

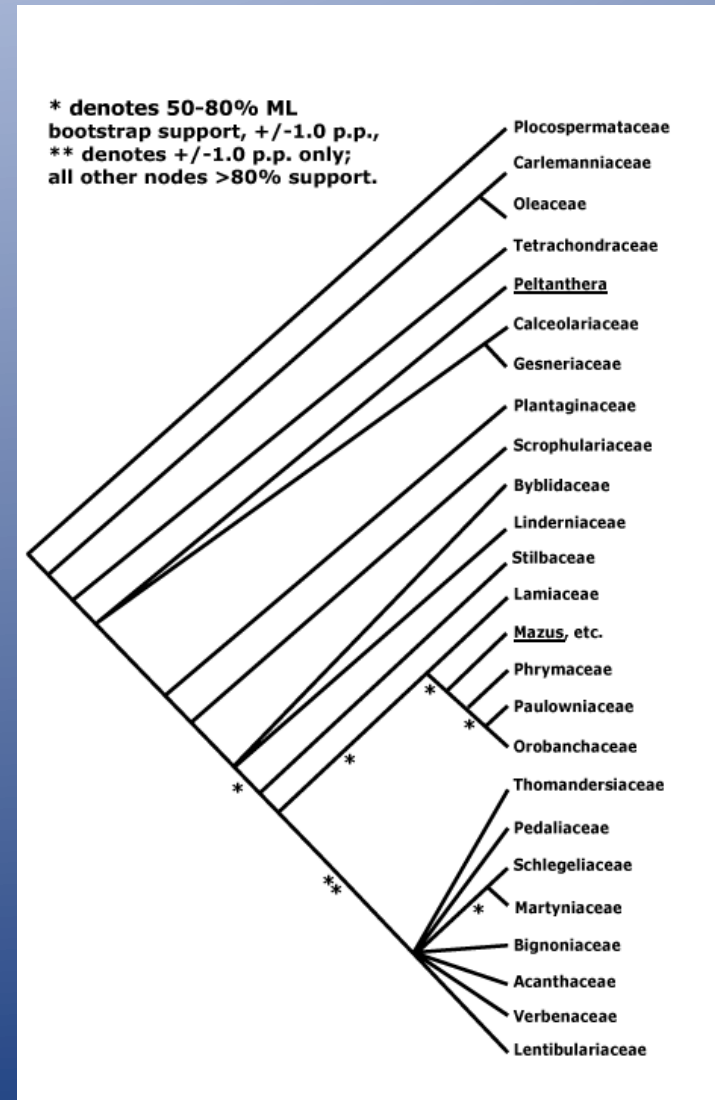
# Systematics and characterisation of the genus *Fraxinus* (Oleaceae)

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# Oleaceae – The olive family

- Basal position in the Lamiales
- 24 extant genera with about 600 species
- Mainly trees and shrubs, occurring on all continents, from temperate to tropical areas
- Some well-known insect-pollinated genera: *Jasminum*, *Forsythia*, *Syringa*, *Ligustrum*
- 6 genera with wind-pollinated species: *Fraxinus*, *Olea*, *Nestegis*, *Phillyrea*, *Forestiera* and *Priogymnanthus*



Insect-  
pollinated  
genera of  
Oleaceae



*Jasminum nitidum*



*Ligustrum vulgare*



*Forsythia x intermedia*



*Chionanthus virginicus*



*Syringa reticulata*

Wind-pollinated  
genera of  
Oleaceae



*Phillyrea latifolia*



*Forestiera pubescens*



*Nestegis sandwicensis*



*Olea europaea*



*Fraxinus excelsior*

# Overview of *Fraxinus*

- First described by Linnaeus in 1753
- *Fraxinus* derived from "phraxis" = fenced or "phraxis" = split
- Almost 800 taxa described but...
- I accept 49 species
- Distributed in the northern hemisphere
- Mostly trees, a few shrubs in dry areas
- Pinnately compound leaves and samaras
- Both wind- and insect-pollinated species
- Remarkable diversity of breeding systems (hermaphrodites, androdioecy, andromonoecy, polygamy, dioecy)
- Commercially important, e.g. *F. americana*
- Many ornamental species, e.g. *F. ornus*



# Old and new classifications of *Fraxinus*

Lingelsheim (1920)

