



Ghent University Botanical Garden

***Mahonia* Nutt. (Berberidaceae)**

VEGETATIVE KEY TO SPECIES IN CULTIVATION

Jan De Langhe

(16 April 2016 - 21 November 2017)

Vegetative identification key.

Introduction:

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

- Use a 10x hand lens to check leaf margin incisions and venation pattern in general.
- Look at the entire plant.
- Beware of hybridisation, especially with plants raised from seed other than wild origin.

Abbreviations used in this key:

- **L/W** = length/width
- **LS** = lower surface
- **M-L** = middle to lowermost (concerning leaflets to be examined)
- **U-M** = uppermost to middle (concerning leaflets to be examined)
- **US** = upper surface

Taxa treated in this key: → p7.

Taxa referred to synonymy in this key: → p8.

Taxa referred to *Berberis* synonymy: → p8.

Remarks: → p8.

References:

- JDL herbarium and [illustrations](#)
- living specimens, in various arboreta, botanic gardens and collections
- literature:

Ahrendt, L.W.A. - (1961) - The genus *Mahonia* Nutt. in J/Linn.Soc.Bot. 57, 410p.
Bean, W.J. & Clarke, D.L. - (1987) - *Mahonia* in Bean's Trees and Shrubs hardy in the British Isles 3, p.7-20. - and [online edition](#)
Boufford, D.E. - (2013) - *Mahonia* (Berberidaceae) in Asia: Typification, Synonymy and Notes in Memoirs of the New York Botanical Garden 108, p.251-283.
Fedde, F. - (1901) - Versuch einer Monographie der Gattung *Mahonia* in Engler Bot. Jahrb. Syst. 31-1, p30-133.
Krüssmann, G. - (1977) - *Mahonia* in Handbuch der Laubgehölze 2, p.289-294.
RHS - (2014) - *Mahonia* in The Hillier Manual of Trees & Shrubs, p.231-232.
Schilling, T. & Watson, M. - (2014) - Clarifying the identities of two Nepalese *Mahonia* in The Plantsman, 2014/June, p.94-100.
Shaw, J. - (2011) - Developments in *Mahonia* in The Plantsman, 2011/March, p.44-49.
Standley, P.C. - (1922) - The genus *Odostemon* in Trees and shrubs of Mexico part.2, p.268-273.
Takeda (1911-1917) - *Mahonia* in Notes from the Royal Botanic Garden, Edinburgh 6, p.209-248 and plate I-XXXVII.
Williams, M.P. - (2017) - *Berberis* in Jepson Flora Project (eds) [Jepson eFlora Taxon page](#)
Whittemore, A.T. - (1997) - *Berberis* in Flora of North America 3. - and [online edition](#)
Ying, T. S., Boufford, D.E. and Brach, A.R. - (2011) - *Mahonia* In Flora of China 19, p.772-800. - and [online edition](#)

I am particularly grateful to Wolfgang Bopp, Dave Boufford, Mona Bourell, Debby Chubb, Olivier Colin, Francisco Garin, Paul Goetghebeur, Tom Hudson, David Jewell, Neil Lancaster, Roy Lancaster, Bram Rammeloo and Bleddyn Wynn-Jones for extra help with constructive comments and specimens.

Also thanks to the responsible persons of various arboreta, botanic gardens and collections where I could collect herbarium specimens since 1982.

My explicit thanks for support goes to Arboretum Kalmthout, Arboretum Wespelaar, Ghent University Botanical Garden, Hillier Gardens and Arboretum, Iturraran Botanic Garden, Royal Horticultural Society Garden Wisley, San Francisco Botanical Garden and Tregrehan Garden.

Last but not least I would like to thank Roy Lancaster for his enthusiasm while guiding me around in his collection.

And a special thank also to Olivier Colin for the guidance in his collection and especially for his speedily answering all my questions.

