



Ghent University Botanical Garden

Abies Mill. (Pinaceae)

VEGETATIVE KEY TO SPECIES IN CULTIVATION

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Vegetative identification key.

Introduction:

This key is based on vegetative characteristics, and therefore also of use when cones are absent.

- Use a 10x hand lens to evaluate stomata, buds and pubescence in general.
- Buds must be dry, rainy weather can affect the visibility of bud scales and resin.
- Look at the entire plant and especially the most healthy shoots.
Young specimens, shade, coning, top crown and strong shoots give an atypical view.
- Beware of hybridisation, especially with plants raised from seed other than wild origin.

Taxa treated in this key: see page 9.

Names referred to synonymy: see page 9.

References:

- JDL herbarium
- living specimens, in various arboreta, botanic gardens and collections
- literature:

Bean, W.J. - (1987) - *Abies* in Trees and Shrubs hardy in the British Isles VOL.1, p. 141-169.
Clarke, D.L. - (1988) - *Abies* in Trees and Shrubs hardy in the British Isles supplement, p. 16-33.
Debreczy, Z., Racz, I. - (2011) - *Abies* in Conifers around the world - 2 VOL., 1089 p.
Eckenwalder, J.E. - (2009) - *Abies* in Conifers of the world, p. 77-119.
Farjon, A. - (1990) - *Abies* in Pinaceae, p. 9-109.
Farjon, A. - (2010) - *Abies* in A Handbook of The World's Conifers, p. 55-128.
Grimshaw, J. & Bayton, R. - (2009) - *Abies* in New Trees, p. 43-61.
Hillier, J. & Lancaster, R. - (2014) - *Abies* in The Hillier Manual of Trees & Shrubs, p. 468-473.
Hunt, R.S. - (1993) - *Abies* in Flora of North America VOL.2, p.354-362.
Mitchell, A.F. - (1972) - *Abies* in Conifers in the British Isles, p. 3-49.
Krüssmann, G. - (1977) - *Abies* in Handbuch der Nadelhölze, p. 21-44.
Liu, T.S. - (1971) - A monograph of the genus *Abies*, 608 p.
Rehder, A. - (1940) - *Abies* in Manual of cultivated trees and shrubs hardy in North America, p. 9-18.
Rushforth, K.D. - (1987) - *Abies* in Conifers, p. 71-87.
Rushforth, K.D. - (2001) - *Abies* in the European Garden Flora VOL.1, p. 88-94.
Rushforth, K.D. - (2008) - The Tibetan silver fir in IDS Yearbook 2008, p. 39-46.
Strandby, U., Christensen, K.I., Sørensen, M. - (2009) - A morphometric study of the *Abies religiosa-hickelii-guatemalensis* complex (Pinaceae) in Guatemala and Mexico, Plant Syst Evol (2009) 280: p. 59-76.

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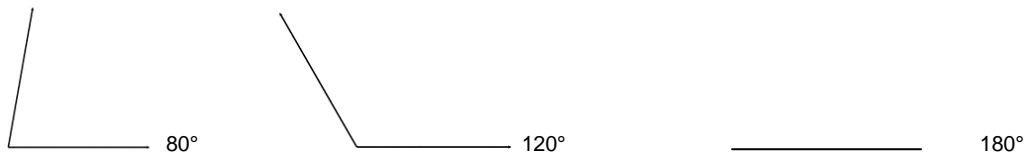
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<http://www.plantentuin.ugent.be>

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

KEY TO GROUPS

- 01 a Foliage above shoot clearly parted in the middle. 02
 b Foliage above shoot predominantly not parted in the middle. 03
- 02 a Leading shoot in bottom view with needle rows predominantly forming a $\leq 80\text{-}120^\circ$ angle.
 **GROUP A1: see page 2**
- b Leading shoot in bottom view with needle rows predominantly forming a $120\text{-}180^\circ$ angle.
 **GROUP A2: see page 4**



- 03 a Needle US with several stomatal lines over the whole length (10x LENS).
 **GROUP B1: see page 6**
- b Needle US without stomatal lines, OR with a few stomata near apex to a few stomatal lines in apical half (10x LENS). **GROUP B2: see page 6**

GROUP A1: Foliage above shoot parted in the middle.

