



Ghent University Botanical Garden

*Pinus* L. (Pinaceae)

VEGETATIVE KEY TO SPECIES IN CULTIVATION

**Jan De Langhe**

(10 May 2010 - 29 October 2014)

## Vegetative key.

This key is based on vegetative characteristics, and therefore also of use when cones are absent. For accurate identification, seed cones are often determinant.

Where relevant, some interesting cone characteristics are also mentioned to facilitate identification.

*Pinus* is the largest genus within the Gymnosperms, with 111 species fide Farjon<sup>-1</sup> or 116 fide Businsky<sup>-2</sup>, about 100 are represented in collections and treated in this key.

**Taxa treated in this key: see page 13.**

**Taxa referred to synonymy: see page 13.**

**Questionable/frequently misapplied names: see page 13.**

To improve accuracy:

- **Examine healthy fresh fascicles to determine fascicle length, needle length and number. Plants in stress situations may show a lower number of needles in part of the fascicles!**
- **Beware of hybridisation, especially with plants raised from seed other than wild collected.**

Background information:

- JDL herbarium specimens.
- living specimens, in various arboreta, botanic gardens and collections, especially these from wild origin.
- literature:

Bean, W.J. - (1987) - *Pinus* in Trees and Shrubs hardy in the British Isles VOL.3, p.209-248.

Bean, W.J. - (1988) - *Pinus* in Trees and Shrubs hardy in the British Isles Supplement, p.372-382.

Bisbee, J. - (2014) - Cone morphology of the *Pinus flexilis-ayacahuite* complex of the southwestern United states and Mexico in Bull. CCP3(1), p.3-33

Businsky, R. - (2004) - A revision of the Asian *Pinus* subsection *Strobus* (Pinaceae) in Willdenovia VOL.34, p.209-257.

Businsky, R. - (2008) - The genus *Pinus* L., Pines: contribution to knowledge in Acta Pruhoniana VOL.88, 126 p.<sup>-2</sup>

Eckenwalder, J.E. - (2009) - *Pinus* in Conifers of the world, p.398-490.

Farjon, A., Perez De La Rosa, J.A. & Styles B.T. - (1997) - A field guide to the pines of Mexico and Central America, 147p.

Farjon, A. & Styles B.T. - (1997) - *Pinus* (Pinaceae) in Flora Neotropica VOL.75, 291p.

Farjon, A. - (2005) - Pines, Drawings and descriptions of the genus *Pinus*, 235p.

Farjon, A. - (2010) - *Pinus* in A handbook of the world's conifers VOL.2, p.608-784.<sup>-1</sup>

Gaussen, H. - (1960) - Genre *Pinus* in Les Gymnospermes actuelles et fossiles, 272p.

Grimshaw, J. & Bayton, R. - (2005) - *Pinus* in New Trees, p.579-629

Hillier, J. & Coombes, A. - (2002) - *Pinus* in The Hillier Manual of Trees & Shrubs, p.457-464.

Krüssmann, G. - (1983) - *Pinus* in Handbuch der Nadelgehölze, p.231-280.

Mitchell, A.F. - (1972) - *Pinus* in Conifers in the British Isles, Forestry Commission Booklet VOL.33, p.185-253.

Perry, J.P. - (1991) - The Pines of Mexico and Central America, 231p.

Thanks to Clément Anthoine, Wolfgang Bopp, Peter Brownless, Koen Camelbeke, Paul Goetghebeur, François Hachette, Tony Kirkham, Andrew Marsh, Jean Merret, Paul Reader, and Rolf Zumbunn, for the constructive comments and help with collecting material. My special thanks goes to Roman Businsky for his valuable comments and patience in answering my questions. Also thanks to the responsible persons of various arboreta, botanic gardens and collections where I could collect herbarium specimens.

**My explicit thanks for support goes to Arboretum de Chèvreloup, Arboretum de Keracoual, Arboretum Wespelaar, Collection Anthoine, Eastwoodhill Arboretum, Ghent University Botanical Garden, Hackfals Arboretum, Hillier Gardens and Arboretum, Royal Botanic Gardens Edinburgh, Royal Botanic Gardens Kew.**

Copyright © 2010-2014 **Jan De Langhe**

Non-commercial use authorized with mentioning "Jan De Langhe - Ghent University Botanical Garden".