Copyright © 2016 - 2017 Jan De Langhe

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

[Plantentuin Universiteit Gent](#)

[Arboretum Wespelaar](#)

KEY TO GROUPS

- 01 a Leaflet LS completely finely reticulate: with numerous tiny areoles, Ø predominantly 1-2 mm (10× LENS) **Group A**. 02
- b Leaflet LS variably reticulate: without or with at least in part rather large and variably shaped/sized areoles, Ø 2-10 mm (10× LENS) **Group B**. 03
- 02 a Lateral leaflets at least in part in ≥4 pairs. **Group A1 → p2**
- b Lateral leaflets in 1-3 pairs. **Group A2 → p3**
- 03 a Leaflet LS chalky white. **Group B1 → p4**
- b Leaflet LS greenish. 04
- 04 a Lateral leaflets predominantly in 8-20 pairs. **Group B2 → p4**
- b Lateral leaflets predominantly in 2-8 pairs. 05
- 05 a Lateral leaflet base cuneate. **Group B3 → p5**
- b Lateral leaflet base rounded, cordate or truncate. **Group B4 → p6**

GROUP A
 Leaflet LS completely finely reticulate:
 with numerous tiny areoles, Ø predominantly 1-2 mm (10× LENS).

GROUP A1
 Lateral leaflets at least in part in ≥4 pairs.

- 01 a Leaflet apex AND margin completely espinulose. ***M. chochoco***
- b Leaflet apex spinulose, OR apex and margin spinulose to spinose. 02
- 02 a Lateral leaflet petiolule 1-3 mm. 03
- b Lateral leaflet petiolule ≤1 mm. 05
- 03 a Lateral leaflets lanceolate, L/W ratio at mid leaflet 3/1-4/1. ***M. russellii***
- b Lateral leaflets narrowly ovate to ovate, L/W ratio at mid leaflet ≤3/1. 04
- 04 a Lateral leaflets +/- overlapping in part, apex acute to obtuse. ***M. paxii***
- b Lateral leaflets distant, apex acute. ***M. hartwegii***
- 05 a Leaf length, at least in part of the foliage, 50-80(-more) cm AND leaflets in (4-)6-8(-10) pairs. ***M. duclouxiana***
- b Leaf length 5-50 cm OR leaflets in 4-6 pairs. 06

- 06 a Lateral leaflets lanceolate, L/W ratio at mid leaflet predominantly 3/1-4/1. 07
 b Lateral leaflets ovate to elliptic, L/W ratio at mid leaflet predominantly <2(-3)/1. 08
- 07 a Leaf length 15-30 cm. Leaflet marginal teeth predominantly <10 pairs. *M. pallida*
 b Leaf length 30-50 cm. Leaflet marginal teeth 10-20 pairs. *M. paniculata*
- 08 a Leaflet margin minutely spinulose serrate, sinuses tiny or almost absent (except juvenile plants). *M. gracilis*
 b Leaflet margin spinulose dentate, sinuses well developed. 09
- 09 a Leaf length 5-20 cm. Lateral leaflet <5 cm. *M. volcania*
 b Leaf length 20-30(-more) cm. Lateral leaflet length 5-10 cm. 10
- 10 a Petiole predominantly 1-3(-5) cm. *M. pinnata*
 b Petiole, at least in part of the leaves, 5-7(-10) cm. 10
- 11 a Basal leaflets variable in position: at least in part of the uppermost leaves quite near base of petiole (examine whole plant). *M. × wagneri*
 b Basal leaflets rather uniformly 3-5(-more) cm from base petiole. *M. aquifolium*

GROUP A2
 Lateral leaflets in 1-3 pairs.