Leading shoot in bottom view with needle rows predominantly forming a $80\text{-}120^\circ$ angle.

- 01 a Needle US, at least in part of the foliage, with 1 to several (sometimes incomplete/interrupted) stomatal lines (10x LENS). 02
 b Needle US without stomatal lines or with a few stomata near apex only (10x LENS). 07
- 02 a Shoot clearly pubescent. 03
 b Shoot glabrous to minutely pubescent in grooves only. 04
- 03 a Shoot pubescence greyish. **A. balsamea**
 b Shoot pubescence ferruginous. **A. kawakamii**
- 04 a Needle US with 1-10 +/- incomplete stomatal lines (10x LENS) [cone bluish-purple, bracts exerted]. **A. vejarii**
 b Needle US with 1-4 +/- incomplete stomatal lines (10x LENS) [cone yellowish-brownish, bracts hidden]. 05
- 05 a Needle US dull pruinose green to greyish green. **A. durangensis**
 b Needle US (shiny) green. 06

- 06 a Needle apex acute to obtuse; LS with midvein prominent, predominantly wider or as wide as stomatal bands. *A. durangensis* var. *coahuilensis*
- b Needle apex obtuse to emarginate; LS with midvein predominantly narrower than stomatal bands. *A. guatemalensis*
- 07 a Needle remarkable slender: Ø 1-1,6 mm. 08
- b Needle obviously wider: Ø 1,6-2(-3) mm. 09
- 08 a Bud dark purplish, +/- covered by whitish/grey resin layer (10× LENS) [cone bract scales exerted and recurved]. *A. sachalinensis*
- b Bud yellowish to reddish brown, +/- covered by whitish/grey resin layer (10× LENS) [cone bract scales hidden]. *A. sibirica*
- 09 a Short needles of upper rows strongly directed forward, forming a narrow ≤45° V-shaped parting. 10
- b Short needles of upper rows directed forward to more sideward, forming a wider 45-60° V-shaped parting. 13
- 10 a Needle 30-70 mm, apex bifid to acute bifid (10× LENS). *A. pindrow*
- b Needle 15-40(-40) mm, apex obtuse to emarginate (10× LENS). 11
- 11 a Bud purplish brown, (very) resinous. Needle LS with sombre greenish white stomatal bands. *A. kawakamii*
- b Bud brown, not to slightly resinous. Needle LS with white stomatal bands. 12
- 12 a Needle Ø 1,8-2,5 mm. Long needles of lower rows predominantly directed forward to sideward, in a 90-120°(-more) angle. *A. nordmanniana*
- b Needle Ø 1,8 mm. Long needles of lower rows predominantly directed forward, in a ≤90° angle. *A. cilicica*
- 13 a Current year shoot above red or mahogany brown AND needle 10-40(-60) × 2-2,5 mm. *A. chengii*
- b Current year shoot above brown to fawn brown or greyish, OR needle <35 mm long OR needle ≤2 mm wide. 14
- 14 a Leading shoot prominently grooved, Ø 3,5-10 mm, with bud well developed, 5-10 mm. *A. spectabilis* sensu lato
- Shoot often pubescent in the grooves with long reddish brown hairs. Coning shoot with foliage assurgent [cone 10-17 × 4-7 cm, bract scales hidden]. *A. spectabilis*
- Shoot almost glabrous to moderately pubescent in the grooves with rather hidden short hairs. Coning shoot with foliage radial [cone 8-12 × 4-5 cm, bract scales exerted]. *A. densa*
- b Leading shoot not or shallowly grooved, Ø <3,5 mm, bud small, <5 mm. 15
- 15 a Foliage above shoot with needles not or slightly ascending. *A. alba*
- b Foliage above shoot with needles clearly ascending. 16
- 16 a Shoot pubescence short and restricted to the grooves. Needle 10-30 × 1,6-2 mm. *A. nephrolepis*
- b Shoot pubescence long and scattered over the surface. Needle 10-23 × 2-2,2 mm. *A. fraseri*

GROUP A2: Foliage above shoot parted in the middle.