## Section Ornus

subsection Euornus (20)

subsection Ornaster (5)

## Section Fraxinaster

subsection Dipetalae (1)

subsection Pauciflorae (5)

subsection Sciadanthus (1)

subsection Melioides (16)

subsection Bumeliodes (15)

63 species

Wallander (2008), updated 2012

Section Dipetalae (3)

Section Ornus (15->16)

Section Fraxinus (5)

Section Pauciflorae (5)

Section Sciadanthus (2)

Section Melioides (10->15)

*incertae sedis* (3)

43->49 species

Dipetalae

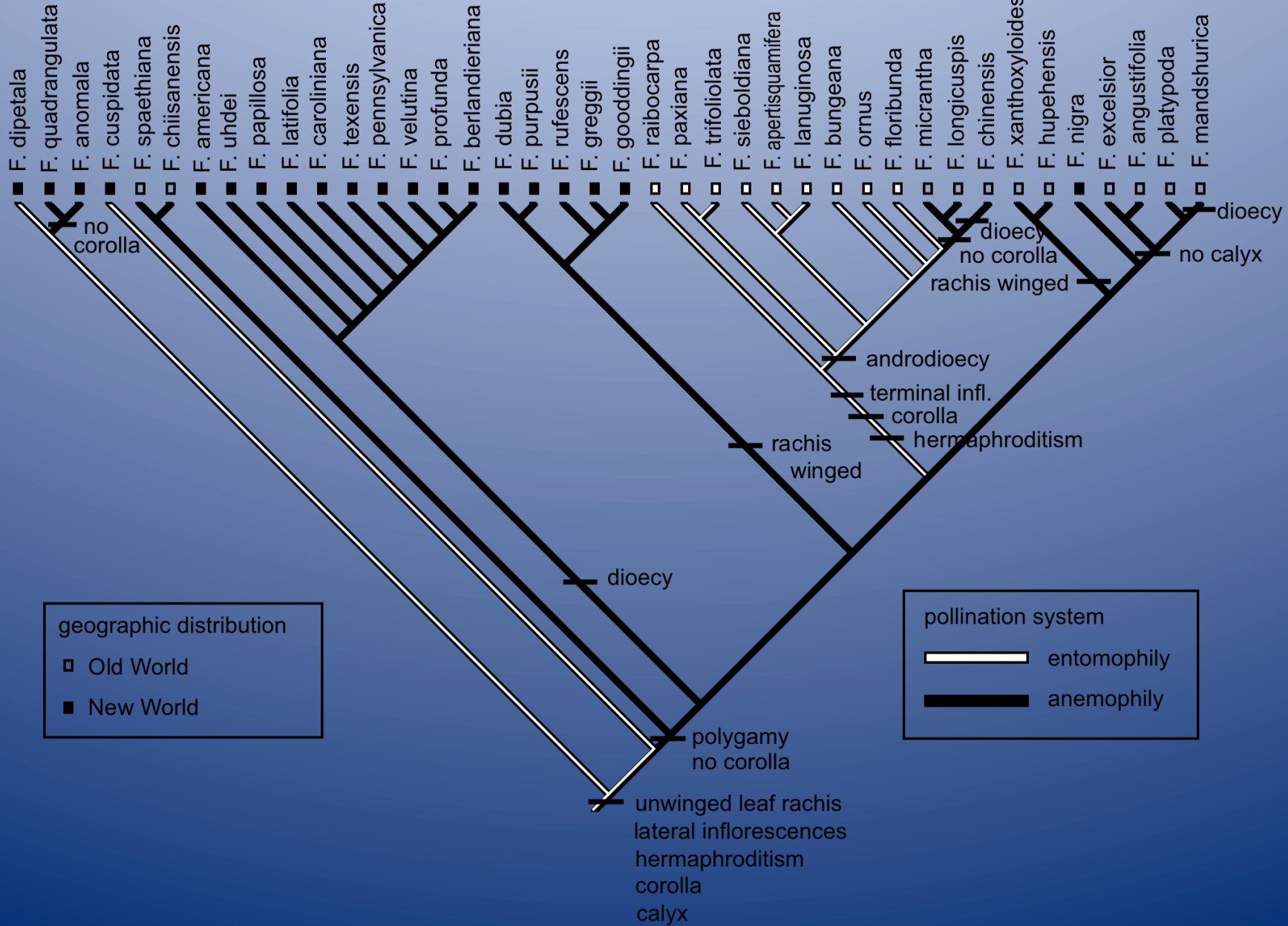
Melioides

Pauciflorae

Ornus

Sciadanthus

Fraxinus



# Sectional classification of *Fraxinus*

## Fraxinus

(5 species)