- 01 a Leaf length predominantly 15-30 cm. 02
 b Leaf length predominantly 5-15 cm. 06
- 02 a Leaflet +/- rectangular elliptic, hard/thick AND margin strongly wavy. *M. dictyota*
 b Leaflet ovate, soft/thin AND margin flat to wavy. 03
- 03 a Stoloniferous shrub AND leaflet US quite dull. *M. repens*
 b Variable shrub, but not simultaneously stoloniferous and with leaflet US quite dull. 04
- 04 a Petiole predominantly 1-3(-5) cm. *M. pinnata*
 b Petiole at least in part of the leaves 5-7(-10) cm. 05
- 05 a Basal leaflets variable in position: at least in part of the uppermost leaves quite near base of petiole (examine whole plant). *M. × wagneri*
 b Basal leaflets rather uniformly (3-)5-10 cm from base petiole. *M. aquifolium*
- 06 a Lateral leaflets always in 1 pair. 07
 b Lateral leaflets in 1-3 pairs. 08
- 07 a Lateral leaflet margin with 1-3 large teeth/side. *M. trifoliolata*
 b Lateral leaflet margin with 6-14 (-more) tiny teeth/side. *M. repens*

- 08 a Uppermost lateral leaflets L/W ratio always $<2/1$ (examine largest leaves, avoid trifoliolate leaves). 09
- b Uppermost lateral leaflets L/W ratio often $>2/1$ (examine largest leaves, avoid trifoliolate leaves). 11
- 09 a Shrub $<0,5$ m. Lateral leaflets in 1-2 pairs. *M. pumila*
- b Shrub to small tree, up to 4 m. Lateral leaflets in 2-3(-6) pairs. 10
- 10 a Terminal leaflet base (broadly) cuneate. *M. trifolia*
- b Terminal leaflet base truncate. *M. volcania*
- 11 a Lowermost lateral leaflets close to petiole base. 12
- b Lowermost lateral leaflets 1-3 cm from petiole base. 13
- 12 a Lateral leaflet margin with 2-6 spinose teeth/side. *M. fremontii*
- b Lateral leaflet margin with 6-12 spinulose teeth/side. *M. nevini*
- 13 a Leaf L/W ratio predominantly $2/1$ *M. haematocarpa*
- b Leaf L/W ratio predominantly $<2/1$ *M. trifoliolata* × *M. swaseyi*

GROUP B
 Leaflet LS variably reticulate: without or with at least in part rather large and variably shaped/sized areoles, Ø 2-10 mm (10× LENS).

GROUP B1
 Leaflet LS chalky white.

- Lateral leaflets in 2-3 pairs, leaflet base cuneate. *M. gracilipes*
- Lateral leaflets in 5-9 pairs, leaflet base rounded to truncate. *M. lancasteri*

GROUP B2
 Leaflets predominantly in 8-20 pairs.

- 01 a U-M lateral leaflets clearly distant AND L/W ratio often $3/1-5/1$ 02
- b U-M lateral leaflets approximate to +/- overlapping, OR L/W ratio predominantly $\leq 3/1$ 05
- 02 a Lateral leaflets predominantly in 11-20 pairs. *M. oiwakensis*
- b Lateral leaflets predominantly in 7-11(-12) pairs. 03
- 03 a Leaflet US reticulate with numerous small areoles visible (10× LENS) *M. simonsii*
- b Leaflet US reticulate with no or only large areoles visible (10× LENS). 04

- 04 a Lowermost basal leaflet clearly longer than wide. *M. eurybracteata*
 b Lowermost basal leaflet suborbicular. *M. huiliensis*
- 05 a Lateral leaflets in 10-22 pairs AND margin entire. *M. microphylla*
 b Lateral leaflets in 8-16 pairs, margin spinulose serrate or spinose dentate. 06
- 06 a Lateral leaflet margin densely spinulose serrate with numerous teeth/side. *M. leptodonta*
 b Lateral leaflet margin distantly spinulose to spinose dentate with <10 teeth/side. 07
- 07 a Lateral leaflets predominantly close to overlapping except lowermost 1(-2) pairs. 08
 b Lateral leaflets predominantly distant. 09
- 08 a U-M lateral leaflet apex <1/5 midvein length. *M. ogisui*
 b U-M lateral leaflet apex 1/3-1/4 midvein length. 09
- 09 a Lateral leaflet midvein length 3-5 cm, marginal teeth <3 mm. *M. subimbricata*
 b Lateral leaflet midvein length 5-9 cm, marginal teeth 5-10 mm. *M. klossii*
- 10 a M-L lateral leaflets sub equal sized and shaped. *M. KR 9150*
 b M-L lateral leaflets clearly shortening towards base. 11
- 11 a U-M lateral leaflet apex predominantly $\geq 1/4$ midvein length..... *M. xmedia*
 b U-M lateral leaflet apex predominantly 1/3-1/4 midvein length. *M. acanthifolia*

