 1300 m, dry region, 1904-07.

The following paratypes designated by Franco are excluded

- *Ludlow, Sherriff & Elliott 13345* (BM): *Cupressus gigantea*, Xizang;
- *Cheng 2066* (BM) & *Cheng 2073* (K; P): *C. chengiana*, Min Jiang drainage, Sichuan;
- *Wilson 798a* (K): *C. chengiana*, Wenchuan, Min Jiang drainage, Sichuan;

<sup>6</sup> The averages without overlap of the cone mass, cone width, cone perimeter and cone volume confirm that exclusion.

<sup>7</sup> The haplotype H4 was found in every single population of Sichuan, being even the unique haplotype found in Li Xian and Mao Xian.

<sup>8</sup> Erect tree, small (up to 30 m high), strongly branched, young foliage densely fastigiata, spreading with age; brownish-red bark; twigs more or less hanging, branchlets 1-1.2 mm, brownish-grey behind the leaves, wrinkled; leaves scaly, fourfold imbricated, monomorphic, acute or obtuse, gray-green, distinctly glandular; pollen cones 2-3 x 1.2-1.5 mm, 8-12 scales, top of filaments spreading in an ovate-rounded blade; seed cones 15-25 x 15-20 mm, globular, glaucous when young, greyish-brown at maturity, formed from 8-10 ligneous scales.

Holotype: valley of Tung River.

- *Cheng 3321* (BM, P): *C. chengiana*, Mao Xian, Min Jiang drainage, Sichuan;
- *Wilson 2105* (K): *C. chengiana*, Mao Xian, Min Jiang drainage, Sichuan;
- *Meyer 1981* (K): *C. gansuensis*, Zhouqu, Bailong Jiang drainage, Gansu;
- *Rock 12073* (K, P): *C. gansuensis*, Wudu, Bailong Jiang drainage, Gansu.

#### **New diagnosis:**

Seed cones up to 2.5 cm, usually semi-globose or oblong, always green (not glaucous) when maturing during the first year after pollination.

Morphologically the most distinctive feature is the size of the seed cones: they are much larger than the ones from the Bailong Jiang (Gansu) and Min Jiang drainage cypresses; on average the seeds cones of *C. fallax* are 1.5 times larger than the ones of *C. gansuensis*, and even 1.8 times larger than the other Sichuan cypresses from the Min Jiang basin (Table 1 & Fig. 17). The larger size of the seed cones implies different morphological characters which are not shared on average with the two other species, such as:

- weight on average between 2.88 and 3.37 g, while the average maximum weight of *C. gansuensis* is 2.27 g and that of *C. chengiana* is 1.85 g;
- scale number: on average the number of scales is clearly distinct from the two other species (that is with no overlap);
- the length, width and perimeter averages are always bigger, as well as the volume averages.

At the molecular level, *C. fallax* is distinguished from the Gansu cypresses by completely different haplotypes (cpDNA) listed in Xu *et al.* (2010) under the numbers H3 to H5 and H7 to H11. It is distinguished from the Min Jiang cypresses by a greater variability of the cpDNA haplotypes (8 vs. 3).

This species is present naturally only in the Dadu He drainage, in the following districts: Barkam, Jinchuan, Danba, Kangding, Luding and Xiaojin.

#### **Conservation status:**

The [IUCN](#) (2020-05-15) evaluates *C. chengiana* as Vulnerable. The *Cupressus* Conservation Project listed *C. chengiana* as previously circumscribed by different recent authors as Endangered. The split in three taxa implies that each species must be now considered as [Critically Endangered](#).

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**Table 1:** Summary of the differences between three *Cupressus* species of Gansu and Sichuan (previously grouped under *C. chengiana*).