*F. angustifolia*  
*F. excelsior*  
*F. mandshurica*  
*F. nigra*  
*F. platypoda*

## Sciadanthus

(2 species)

*F. hubeiensis*  
*F. xanthoxyloides*

## Pauciflorae

(5 Mesoamerican species)

*F. dubia*  
*F. gooddingii*  
*F. greggii*  
*F. purpusii*  
*F. rufescens*

## Ornus

(16 Eurasian species)

*F. apertisquamifera*  
*F. baroniana*  
*F. bungeana*  
*F. chinensis*  
*F. floribunda*  
*F. griffithii*  
*F. hopeiensis*  
*F. lanuginosa*  
*F. longicuspis*  
*F. malacophylla*  
*F. micrantha*  
*F. ornus*  
*F. paxiana*  
*F. raibocarpa*  
*F. sieboldiana*  
*F. trifoliolata*

## Dipetalae

(3 American species)

*F. anomala*  
*F. dipetala*  
*F. quadrangulata*

## Melioides

(15 American species)

*F. albicans*  
*F. americana*  
*F. berlandieriana*  
*F. biltmoreana*  
*F. caroliniana*  
*F. coriacea*  
*F. cubensis*  
*F. latifolia*  
*F. papillosa*  
*F. pauciflora*  
*F. pennsylvanica*  
*F. profunda*  
*F. smallii*  
*F. uhdei*  
*F. velutina*

## Incertae sedis

(3 species)

*F. cuspidata*  
*F. chiisanensis*  
*F. spaethiana*



# Section Fraxinus

- 2 European, 2 Asian and 1 American species
- Large deciduous, wind-pollinated trees
- Apetalous flowers with no calyx (American *F. nigra* with deciduous calyx)
- Lateral inflorescences, terminal leaf shoots
- Dioecious, andromonoecious or polygamous



# *Fraxinus excelsior* - European or Common ash

- Distributed in northern and central Europe
- Large deciduous tree, up to 35 m
- Polygamous but functionally dioecious



# *Fraxinus angustifolia* - Narrow-leaved ash

- ssp. *angustifolia* in SW Europe and NW Africa
- ssp. *oxycarpa* in SE & C Europe (Caucasian ash), syn. *F. pallisiae*
- ssp. *syriaca* from Turkey to Central Asia (Syrian ash), syn. *F. potamophila*, *F. sogdiana*
- Large deciduous trees (up to 30 m)
- Andromonoecious
- Racemes (*F. excelsior* panicles)



# *F. mandshurica* – Manchurian ash

- Distributed in eastern Asia (China, E Russia, Korea)
- Large, deciduous, dioecious tree
- Important timber tree
- Dioecious, with anther rudiments in female flowers



# Section Sciadanthus

- 2 species
  - *F. xanthoxyloides* – Afghan or Algerian ash – a small tree or shrub in N Africa and the Himalayas
  - *F. hubeiensis*, medium-sized tree in China
- Small compound leaves with winged leaf-rachis
- Many-flowered inflorescences
- Polygamous, wind-pollinated flowers
- Calyx but no petals (male flowers of *F. xanthoxyloides* have no calyx)
- Large clustered samaras