Leading shoot in bottom view with needle rows predominantly forming a 120-180° angle.

- 01 a Needle +/- concolourous, OR LS rather dull greyish green to greenish white to the naked eye. 02
- b Needle clearly bicoloured: LS obvious white to glaucous white to the naked eye. 05
- 02 a Needle US with stomatal lines. *A. concolor* var. *lowiana*
- b Needle US without stomatal lines, or with few stomata near apex. 03
- 03 a Needle 15-35 × 2-2,5 mm AND foliage above shoot +/- assurgent and often recurved, below shoot pectinate and recurved in part. *A. recurvata*
- Needle 25 mm, especially on young shoots US often +/- glaucous. *A. recurvata* var. *recurvata*
- Needle 20-35 mm, US green. *A. recurvata* var. *ernestii*
- b Needle 20-75 × 2,5-4,5 mm. Foliage above shoot ascending to +/- assurgent, below shoot pectinate. 04
- 04 a Current year shoot (and second year shoot in lesser degree) pubescent in the grooves (10× LENS) [Cone with bract scales exserted]. *A. firma*
- b Current year shoot glabrous or minutely pubescent (10× LENS) [Cone with bract scales hidden]. *A. chensiensis*
- Needle long: 40-90 × 3-4,5 mm. *A. chensiensis* subsp. *salouenensis*
- Needle shorter: 20-45 × 2,5-3,5 mm.
- Needle Ø 2,5-3,5 mm. *A. chensiensis* subsp. *chensiensis*
- Needle Ø 2,5 mm. *A. chensiensis* subsp. *yulongxueshanensis*
- 05 a Needle US with 1-several weakly developed stomata lines in apical third to apical half (sometimes from apex to base), at least in part of the leaves. 06
- b Needle US without stomata rows, OR with only a few stomata near the apex. 08
- 06 a Needle apex acute to rounded (10× LENS). *A. mexicana*
- b Needle apex notched (10× LENS). 07
- 07 a Shoot sparsely pubescent. Needle LS with 4-8 rows/stomatal band. *A. balsamea*
- b Shoot +/- densely pubescent. Needle LS with 8-12 rows/stomatal band. *A. fraseri*
- 08 a Needle apex predominantly obtuse to acute or to mucronulate (10× LENS). 09
- b Needle apex notched to obtuse, sometimes +/- bifid (10× LENS). 11
- 09 a Needle short: 10-22 × 2-3 mm, apex obtuse to mucronulate (10× LENS). ... *A. nebrodensis*
- b Needle long: 15-35 × 1,5-2,5 mm, apex acute to +/- acuminate (10× LENS). 10
- 10 a Shoot glabrous. Needle US not or +/- slightly grooved (10× LENS). *A. cephalonica*
- a Shoot (minutely) pubescent, at least in part, Needle US clearly grooved over the whole length. *A. religiosa*