<http://www.plantentuin.ugent.be>

<http://www.arboretumwespelaar.be/EN>

## Key to subgenera:

- 01 a Fascicle sheaths deciduous (sometimes recurving at first). ..... subgenus **STROBUS**  
1 exception *P. nelsonii*.
- b Fascicle sheaths persistent. see page 6 ..... subgenus **PINUS**  
2 exceptions *P. leiophylla* and *P. lumholtzii*.

## subgenus

# ***Strobis***

- 01 a Needles 1 or 1(-2)/fascicle; thick, very rigid, Ø terete [cone globoid - if open then  $L \leq W$ , <7 cm; peduncle <10 mm]. ..... *P. monophylla*  
**Fascicle sheaths persistent** but also belonging to subgenus **Strobis**. Needles apparently 1/fascicle, but splitting after strong rolling between two fingers in 3 slender needles, Ø triangular [cone cylindrical, 5-12 cm; peduncle >25 mm]. ..... *P. nelsonii*
- b Needles predominantly 2-more/fascicle, Ø flat, crescent or triangular. .... 02
- 02 a Needles 2/fascicle. Needle Ø remarkable flat, width 1,5-4(-7) mm. .... *P. krempfii*
- b Needles (1-)2-3-4-5/fascicle. Needle Ø crescent-shaped to triangular, Ø 1-2 mm. .... 03
- 03 a Needles predominantly 3/fascicle. .... 04
- b Needles not predominantly 3/fascicle. .... 07
- 04 a Needles strongly pendent **AND** needle length 20-30 cm (fascicle sheaths deciduous but belonging to subgenus **Pinus**). ..... *P. lumholtzii*
- b Needles spreading or downswept (pendulous shoots) **AND** needle length <15 cm. ... 05
- 05 a Young shoot pruinose, needles drooping. Stomata predominantly on inner faces [cone 5-10 cm; peduncle long]. ..... *P. pinceana*
- b Young shoot yellowish or greyish green, needles spreading. Stomata on all faces [cone sessile or peduncle short]. .... 06
- 06 a Needle width +/- 2 mm [cone 5-7 cm; apophyses thickened, umbo spiny]. ..... *P. bungeana*
- b Needle width +/- 1 mm [cone 12-20 cm; apophyses very thick, grooved and strongly reflexed]. ..... *P. gerardiana*
- 07 a Needles <5/fascicle. .... 08
- b Needles predominantly 5/fascicle. .... 12
- 08 a Needles predominantly 4/fascicle. .... 09
- b Needles predominantly <4/fascicle. .... 10

- 09 a Needles lax, (3-)4(-5)/fascicle **AND** needle length 6-10 cm [cone ovoid-conical, 10-15 cm; peduncle 15-30 mm]. ..... *P. rzedowskii*
- b Needles rigid, (2-3-)4/fascicle **AND** needle length 2-6 cm [cone globoid - if open then L ≤ W, <7(-10) cm; peduncle <5 mm]. ..... *P. quadrifolia*
- 10 a Fascicle sheaths not recurving. .... *P. remota*
- b Fascicle sheaths recurving. .... 11
- 11 a Needles up curved, predominantly (1-)2/fascicle. .... *P. edulis*
- b Needles straight, predominantly 2-3(-4)/fascicle. .... *P. cembroides*
- 12 a Leaves ≤5 cm **AND** rigid and thick, +/- closely directed forwards, often persisting very long and arranged like 'foxtail shoots'. .... 13
- b Leaves >5 cm at least in part, **AND/OR** relatively lax and thin, spreading in various directions or +/- pendulous. .... 17
- 13 a Leaves (yellowish-) green. Stomata on all faces (10× LENS), outer faces with lines often interrupted [cone remains closed, persistent, 5-8 cm]. ..... *P. albicaulis*
- b Leaves dark green to glaucous green. Stomata on inner faces only [cone opens at maturity, falling after seed dispersal, 5-10 cm]. .... 14
- 14 a Fascicle sheaths recurving and obviously forming rosettes before falling [cone globular, 3-5 cm]. ..... *P. culminicola*
- b Fascicle sheaths not or only slightly recurving before falling [cone globular-cylindrical, 5-10 cm]. .... 15
- 15 a Needles with resin droplet [cone scales with strong 4-10 mm prickles]. ..... *P. aristata*
- b Needles without resin droplet [cone scales without, or with soft 1-6 mm long prickles]. ... 16
- 16 a Needle apex predominantly acuminate and remarkably hyaline (10× LENS), [cone scales with without prickles]. ..... *P. balfouriana*
- b Needle apex acute, not or slightly hyaline [cone scales with soft 1-6 mm long prickles].  
..... *P. longaeva*
- 17 a Fascicle sheaths recurving and obviously forming rosettes before falling. .... 18
- b Fascicle sheaths not or only slightly recurving before falling. .... 19
- 18 a Needles (3-)4-5/fascicle. Needle margin serrulate (10× LENS) [cone ovoid-conical, 10-15 cm, opening soon; scales +/- flexible]. ..... *P. rzedowskii*
- b Needles predominantly 5/fascicle. Needle margin entire (10× LENS) [cone ovoid, 17-25 cm, opening slowly; scales massive and thick]. ..... *P. maximartinezii*
- 19 a Needle outer face with 4-6 obvious stomata lines (10× LENS). Fascicle sheaths deciduous but taxon belonging to subgenus *Pinus*. ..... *P. leiophylla*
- b Needle outer face without or with 1-2-3 (sometimes intermitted) stomata lines (10× LENS). .... 20
- 20 a Needles predominantly drooping. .... 21
- b Needles predominantly spreading to pointing forward. .... 23