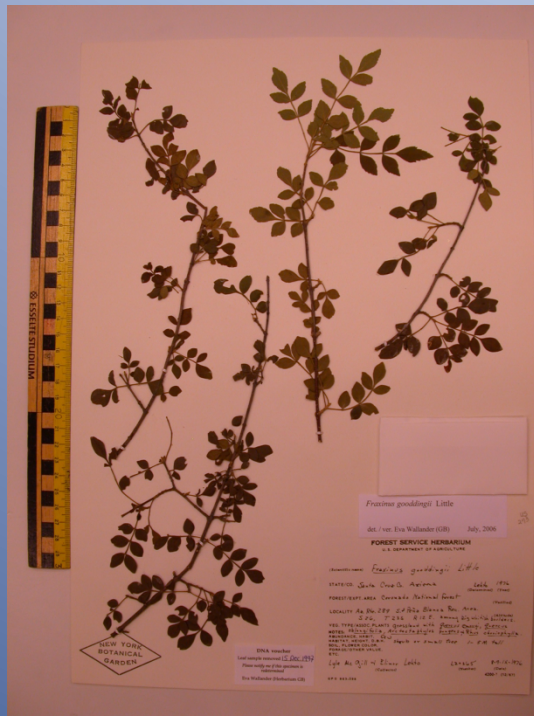
# Section Pauciflorae

- 5 species in arid regions of south-western USA, Mexico and Guatemala
- Small trees or shrubs with small coriaceous leaves
- Small compound leaves with winged leaf-rachis
- Few-flowered inflorescences
- Apetalous, wind-pollinated flowers, with calyx
- Small samaras

*F. dubia*  
*F. gooddingii*  
*F. greggii*  
*F. purpusii*  
*F. rufescens*

*F. greggii* – Littleleaf ash

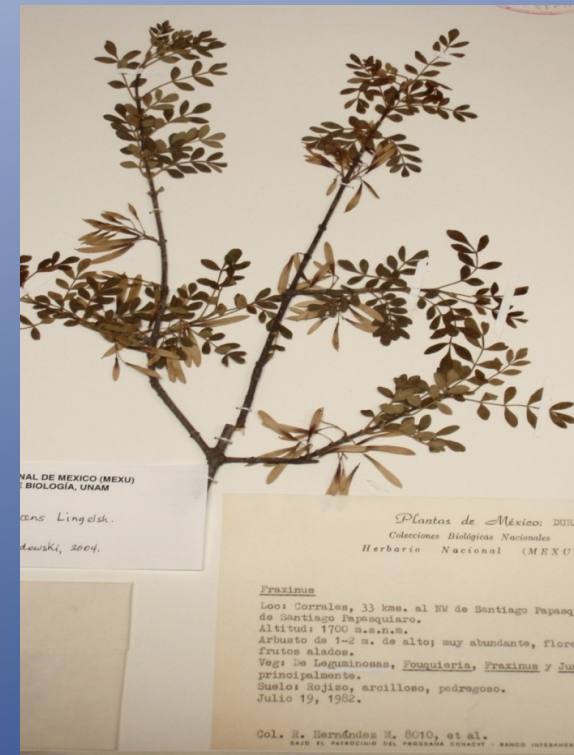




*F. gooddingii*  
 Arizona and Sonora



*F. greggii*  
 Texas and NE  
 & C Mexico



*F. rufescens*  
 C Mexico



*F. purpusii*  
NE & C Mexico, Guatemala



*F. dubia*  
E Mexico, Guatemala

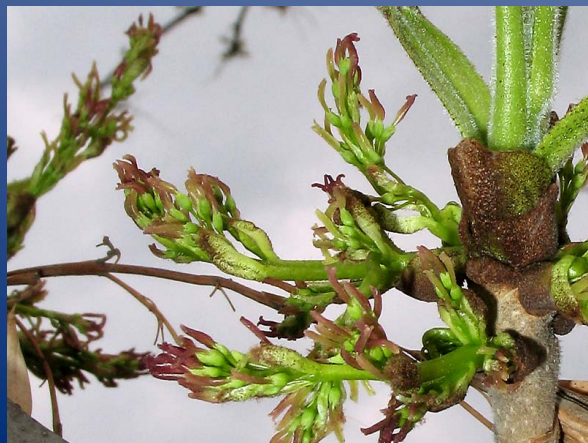
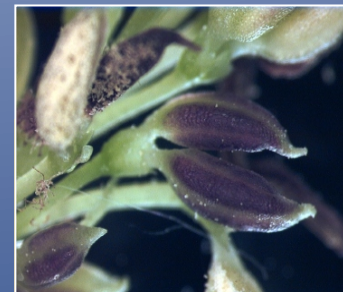


# Section Melioides

- 15 American species
- Large or small, deciduous, wind-pollinated trees
- Apetalous, unisexual flowers with calyx
- Dioecious (without rudimentary organs of the opposite sex)