- 11 a Shoot clearly grooved, forming a regular pattern of dark lines (10× LENS). 12
- b Shoot shallowly grooved, without a pattern of dark lines (10× LENS). 13
- 12 a Shoot glabrous (10× LENS). **A. homolepis**
- Cone 7-10 cm, purplish blue (brownish later), apex obtuse. **A. homolepis** var. **homolepis**
 - Cone 10-14 cm, green (brownish later), apex depressed. **A. homolepis** var. **umbellata**
- b Shoot +/- pubescent in the grooves (10× LENS). **A. spectabilis sensu lato**
- Shoot often pubescent in the grooves with long reddish brown hairs.
Coning shoot with foliage assurgent [cone 10-17 × 4-7 cm, bract scales hidden]. **A. spectabilis**
 - Shoot almost glabrous to moderately pubescent in the grooves with rather hidden short hairs.
Coning shoot with foliage radial [cone 8-12 × 4-5 cm, bract scales exerted]. **A. densa**
- 13 a Needles densely packed on rather thick shoots. 14
- b Needles loosely placed on rather slender shoots. 15
- 14 a Shoot yellow grey but sometimes reddish in part of branches. Needle Ø 2,5-3,5 mm
AND/OR length 40-70 mm (see 04b -page 4, for infraspecific taxa). **A. chensiensis**
- b Shoot orange brown to purplish brown. Needle Ø <2,5 mm, length ≤40 mm. **A. forrestii**
- Shoot glabrous. **A. forrestii** var. **forrestii**
 - Shoot pubescent, hairs ferruginous.
 - Foliage with lower needle rows predominantly forming a <170° angle. **A. forrestii** var. **georgei**
 - Foliage with lower needle rows predominantly forming a 180°(-more) angle. ... **A. forrestii** var. **ferreana**
- 15 a Needle relatively short: ≤30 mm. **A. fabri**
- Foliage above shoot with needles predominantly strongly directed sideward, few needles also backward.
..... **A. fabri** subsp. **fabri**
 - Foliage above shoot with needles directed forward and sideward. **A. fabri** subsp. **minensis**
- b Needle relatively long: 15-60 mm. 16
- 16 a Current year shoot LS olive greenish. **A. grandis**
- b Current year shoot rusty to coppery. **A. fordei**

GROUP B1: Foliage above shoot predominantly not parted in the middle.
Needle US with several stomatal lines over the whole length (10× LENS).

- 01 a Shoot densely pubescent, dark orange to purplish brown AND Needle at base closely appressed to shoot (10× LENS). 02
- b Shoot pale yellowish or greyish brown, glabrous to sparsely pubescent, OR needle at base clearly ascending (10× LENS). 03
- 02 a Needle Ø 1,5-2 mm. Foliage very dense: at mid shoot 16-20 needles/cm [cone 15-25 cm, bracts exerted]. **A. procer**
- b Needle Ø ≤1,6 mm. Foliage +/- sparse: at mid shoot ≤14 needles/cm [cone 15-25 cm, bracts hidden]. **A. magnifica**
 - Intermediate: Foliage +/- sparse and cone <15 cm, bracts exerted. **A. magnifica** var. **shastensis**
- 03 a Needle relatively long and slender, leathery and flexible: 15-40(-60) × 1,5-2,5 mm. 04
- b Needle relatively short and thick, +/- rigid: 6-20 × 2-3 mm. 06
- 04 a Needle 40-60 mm. Foliage in front view with needles +/- strongly curved upward and/or +/- directed forward. **A. concolor**
- b Needle 15-45 mm. Foliage in front view with needles ascending and directed forward. . 05
- 05 a Needle green, apex acute to obtuse, 15-40 × 2-2,5 mm. **A. gamblei**
- b Needle often glaucous green, apex emarginate to obtuse, 25-45 × 1,5-2 mm. **A. lasiocarpa**
 - Foliage in front view with needles distributed in upper half. **A. lasiocarpa** var. **arizonica**
 - Foliage in front view with needles also scattered in lower half. **A. lasiocarpa** var. **lasiocarpa**
- 06 a Shoot pubescent. **A. xinsignis**
- b Shoot glabrous. 07
- 07 a Needle US with 8-14 stomatal lines. **A. pinsapo**
- b Needle US with 2-8 stomatal lines. **A. numidica**

GROUP B2: Foliage above shoot predominantly not parted in the middle.
Needle US without stomatal lines,
OR with a few stomata near apex to a few stomatal lines in apical half (10× LENS).