- 21 a Needles <14 cm. Some fascicles conspicuously curved at base. Needle 1-1,5 mm thick [cone scales woody and rigid, slow and slightly opening]. ..... *P. armandii*
- b Needles 12-24 cm. Fascicles not or rarely slightly curved at base. Needle narrow 0,75-1 mm thick [cone scales soft woody, soon and fully opening] . ..... 22
- 22 a Shoot glabrous. Needles drooping, predominantly 12-18 cm, lasting 2-4 years, densely set on the shoot [cone 15-30 cm, peduncle 2-4 cm]. ..... *P. wallichiana*
- b Shoot finely pubescent. Needles strongly hanging, predominantly 15-24 cm, lasting 2 years, predominantly near shoot end [cone 12-20 cm, peduncle 4-6 cm]. ..... *P. bhutanica*
- Shoot finely pubescent but needles partly spreading at least at first and less strongly hanging later:
- Needle length 8-16 cm [cone 15-25 cm ] (*P. strobus* × *P. wallichiana*). ..... *P. xschwerinii*
- Needles length 14-18 cm [cone 25-32 cm] (*P. ayacahuite* × *P. wallichiana*). ..... *P. xholfordiana*
- 23 a Needle straight AND remarkably thin: Ø 0,5-0,7 mm. .... 24
- b Needle straight to curved or twisted, OR thicker: Ø 0,7-1,2 (-1,5) mm. .... 26
- 24 a Shoot glabrous [cone 8-15 cm, basal scales appressed; peduncle ≤1 cm and thick]. ..... *P. peuce*
- b Shoot pubescent or pubescence restricted to base of fascicles [cone 8-20 cm, basal scales often recurved; peduncle 2-3(-more) cm, slender]. ..... 25
- 25 a Needle margin serrate with up to 12 teeth/cm [cone basal scales recurved, peduncle 2-3 cm]. ..... *P. strobus*
- b Needle margin densely serrate with up to 25 teeth/cm [cone basal scales appressed, peduncle 1,5-4,5 cm]. ..... *P. chiapensis*
- 26 a Young shoot densely pubescent, with dense mostly yellowish to rusty coloured layer obscuring shoot surface [cone +/- sessile, often remaining closed]. ..... 27
- b Young shoot glabrous or moderately pubescent, with shoot surface visible trough pubescence [cone clearly with peduncle, opening at maturity]. ..... 29
- 27 a Shrub or rarely a small tree (1-4 m). Needles glaucous green, 4-7 cm × 1 mm [cone 3-5 cm]. ..... *P. pumila*
- b Tree. Needles green, 5-11(-13) cm × 1-1,7 mm [cone 5-12 cm]. ..... 28
- 28 a Bud scales dull (resinous layer?). Needles 5-8(-10) cm × 1-1,5 mm [cone 5-8 cm]. ..... *P. cembra*
- b Bud scales shiny (resin absent?). Needles 6-11(-13) cm × 1-1,7 mm [cone 7-12 cm]. ..... *P. sibirica*
- 29 a Needle outer face with (0-)1-2(-3), sometimes interrupted stomata lines (visible with 10× LENS). ..... 30
- b Needle outer face without stomata lines (10× LENS). ..... 33
- 30 a Needle length 3-7 cm. .... 31
- b Needle length 5-10 cm. .... 32