GROUP B3
 Leaflets predominantly in 2-8 pairs.
 Lateral leaflet base cuneate.

- 01 a Lowest lateral leaflets predominantly >3 cm above petiole base.02
 b Lateral basal leaflets predominantly ≤ 2 cm above petiole base. 06
- 02 a Leaflets entire ore almost so with 0-1(-3) tiny teeth/side near apex. *M. shenii*
 b Leaflets spinulose serrate to spinose dentate with 2-12 teeth/side. 02
- 03 a U-M lateral leaflet L/W ratio 4/1-6/1. *M. fortunei*
 b U-M lateral leaflet L/W ratio 2/1-3/1. 04
- 04 a Lateral leaflet margin with 12-18 tiny teeth/side. *M. paucijuga*
 b Lateral leaflet margin with 3-9 teeth/side. 05
- 05 a Lateral leaflet >50 mm wide, base 3-5 veined. *M. cfr. nitens*
 b Lateral leaflet <40 mm wide, pinnately veined. *M. brevircema*

06 a	Lateral leaflet L/W ratio 4/1-10/1.	<i>M. eurybracteata</i>
b	Lateral leaflet L/W ratio 2/1-3/1.	07
07 a	U-M lateral leaflet margin predominantly with 8-16 teeth/side.	08
b	U-M lateral leaflet margin predominantly with 3-8 teeth/side.	09
08 a	U-M lateral leaflet margin predominantly with 10-16 teeth/side. LS vein reticulation with areoles visible (10× LENS).	<i>M. polyodonta</i>
b	U-M lateral leaflet margin predominantly with 8-12 teeth/side. Leaflet LS vein reticulation obscured with only veins and forks visible (10× LENS).	<i>M. lushuiensis</i>
09 a	U-M lateral leaflet margin with 5-8 teeth/side.	10
b	U-M lateral leaflet margin with 3-7 teeth/side.	11
10 a	Leaflet LS vein reticulation with numerous areoles visible (10× LENS).	<i>M. calamicaulis</i>
b	Leaflet LS vein reticulation obscured with only veins, forks and few larger areoles visible (10× LENS).	<i>M. taronensis</i>
11 a	U-M lateral leaflet L/W ratio +/- 2/1.	<i>M. nitens</i>
b	U-M lateral leaflet L/W ratio 2/1-3/1.	12
12 a	Leaflet LS yellowish green, apex abruptly caudate.	<i>M. xemeiensis</i>
b	Leaflet LS initially +/- powdery white, apex gradually acuminate.	<i>M. xsavilliana</i>

<p>GROUP B4 Leaflets predominantly in 2-8 pairs. Lateral leaflet base rounded, cordate or truncate.</p>

01 a	Lateral leaflets predominantly in 2-6 pairs.	02
b	Lateral leaflets predominantly in 6-8 pairs.	08
02 a	Lateral leaflet US completely reticulate with numerous tiny areoles (10× LENS).	03
b	Lateral leaflet US not to moderately reticulate with variably sized areoles 2-10 mm (10× LENS).	05
03 a	Lateral leaflet margin predominantly with 10-16 teeth/side.	<i>M. polyodonta</i>
b	Lateral leaflet margin predominantly with 5-9 teeth/side.	04
04 a	Leaflet LS reticulate with elevated veins (10× LENS).	<i>M. longibracteata</i>
b	Leaflet LS reticulate with veins dark-contrasting but not elevated (10× LENS).	<i>M. species nov.</i>
05 a	Middle lateral leaflet pairs strongly overlapping at base, marginal teeth up to 10-15 mm.	<i>M. leveilleana</i>
b	Middle lateral leaflet pairs not overlapping at base, marginal teeth ≤5 mm.	06