- 01 a Needle +/- concolourous, OR LS +/- sombre: stomatal bands greyish green to greenish white. 02
- b Needle clearly bicoloured, LS showy: stomatal bands white to glaucous white. 04
- 02 a Foliage above shoot ascending. Needle apex bifid, length 5-7(-more) cm. **A. pindrow**
- b Foliage above shoot ascending to assurgent. Needle apex acute, OR/IF bifid then with length <4 cm. 03

- 03 a Foliage above shoot strongly ascending to assurgent, below shoot directed forward and downward. **A. holophylla**
- b Foliage above shoot assurgent and recurved in part, below shoot pectinate and recurved in part. **A. recurvata**
- Needle 25 mm, US often +/- glaucous on young shoots. **A. recurvata** var. **recurvata**
- Needle 20-35 mm, US green. **A. recurvata** var. **ernestii**
- 04 a Bud apex predominantly acute **AND** scales visible, not to slightly resinous (10× LENS). 05
- b Bud apex predominantly obtuse **AND** scales obscured or very resinous (10× LENS). 12
- 05 a Needle 30-60 mm, apex painfully pungent. Bud yellowish brown, 10-20 mm, with remarkable large scales. **A. bracteata**
- b Needle 15-35 mm, **OR** apex notched, obtuse or acute, **OR** bud ≤10 mm. 06
- 06 a Foliage above shoot assurgent to erect. 07
- b Foliage above shoot predominantly ascending and directed forward at ≤60°. 10
- 07 a Shoot glabrous (10× LENS). 08
- b Shoot pubescent, at least in part of the branches (10× LENS). 09
- 08 a Needle long: 15-35 × 2-2,5 mm, apex acute or rarely obtuse (10× LENS). ... **A. cephalonica**
- b Needle short: 15-25 × 2-3 mm, apex obtuse to shallowly notched (10× LENS). **A. numidica**
- 09 a Needle apex obtuse to (sub-)mucronate (10× LENS). **A. nebrodensis**
- b Needle apex emarginate (10× LENS). **A. pardei**
- 10 a Needle apex predominantly obtuse to acute (10× LENS). **A. xborisii-regis**
- b Needle apex predominantly emarginate to obtuse. 11
- 11 a Needle Ø 1,8 mm. Current year shoot with lower needle rows predominantly directed forward, forming a ≤90° angle [cone bracts exposed]. **A. cilicica**
- Shoot initially pubescent. **A. cilicica** subsp. **cilicica**
- Shoot glabrous. **A. cilicica** subsp. **isaurica**
- b Needle Ø 1,8-2,5 mm. Current year shoot with lower needle rows predominantly directed forward to sideward, forming a 90-120° angle [cone bracts hidden]. **A. nordmanniana**
- Shoot +/- pubescent. Needle Ø >2-2,5 mm. **A. nordmanniana** subsp. **nordmanniana**
- Young shoot glabrous. Needle Ø ≤1,8 mm. **A. nordmanniana** subsp. **equitrojana**
- 12 a Needle LS midrib very narrow and often whitish obscured, margin revolute. ... **A. delavayi**
- b Needle LS midrib predominantly clearly visible, margin not or slightly revolute. 13
- 13 a Needle remarkable slender: Ø 1-1,6 mm. 14
- b Needle obviously wider: Ø 1,6-2(-3) mm. 15