- 31 a **Needle inner faces clearly paler due of the quite visible stomata lines.** [cone opens, apophyses crescent-shaped, 7-14 cm]. ..... *P. flexilis*
- b **Needle inner faces not remarkably paler than the outer face.** [cone remains closed, persistent, apophyses triangular, 5-8 cm]. ..... *P. albicaulis*
- 32 a **Needle apex +/- hard to the touch, outer face with stomata in continuous lines** [cone gigantic 30-60 cm, peduncle  $\geq$ 5 cm]. ..... *P. lambertiana*
- b **Needle apex +/- soft to the touch, outer face with stomata predominantly in interrupted lines** [cone 10-25 cm, apophyses prolonged to slightly reflexed, peduncle <2 cm]. *P. reflexa*
- 33 a **Needles predominantly curved to falcate.** ..... 34
- b **Needles predominantly slightly curved to straight.** ..... 35
- 34 a **Needle inner face with 3-4 stomata lines. Margin rather distantly serrulate except basal 1/4(-1/2), halfway with  $\leq$ 15 teeth/cm ( $\times$ 10 LENS)** [cone almost sessile, spreading].  
..... *P. parviflora*
- b **Needle inner face with (4-)5-8 stomata lines. Margin closely serrulate from apex to almost very base, halfway with 18-40 teeth/cm ( $\times$ 10 LENS)** [cone with long peduncle, curved down to pendulous]. ..... *P. wangii* subsp. *kwangtungensis*
- 35 a **Needle length relatively short, predominantly <10 cm.** ..... 36
- b **Needle length at least in part 10-14(-20) cm.** ..... 37
- 36 a **Needle inner faces with +/- 2 stomata lines (10 $\times$  LENS)** [cone 10-25 cm]. .... *P. monticola*
- b **Needle inner faces with (2-)3-4 stomata lines (10 $\times$  LENS)** [cone  $\leq$ 11 cm]. *P. morrisonicola*
- 37 a **Needle inner faces predominantly with 3-5(-more) stomata lines (10 $\times$  LENS).** ..... 38
- b **Needle inner faces predominantly with 2(-3) stomata lines (10 $\times$  LENS).** ..... 39
- 38 a **Needle length 10-20 cm, inner faces predominantly with 3-5 stomata lines** [cone 15-50 cm, apophyses elongated and strongly recurved]. ..... *P. strobiformis*
- b **Needle length 6-13 cm, inner faces predominantly with 5(-more) stomata lines** [cone 9-14 cm, apophyses broadly triangular and recurved]. ..... *P. koraiensis*
- 39 a **Needle length 8-14 cm** [cone 10-25 cm, scales +/- 3 cm wide, straight to recurved].  
..... *P. stylesii*
- b **Needle length 10-20 cm** [cone 16-60 cm, scales +/- 1-1,5 cm wide and recurved]. ..... 40
- 40 a **Cone 16-45 cm, flexible and light  $\leq$ 160 g, apophyses with a 5-10 mm long +/- reflexed prolongation.** ..... *P. ayacahuite*
- b **Cone 20-50 cm, woody and heavy 200-480 g, apophyses recurved with a 15-22 mm long tongue-like reflexed prolongation.** ..... *P. veitchii*

subgenus

*Pinus*

- 01 a Fascicle sheath finally deciduous (the only exceptions in this subgenus, but the needle outer faces with 3-6 stomata lines). ..... 02
  - b Fascicle sheath persistent. .... 03
- 02 a Needles predominantly 3/fascicle. Needle length 20-30 cm. .... *P. lumholtzii*
  - b Needles 3-5/fascicle. Needle length 7-17 cm. .... *P. leiophylla*
- 03 a Needles apparently 1/fascicle, but splitting after strong rolling between two fingers in 3 slender needles, Ø triangular [cone cylindrical, 5-12 cm, stalk >25 mm]. Fascicle sheaths persistent but taxon belonging to subgenus ***Strobus***. .... *P. nelsonii*
  - b Needles at least 2/fascicle. .... 04
- 04 a Needles predominantly 3-5(-more)/fascicle or 5/fascicle. .... **GROUP A see page 7**
  - b Needles predominantly ≤3/fascicle. .... 05
- 05 a Needles predominantly 3/fascicle (fascicles with 2 or 4 needles possible).  
..... **GROUP B see page 8**
  - b Needles predominantly 2/fascicle (few fascicles with 3 needles possible).  
..... **GROUP C see page 10**

subgenus *Pinus*

Group A

Needles predominantly 3-5(-more) or 5/fascicle:

- 01 a Shoot slender,  $\varnothing \leq 1$  cm. .... 02  
b Shoot thick,  $\varnothing > 1$  cm. .... 07
- 02 a Needles +/- pendant. .... 03  
b Needles spreading. .... 04
- 03 a Needles (4-)5(-6)/fascicle. Needle length 20-30(-35) cm [cone 7-16 cm, peduncle  $< 1$  cm].  
..... *P. pseudostrobus*  
b Needles (3-)4(-5)/fascicle. Needle length 16-18(-25) cm [cone 4-7 cm, peduncle 1-2 cm].  
..... *P. tecunumanii*
- 04 a Needle length  $< 13$  cm AND needles (3-)4-5/fascicle. .... *P. arizonica* var. *cooperi*  
b Needle length 10-20(-25) cm, needles variable in number 3-5 or (2-)3-4(-5)/fascicle. .. 05
- 05 a Shoot very slender +/-  $\varnothing 5$  mm. Scale leaves not ciliate at margin. .... *P. occidentalis*  
b Shoot thicker  $\varnothing 7-9(-10)$  mm. Scale leaves ciliate at margin. .... 06
- 06 a Needles 3-4(-5)/fascicle, +/- curved or twisted, directed side wards [cone scales with deciduous prickle]. .... *P. arizonica* var. *arizonica*  
b Needles (2-)3-4/fascicle +/- straight, directed forwards [cone scales without prickle].  
..... *P. lawsonii*
- 07 a Needle very long, length 20-45 cm, often  $> 30$  cm. .... 08  
b Needle length 10-25(-30) cm. .... 09
- 08 a Needles (4-)5(-6)/fascicle. Needle (17-)25-40(-45) cm  $\times$  1,1-1,6 mm, fresh fascicle sheath length up to 40 mm [cone 15-35  $\times$  8-15 cm]. .... *P. devoniana*  
b Needles (3-4-)5(-6)/fascicle. Needle (15-)20-35(-40) cm  $\times$  1,1-1,6 mm, fresh fascicle sheath length 25-35 mm [cone 8-20  $\times$  5-10 cm]. .... *P. montezumae*
- 09 a Needle length (6-)10-17(-22) cm, fresh fascicle sheath length 30-40 mm. .... *P. hartwegii*  
b Needle length predominantly 14-25 cm, fresh fascicle sheath length 20-30 mm. .... 10
- 10 a Needle thick  $\varnothing$  +/- 2 mm [cone massive 10-15 cm, scales very thick woody]. .... *P. torreyana*  
b Needle less thick  $\varnothing 0,7-1,6$  mm [cone 5-10 cm, scales woody]. .... 11
- 11 a Needle straight,  $\varnothing 0,8-1,6$  mm [cone L  $>$  W when open]. .... *P. durangensis*  
b Needle straight to curved,  $\varnothing 0,7-1$  mm [cone L  $\leq$  W when open]. .... *P. oocarpa*