- 06 a Lateral middle leaflet LW ratio clearly $<2/1$ AND margin with 2-5 teeth/side. ... *M. japonica*
 b Lateral middle leaflet LW ratio $\geq 2/1$, OR margin with 4-6 teeth/side. 07
- 07 a U-M lateral leaflet apex predominantly $\geq 1/4$ leaflet length. *M. xmedia*
 b U-M lateral leaflet apex predominantly $1/3-1/4$ leaflet length. *M. xlindsayae*
- 08 a Lateral leaflet margin entire for basal quarter to basal third. *M. nitens* 'Kalmthout'
 b Lateral leaflet margin dentate from apex almost to base. 09
- 09 a Lateral leaflet margin predominantly with 2(-3) teeth/side up to 10-15mm. *M. sheridaniana*
 b Lateral leaflet margin predominantly with 3-8(-more) teeth/side ≤ 5 mm. 10
- 10 a M-L lateral leaflet pairs predominantly overlapping at base. *M. bealei*
 b M-L lateral leaflet pairs not overlapping at base. 11
- 11 a Lateral leaflet apex acute. 12
 b Lateral leaflet apex acuminate. 13
- 12 a Lateral leaflet oblong, margin with 5-8 teeth/side. *M. bodinieri*
 b Lateral leaflet ovate, margin with 6-13 teeth/side. *M. nervosa*
- 13 a Leaflet LS venation and areoles predominantly obscured (10x LENS). *M. xmedia*
 b Leaflet LS venation and areoles predominantly visible (10x LENS). 14
- 14 a Leaflet US venation minutely reticulate, with 5-7 areoles/cm (10x LENS). . *M. duclouxiana*
 b Leaflet LS venation +/- reticulate, with 1-3 areoles/cm (10x LENS). *M. napaulensis*

Taxa treated in this identification key.

M. acanthifolia
M. aquifolium
M. bealei
M. bodinieri
M. breviracema
M. calamicaulis
M. chochoco
M. dictyota
M. duclouxiana
M. xemeiensis (*M. gracilipes* x *M. nitens*)
M. eurybracteata
M. fortunei
M. fremontii
M. gracilipes
M. gracilis
M. haematocarpa
M. hartwegii
M. huiliensis
M. japonica
M. klossii
M. lancasteri
M. leptodonta
M. leveilleana
M. xlindsayae (*M. duclouxiana* x *M. japonica*)
M. longibracteata
M. lushuiensis
M. KR 9150
M. xmedia (*M. japonica* x *M. oiwakensis*)
M. microphylla
M. moranensis

M. napaulensis
M. nervosa
M. nevinii
M. nitens
M. nitens 'Kalmthout'
M. cf. nitens
M. ogisui
M. oiwakensis
M. pallida
M. paniculata
M. paucijuga
M. paxii
M. pinnata
M. polyodonta
M. pumila
M. repens
M. russellii
M. xsavilliana (*M. eurybracteata* x *M. gracilipes*)
M. shenii
M. sheridaniana
M. simonsii
M. species nov.
M. subimbricata
M. taronensis
M. trifolia
M. trifoliolata
M. trifoliolata x *swaseyi*
M. volcania
M. xwagneri (*M. aquifolium* x *M. pinnata*)

Taxa referred to synonymy in this identification key.