- 14 a Bud purplish, +/- covered by whitish/grey resin layer (10× LENS) [cone bract scales exerted and recurved]. **A. sachalinensis**
- b Bud yellowish to reddish brown, +/- covered by whitish/grey resin layer (10× LENS) [cone bract scales hidden]. **A. sibirica**
- 15 a Shoot prominently striated to ridged **AND** glabrous. Needle US shiny and predominantly without or with a shallow groove in basal half (10× LENS). **A. cephalonica**
- b Shoot smooth, **OR** pubescent, **OR** needle US clearly grooved (10× LENS). 16
- 16 a Shoot (reddish) brown to purplish. 17
- b Shoot pale yellowish to greyish brown. 20
- 17 a Bark remarkably exfoliating, breaking into rough plates later. Needle US with a few stomata or several (interrupted) rows towards the middle. **A. squamata**
- b Bark not exfoliating, smooth, scaly to fissured. Needle US without, or with a few stomata near apex. 18
- 18 a Shoot pubescent, ferruginous hairs (10× LENS); orange brown. ... **A. forrestii** var. **georgei**
- b Shoot glabrous (10× LENS); reddish to purplish brown at least in part of the branches. 19
- 19 a Shoot orange brown. **A. forrestii** var. **forrestii**
- b Shoot reddish to purplish brown at least in part of the branches. **A. fargesii**
- 20 a Needle firm (often remarkably widened towards apex), relatively short **AND** wide: ≤25 mm long **AND** Ø 2-2,5 mm. **A. koreana**
- Needle 25-30 mm **AND** Ø 2-2,5 mm, apex often acute (not emarginate/obtuse as preceding). **A. xarnoldiana**
- b Needle slender (not widened towards apex), relatively long **AND** narrow: 10-40(-60) mm long **AND/OR** Ø 1,6-2 mm. 21
- 21 a Foliage yellowish to grey green. Shoot pubescent in grooves. **A. nephrolepis**
- b Foliage dark green. Shoot uniformly pubescent. 22
- 22 a Foliage above shoot with part of needles upswept, showing white needle LS. .. **A. veitchii**
- Needle 15-38 × 1,5- 2,2 mm. Cone 4-8 cm. **A. veitchii** var. **veitchii**
- Needle 8-20 × 2 mm. Cone ≤4 cm. **A. veitchii** var. **sikokiana**
- b Foliage above shoot with needle LS hidden (only a few small needles near end bud may show LS). 23
- 23 a Foliage above shoot with needles strongly ascending to assurgent **AND** shoot +/- visible. **A. fraseri**
- b Foliage above shoot with needles directed downward to slightly ascending **AND** covering shoot. 24
- 24 a Bud ≥4 mm. Needle 15-35 mm, LS with 5-8 stomatal lines (10× LENS), bruised foliage emits a sharp tangerine scent. **A. amabilis**
- b Bud ≤3 mm. Needle 10-20(-25) mm, LS with 10-14 stomatal lines (10× LENS), bruised foliage emits a heavy balsam scent. **A. mariesii**

Taxa treated in this identification key.

- A. alba*
A. amabilis
A. ×arnoldiana (*A. koreana* × *A. veitchii*)
A. balsamea
A. ×borisii-regis (*A. alba* × *A. cephalonica*)
A. bracteata
A. cephalonica
A. chengii
A. chensiensis
 - subsp. *chensiensis*
 - subsp. *salouenensis*
 - subsp. *yulongxueshanensis*
A. cilicica
 - subsp. *cilicica*
 - subsp. *isaurica*
A. concolor
 - var. *lowiana*
A. delavayi
A. densa
A. durangensis
 - var. *coahuilensis*
A. fabri
 - subsp. *fabri*
 - subsp. *minensis*
A. fargesii
A. firma
A. fordei
A. forrestii
 - var. *ferreana*
 - var. *forrestii*
 - var. *georgei*
A. fraseri
A. gamblei
A. grandis
A. guatemalensis
- A. holophylla*
A. homolepis
 - var. *homolepis*
 - var. *umbellata*
A. ×insignis (*A. nordmanniana* × *A. pinsapo*)
A. kawakamii
A. koreana
A. lasiocarpa
 - var. *arizonica*
 - var. *lasiocarpa*
A. magnifica
A. mariesii
A. mexicana
A. nebrodensis
A. nephrolepis
A. nordmanniana
 - subsp. *equi-trojani*
 - subsp. *nordmanniana*
A. numidica
A. pardei
A. pindrow
A. pinsapo
A. procera
A. recurvata
 - var. *ernestii*
 - var. *recurvata*
A. religiosa
A. sachalinensis
A. sibirica
A. spectabilis
A. squamata
A. veitchii
 - var. *sikokiana*
 - var. *veitchii*
A. vejarii

Names referred to synonymy in this identification key.

- A. chayuenis* = *A. forrestii* var. *ferreana*
A. ferreana = *A. forrestii* var. *ferreana*
A. nordmanniana subsp. *bornmuelleriana* = *A. nordmanniana*
 subsp. *equi-trojani*
- A. pindrow* var. *brevifolia* = *A. gamblei*
A. pseudochensiensis = *A. gamblei*
A. vejari subsp. *mexicana* = *A. mexicana*