subgenus *Pinus*

*Group B*

**Needles predominantly 3/fascicle:**

- 01 a Needle length predominantly 25-45 cm AND fresh fascicle sheath length 20-40 mm (length may reduce during years). ..... 02
- b Needle length predominantly  $\leq 25$  cm, OR fresh fascicle sheath length 5-20 mm. .... 05
- 02 a Leafy leading shoot relatively thick ( $\geq 1$  cm), (very) stout and rigid. .... 03
- b Leafy leading shoot relatively thin ( $< 1$  cm), +/- slender and supple. .... 04
- 03 a Bud brown. Fascicle sheath length initially 35-40(-50) mm [cone 8-15 cm]. *P. engelmannii*
- b Bud silvery white. Fascicle sheath length initially 25-30 mm [cone 15-25 cm]. *P. palustris*
- 04 a Needles widely pendent [cone 10-20 x 7-12 cm, scales thick woody and stiff]. *P. roxburghii*
- b Needles +/- curtain-like drooping along both sides of shoot [cone 5-12 x 4-6,5 cm, scales thin woody]. ..... *P. patula*
- 05 a Needles 0,5-1 mm. .... 06
- b Needles 1-1,5(-2) mm. .... 07
- 06 a Needle outer face with  $\leq 5$  stomata lines (10x LENS) [cone  $\leq 4$  cm]. ..... *P. herrerae*
- b Needle outer face with  $> 5$  stomata lines (10x LENS) [cone 4-8 cm]. ..... *P. kesiya*
- 07 a Stem and older branches with adventitious shoot development. .... 08
- b Stem and older branches without adventitious shoots. .... 09
- 08 a Fascicle sheaths initially 10-15 mm. Needles predominantly 6-12 cm. [cone 3-8 cm].  
..... *P. rigida*
- b Fascicle sheaths initially 20-25 mm. Needles predominantly 15-20 cm [cone 6-10 cm].  
..... *P. serotina*
- 09 a Needles predominantly  $< 16$  cm. .... 10
- b Needles predominantly 15-30 cm. .... 13
- 10 a Needles often curved, 3/fascicle and often with 2/fascicle [cone 7-12 x 6-10 cm, serotinous]. ..... *P. radiata*
- b Needles usually straight, 3/fascicle (fewer to exceptionally with 2/fascicle). .... 11
- 11 a Young shoot brown [cone  $\leq 7$  cm, falling]. ..... *P. teocote*
- b Young shoot pale [cone 8-15 cm, serotinous]. ..... 12
- 12 a Needles often bright green [cone 8-15 x  $< 7$  cm, apophyses and umbo +/- flat]. ... *P. greggii*
- b Needles rather dark green [cone 7-12 x 6-10 cm, larger apophyses tubercular with sharp umbo]. ..... *P. attenuata*

- 13 a Needles 3/fascicle. Needle length often >25-32 cm, at least in part of the needles. .... 14
- b Needles (2-)3(-4)/fascicle. Needle length predominantly 15-25 cm. .... 16
- 14 a Needle outer surface with <8 stomata lines [cone ≤25 cm, umbo slightly raised].  
..... *P. canariensis*
- b Needle outer surface with 10-14 stomata lines [cone 17-35 cm, umbo claw-like enlarged].  
..... 15
- 15 a Leaves spreading to drooping, Ø +/- 1,5 mm [cone dull brown, larger apophysis + umbo  
<2 cm]. ..... *P. sabiniana*
- b Leaves spreading, Ø 1,9-2,2 mm [cone pale brown, larger apophysis + umbo>2,5 cm].  
..... *P. coulteri*
- 16 a Needles (2-)3(-4)/fascicle and blue-green [cone 5-9 cm, scales without prickle]. *P. lawsonii*
- b Needles (2-)3/fascicle yellowish green to dark green, rarely blue-green [cone (5-)10-35  
cm, scales with prickle]. ..... 17
- 17 a Needle slender, Ø 1-1,2 mm. .... *P. yunnanensis*
- b Needle rigid Ø ≥1,5 mm. .... 18
- 18 a Needles often curved. .... 19
- b Needles often twisted. .... 20
- 19 a Bud resinous. Needles 3/fascicle but frequently 2/fascicle [cone 7-15 cm]. . *P. ponderosa*
- b Bud without resin. Needles predominantly 3/fascicle (rarely 2/fascicle) [cone 15-25 cm].  
..... *P. jeffreyi*
- 20 a Current year shoot (very) rough. Needle apex acute pungent [cone 5-12 cm, peduncle  
+/- 2 cm]. ..... *P. caribaea*
- b Current year shoot not or slightly rough. Needle apex acute to acuminate. .... 21
- 21 a Needles 2-3/fascicle [cone 9-18 cm, peduncle 2-3 cm]. ..... *P. elliotii*
- b Needles (2-)3/fascicle [cone 6-12 cm, sessile]. ..... *P. taeda*

subgenus *Pinus*

Group C

Needles predominantly 2/fascicle:

- 01 a Current year end shoot slender,  $\varnothing < 5$  mm (avoid strong shoots and side shoots). .... 02  
b Current year end shoot stout,  $\varnothing 5-7(-10)$  mm. .... 17
- 02 a Needle length predominantly 2-8 cm. .... 03  
b Needle length predominantly  $>10$  cm or variable 7-15 cm. .... 09
- 03 a Mature needles moderately to strongly blue-green. .... *P. sylvestris*  
b Mature needles yellow green to dark green. .... 04
- 04 a Young shoot pruinose. .... *P. virginiana*  
b Young shoot green to (yellowish- or grey-) brown. .... 05
- 05 a Bud not resinous; scales fringed. .... *P. brutia* var. *pityusa*  
b Bud often resinous; scales not fringed. .... 06
- 06 a Shrub, 1-3(-more) m, with 1-several major branches ascending and low to or laying on the ground at their base. .... *P. mugo*  
b Tree up to 20 (-more) m, IF shrub then not with such +/- laying down branches. .... 07
- 07 a Bud curved and contorted before sprouting [cone recurving]. .... *P. contorta*  
b Bud straight [cone pointing towards shoot apex]. .... 08
- 08 a Needle 5-8 cm,  $\varnothing 1-1,5$  mm [cone 5-10 cm, armed with stout spine]. .... *P. pungens*  
b Needle  $\leq 5$  cm,  $\varnothing 1,5-2,5$  mm [cone 3-5 cm, unarmed or with a minute prickle]. *P. banksiana*
- 09 a Crown distinctively densely globe- to dome shaped. .... *P. pinea*  
b Crown different. .... 10
- 10 a Needles 2/fascicle and often with a few 3-needled fascicles. .... 11  
b Needles 2/fascicle. .... 12
- 11 a Bud scales free, often recurving and fringed [cone 6-11 cm, scales unarmed]. ... *P. brutia*  
b Bud scales not to slightly free, with small fringes or fringeless [cone 4-7 cm, scales armed]. .... *P. echinata*
- 12 a End shoot remarkably slender,  $\varnothing \leq 2,5$  mm AND bud scales appressed. .... *P. glabra*  
b End shoot slender  $\varnothing \geq 2,5$  mm. Bud scales at least partly free to reflexed. .... 13
- 13 a Needle  $\varnothing 1-1,5$  mm. .... *P. brutia*  
b Needle  $\varnothing 0,7-1$  mm. .... 14

14 a	Needles arching sideward. ....	<i>P. taiwanensis</i>
b	Needles spreading forward. ....	15
15 a	Needles pale yellowish green. ....	<i>P. halepensis</i>
b	Needles dark green. ....	16
16 a	Needles predominantly arranged towards shoot end. ....	<i>P. densiflora</i>
b	Needle at least on strong shoots +/- densely arranged foxtail-like. ....	<i>P. henryi</i>
17 a	Needle length predominantly $\leq 8$ cm. ....	18
b	Needle length predominantly $\geq 10$ cm. ....	19
18 a	Needles 2(-3)/fascicle. Needle often contorted, apex (sub-)acute. ....	<i>P. pungens</i>
b	Needles 2/fascicle. Needle straight +/- curved, apex mucronate. ....	<i>P. uncinata</i>
19 a	Needle $\varnothing$ 0,7-1 mm. ....	20
b	Needle $\varnothing$ 1-1,8(-2) mm. ....	21
20 a	Needles 2(-3)/fascicle, pale green. ....	<i>P. massoniana</i>
b	Needles 2/fascicle, dark green. ....	<i>P. hwangshanensis</i>
21 a	Needles brittle, snap after bending between fingers. ....	<i>P. resinosa</i>
b	Needles rigid. ....	22
22 a	Needle with $\leq 6$ stomata lines, at least on outer face (10 $\times$ LENS). ....	<i>P. densata</i>
b	Needle with $\geq 6$ stomata lines/face (10 $\times$ LENS). ....	23
23 a	Needle length 6-12(-13) cm. ....	24
b	Needle length 10-20 cm, always $>13$ cm at least in part of the needles. ....	26
24 a	Bud grey- to silvery white without resin. ....	<i>P. thunbergii</i>
b	Bud brownish, or obscured by resin. ....	25
25 a	Young shoot green to brownish. Needle length 8-13 cm, $\varnothing$ 1,6-1,8 mm. .....	<i>P. nigra</i> subsp. <i>nigra</i>
b	Young shoot bloomed. Needle length 6-11 cm, $\varnothing$ 1,2-1,5 mm. ....	<i>P. heldreichii</i>
26 a	Bud large 20-35 mm with free to strongly reflexed scales. Needle 10-25 cm $\times$ 1,5-2 mm with 8-15 stomata lines. ....	<i>P. pinaster</i>
b	Bud 10-20 mm with free to appressed scales. Needle 10-15-18 cm. ....	27
27 a	Bud initially +/- purplish and resinous [cones clustered, persistent]. ....	<i>P. muricata</i>
b	Bud brownish +/- resinous. ....	28