M. amplexans – *M. dictyota*
M. bodinieri – *M. leveilleana*
M. confusa = *M. eurybracteata*
M. fargesii = *M. sheridaniana*
M. flavida = *M. duclouxiana*
M. leschenaultii = *M. acanthifolia*
M. magnifica = *M. simonsii*
M. mairei = *M. duclouxiana*

M. manipurensis = *M. napaulensis*
M. nepalensis = *M. napaulensis*
M. salweenensis = *M. napaulensis*
M. schiedeana = *M. trifolia*
M. siamensis = *M. duclouxiana*
M. sikkimensis = *M. napaulensis*
M. tikushiensis = *M. japonica*
M. veitchiorum – *M. calamicaulis* in part, *M. polyodonta* in part

Taxa referred to *Berberis* synonymy.

M. acanthifolia → *B. acanthifolia*
M. aquifolium → *B. aquifolium*
M. bealei → *B. bealei*
M. bodinieri → *B. bodinieri*
M. brevircacema → *B. brevircacema*
M. calamicaulis → *B. veitchiorum*
M. chochoco → *B. chochoco*
M. dictyota → *B. dictyota*
M. duclouxiana → *B. duclouxiana*
M. eurybracteata → *B. eurybracteata*
M. fortunei → *B. fortunei*
M. fremontii → *B. fremontii*
M. gracilipes → *B. gracilipes*
M. gracilis → *B. gracilis*
M. haematocarpa → *B. haematocarpa*
M. hartwegii → *B. hartwegii*
M. huiliensis → *B. huiliensis*
M. japonica → *B. japonica*
M. klossii → *B. klossii*
M. lancasteri → *B. lancasteri*
M. leptodonta → *B. leptodonta*
M. leveilleana → *B. leveilleana*
M. longibracteata → *B. longibracteata*
M. lushuiensis → *B. lushuiensis*
M. xmedia → *B. xhortensis*
M. microphylla → new name not yet available

M. moranensis → *B. moranensis*
M. napaulensis → *B. napaulensis*
M. nervosa → *B. nervosa*
M. nevinii → *B. nevinii*
M. nitens → *B. nitens*
M. ogisui → *B. ogisui*
M. oiwakensis → *B. oiwakensis*
M. pallida → *B. pallida*
M. paniculata → *B. hemsleyi*
M. paucijuga → *B. paucijuga*
M. paxii → *B. paxii*
M. pinnata → *B. pinnata*
M. polyodonta → *B. polyodonta*
M. pumila → *B. pumila*
M. repens → *B. repens*
M. russellii → *B. russellii*
M. shenii → *B. shenii*
M. sheridaniana → *B. sheridaniana*
M. simonsii → *B. assamana*
M. subimbricata → *B. subimbricata*
M. taronensis → *B. tibetensis*
M. trifolia → *B. trifolia*
M. trifoliolata → *B. trifoliolata*
M. volcania → *B. volcania*
M. xwagneri → *B. xwagneri*

Questionable/frequently misapplied names.

M. eutriphylla in collections is *M. trifolia*.

M. flavida Ogisui 225 is not *M. duclouxiana* (including *M. flavida* fide FoC) its status is not clear to me, hence it is not taken into account here.

Due of obvious differences *M. hartwegii* and *M. paxii* are kept apart here, although Sergio Zamudio treats them as synonyms.

M. KR 9150 is the temporary indication for a Vietnamese plant similar to *M. subimbricata* but with clearly more distant leaflets.

M. lancasteri is a nomen ineditum.

M. cfr. *nitens* shows similarity to *M. nitens*, but differs from the latter in absence of leaflets near petiole base.

M. nitens 'Kalmthout' shows similarity to *M. nitens* too, but differs from the latter in smaller, more numerous leaflets with rounded leaflet base. It is collected by Jelena and Robert de Belder and probably deserves botanical name status.

Due of the immense variability of the *M. pinnata* complex, both infraspecific taxa and *M. moranensis* are included.

For the time being *M. piperiana* is excluded, as no typical representative specimen has been encountered in collections during this study.

M. species nov. is the provisional name for a *Mahonia* from Vietnam that does not match any description to my knowledge so far, probably it is a new species.