In red: overlaps

in blue: without overlap

	Haplotypes cpDNA (Xu <i>et al.</i> 2010)	Average cone mass (Feng <i>et al.</i> 2017) [g]	Average number of cone scales (Feng <i>et al.</i> 2017) [#]	Average length of cones (Feng <i>et al.</i> 2017) [cm]	Average width of cones (Feng <i>et al.</i> 2017) [cm]	Average perimeter of cones (Feng <i>et al.</i> 2017) [cm]
<b><i>Cupressus gansuensis</i></b>	<b>H12 to H20</b>	1.89 to 2.27	8.81 to 9.28	1.56 to 1.73	1.54 to 1.57	6.06 to 6.25
Average for species		<b>2.08</b>	<b>9.07</b>	<b>1.62</b>	<b>1.55</b>	<b>6.12</b>
<b><i>Cupressus chengiana</i></b>	<b>H3, H4 &amp; H6</b>	1.40 to 1.85	9.06 to 9.35	1.35 to 1.59	1.30 to 1.48	5.45 to 6.04
Average for species		<b>1.69</b>	<b>9.16</b>	<b>1.47</b>	<b>1.40</b>	<b>5.73</b>
<b><i>Cupressus fallax</i></b>	<b>H3, H4, H5, H7 to H11</b>	2.88 to 3.37	9.67 to 10.25	1.76 to 1.95	1.63 to 1.80	6.70 to 7.06
Average for species		<b>3.06</b>	<b>10.05</b>	<b>1.86</b>	<b>1.69</b>	<b>6.83</b>
	Average seed thickness (Feng <i>et al.</i> 2017) [mm]	Average seeds per cone (Feng <i>et al.</i> 2017) [#]	Index #1 Cones (computed data) [cm <sup>3</sup> ]	Index #2 Cones (computed data) [cm <sup>3</sup> ]	Index #3 Seeds (computed data) [mm <sup>3</sup> ]	1sr year cone colour (various authors)
<b><i>Cupressus gansuensis</i></b>	1,58 to 1,68	39.23 to 42.79	3.70 to 4.26	1.94 to 2.23	26.94 to 31.20	glaucous/blue
Average for species	<b>1.62</b>	<b>41.44</b>	<b>3.98</b>	<b>2.08</b>	<b>29.07</b>	
<b><i>Cupressus chengiana</i></b>	1,17 to 1,37	39.57 to 49.40	2.28 to 3.48	1.19 to 1.82	13.66 to 20.18	green
Average for species	<b>1.3</b>	<b>43.37</b>	<b>2.88</b>	<b>1.5</b>	<b>16.92</b>	
<b><i>Cupressus fallax</i></b>	1,25 to 1,36	57.21 to 72.58	4.73 to 6.32	2.48 to 3.31	16.57 to 20.33	green
Average for species	<b>1.28</b>	<b>63.02</b>	<b>5.56</b>	<b>2.89</b>	<b>18.45</b>	
<b><i>Cupressus gansuensis</i></b>	Cone shape ± cuboid (1)	Pollen release January (2)				
<b><i>Cupressus chengiana</i></b>	round	(August)? (3)				
<b><i>Cupressus fallax</i></b>	± oblong	February (2)				

The following indexes are calculated using the data by Feng *et al.*

Index #1: Average cone volume: enclosing parallelepiped rectangle.

Index #2: Average cone volume: spheroid.

Index #3: Average seed volume: enclosing parallelepiped rectangle.

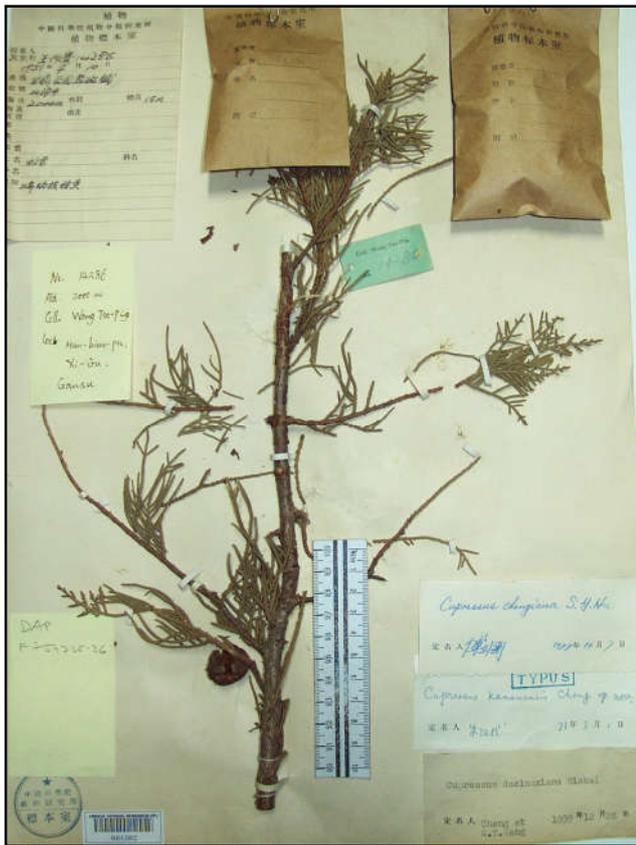
Various authors: Silba 2005, JH & DM pers. obs., *Flora of China*, etc.

Computed data: thanks to the data of Feng *et al.* 2017.

(1) More like a parallelepiped than like a spheroid.

(2) Pers. obs. (DM) on cultivated trees in the South of France.

(3) DP Little 2005: 237, but obviously not correct.