- 28 a Needles 2(-3)/fascicle. Shoot orange brown. .... *P. tabuliformis*
- b Needles 2/fascicle. Shoot green to brown soon grey brown. .... *P. nigra*
- Needles spreading forwards, Needle length 8-13 cm, dark green. .... *P. nigra* subsp. *nigra*
  - Needles more spreading, Needle length 8-15(-17) cm, light green.
    - Needle 8-15 cm, slender 1,2-1,5 mm. .... *P. nigra* subsp. *laricio*
    - Needle (8-)12-17 cm, rigid 1,5-2 mm. .... *P. nigra* subsp. *pallassiana*

## Taxa treated in this identification key.

### subgenus *Strobus*

*P. albicaulis*  
*P. aristata*  
*P. armandii*  
*P. ayacahuite*  
*P. balfouriana*  
*P. bhutanica*  
*P. bungeana*  
*P. cembra*  
*P. cembroides*  
*P. chiapensis*  
*P. culminicola*  
*P. edulis*  
*P. flexilis*  
*P. gerardiana*

*P. ×holfordiana* (*P. ayacahuite* × *P. wallichiana*)  
*P. koraiensis*  
*P. kempfii*  
*P. lambertiana*  
*P. longaeva*  
*P. maximartinezii*  
*P. monophylla*  
*P. monticola*  
*P. morrisonicola*  
*P. nelsonii*  
*P. parviflora*  
*P. peuce*  
*P. pinceana*  
*P. pumila*

*P. quadrifolia*  
*P. remota*  
*P. reflexa*  
*P. rzedowskii*  
*P. ×schwerinii* (*P. strobus* × *P. wallichiana*)  
*P. sibirica*  
*P. strobiformis*  
*P. strobus*  
*P. stylesii*  
*P. veitchii*  
*P. wallichiana*  
*P. wangii* subsp. *kwangtungensis*

### subgenus *Pinus*

*P. arizonica*  
*P. attenuata*  
*P. banksiana*  
*P. brutia*  
*P. brutia* var. *pityusa*  
*P. canariensis*  
*P. caribaea*  
*P. contorta*  
*P. contorta* var. *contorta*  
*P. coulteri*  
*P. densata*  
*P. densiflora*  
*P. devoniana*  
*P. durangensis*  
*P. echinata*  
*P. elliotii*  
*P. engelmannii*  
*P. glabra*  
*P. greggii*  
*P. halepensis*  
*P. hartwegii*  
*P. heldreichii*

*P. henryi*  
*P. herrerae*  
*P. hwangshanensis*  
*P. jeffreyi*  
*P. kesiya*  
*P. lawsonii*  
*P. leiophylla*  
*P. lumholtzii*  
*P. massoniana*  
*P. montezumae*  
*P. mugo*  
*P. muricata*  
*P. nigra*  
*P. nigra* subsp. *laricio*  
*P. nigra* subsp. *nigra*  
*P. nigra* subsp. *pallasiana*  
*P. occidentalis*  
*P. oocarpa*  
*P. palustris*  
*P. patula*  
*P. pinaster*  
*P. pinea*

*P. ponderosa*  
*P. pseudostrobus*  
*P. pungens*  
*P. radiata*  
*P. resinosa*  
*P. rigida*  
*P. roxburghii*  
*P. sabiniana*  
*P. serotina*  
*P. sylvestris*  
*P. tabuliformis*  
*P. taeda*  
*P. taiwanensis*  
*P. tecumanianii*  
*P. teocote*  
*P. thunbergii*  
*P. torreyana*  
*P. uncinata*  
*P. virginiana*  
*P. yunnanensis*

## Taxa referred to synonymy in this identification key.

*P. ×digenea* = *P. ×rhaetica nothosubsp. digenea*  
*P. divaricata* = *P. banksiana*  
*P. johannis* = *P. cembroides* var. *bicolor*  
*P. kochiana* = *P. sylvestris* var. *hamata*  
*P. michoacana* = *P. devoniana*

*P. pityusa* = *P. brutia* var. *pityusa*  
*P. pseudopumillio* = *P. uncinata* subsp. *uliginosa*  
*P. rudis* = *P. hartwegii*  
*P. sylvestriflora* = *P. densiflora*  
*P. tenuifolia* = *P. maximinoi*

## Questionable/frequently misapplied names.

It is questionable if *Pinus fenzeliana* is in cultivation. A plant under this name is *P. wangii* subsp. *kwangtungensis*.