**Fig. 2: Type** of *C. gansuensis*, T.P.Wang 14286.  
© Beijing Herbarium, Beijing (PE00013002).

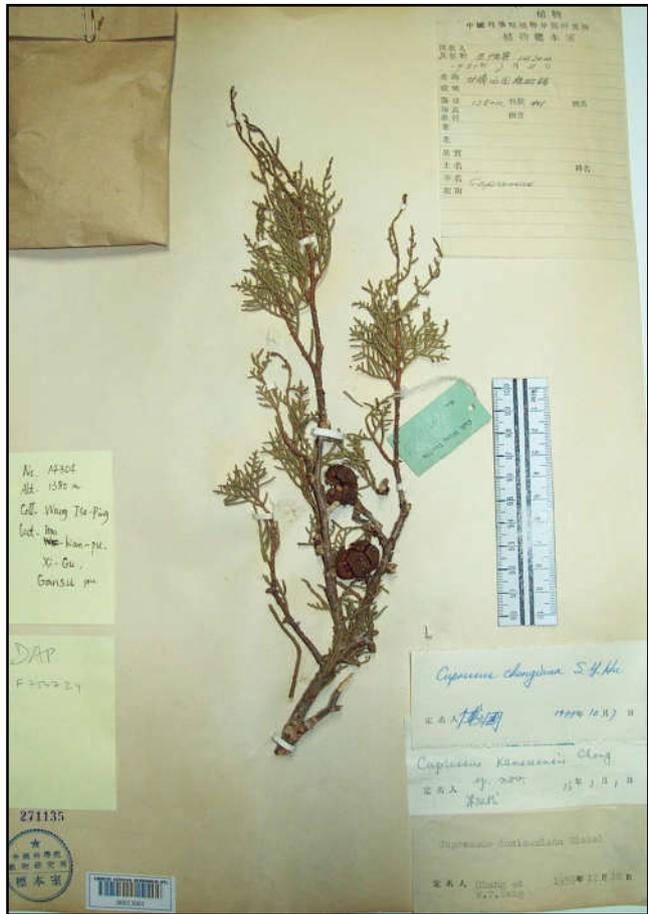


**Fig. 3: Isotype** of *C. gansuensis*, T.P.Wang 14286.  
© Wuhan Herbarium, Hubei (HIB0088916).

**Fig. 4: Isotype** of *C. gansuensis*, T.P.Wang 14286.  
© WUK Herbarium, Shaanxi (WUK0049974).



**Fig. 5: Paratype** of *C. gansuensis*, T.P.Wang 14304.  
© Beijing Herbarium, Beijing (PE00013001).





**Fig. 6: Paratype** of *C. gansuensis*, T.P.Wang 14304.  
© WUK Herbarium, Shaanxi (WUK0049417).



**Fig. 7: Paratype** of *C. gansuensis*, F.N.Meyer 1981.  
© Kew Herbarium, R.B.Gardens, UK (K000088053).

**Fig. 8: Paratype** of *C. gansuensis*, F.N.Meyer 1981.  
© C.V.Starr Herbarium, NYBG (NY00345678).

**Fig. 9: Paratype** of *C. gansuensis*, J.F.Rock 12073.  
© Kew Herbarium, R.B.Gardens, UK (K000088062).



**Phenology of *C. gansuensis*: development of the seed cones after pollination.**



**Fig. 10:** *C. gansuensis* seed cones, less than one full month after pollination, cult., France. 2020-02-05.

**Fig. 11:** *C. gansuensis* seed cones, two months after pollination, cult., France. 2020-03-25.





**Fig. 12:** *C. gansuensis* seed cones, three months after pollination, cult., France. 2020-04-10.



**Fig. 13:** *C. gansuensis* seed cones, three months and a half after pollination, cult., France. 2020-04-23.

**Fig. 14:** *C. gansuensis* seed cones, four months after pollination, cult., France. 2020-05-03.



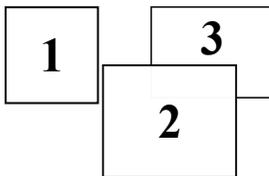
**NB:** For comparison of the seed cones at the same scale, see Fig.17, p. 12.

**Fig. 15 & 16 (bottom):** Comparison of seed cones of *C. gansuensis* (left, 2020-02-05) and *C. fallax* (right, 2020-02-03) about one year after pollination, cult., France.





**Fig. 17:** Comparison of the three *Cupressus* species from Sichuan and Gansu, China.



1. *Cupressus chengiana*, Min Jiang, *Cheng 2066*, isotype K.
  2. *Cupressus fallax*, Dadu He, *Wilson 2106*, isotype K.
  3. *Cupressus gansuensis*, Bailong Jiang, *Meyer 1981*, paratype K.
- All photographs at the same scale; links in appendix 1.  
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