*F. americana*



*F. pennsylvanica*

# Western and south-western ashes

- *F. albicans* – Texas ash
- *F. berlandieriana* - Mexican ash
- *F. coriacea* – Leather-leaved ash
- *F. latifolia* – Oregon ash
- *F. papillosa* – Chihuahuan ash
- *F. velutina* – Velvet, Desert, Arizona ash
- *F. uhdei* – Tropical or Shamel ash



*F. latifolia*



*F. velutina*

# South-western ashes



*F. berlandieriana*



*F. papillosa*



*F. albicans*



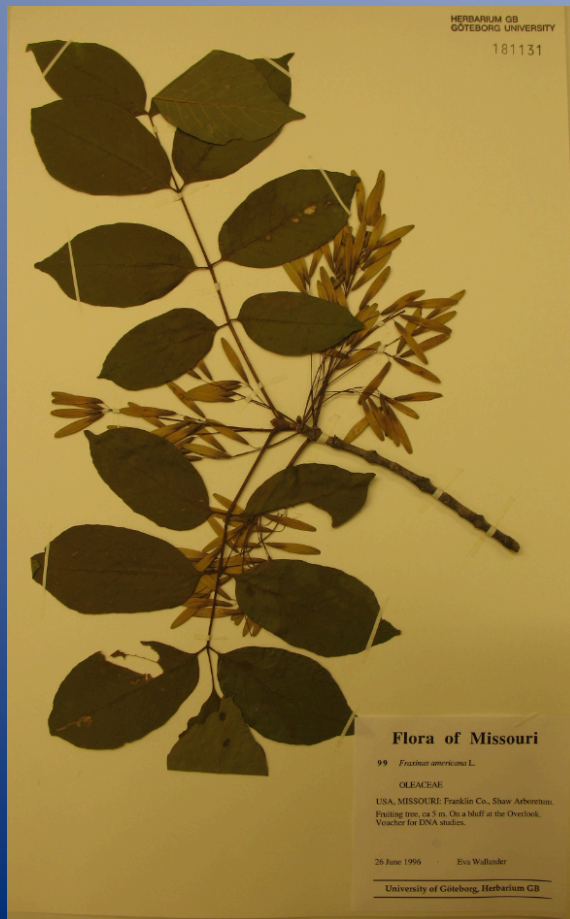
*F. uhdei*

# Eastern and south-eastern ashes

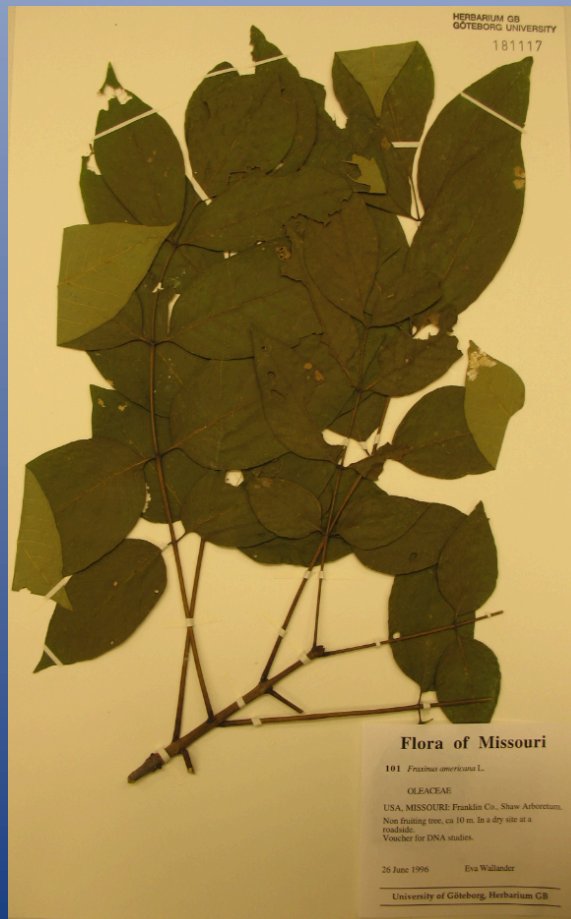
- *F. americana* (2n) - White ash
- *F. smallii* (4n) – Small's ash
- *F. biltmoreana* (6n) – Biltmore ash
- *F. caroliniana* – Water or Carolina ash
- *F. cubensis* – Cuban water ash
- *F. pauciflora* – Swamp ash
- *F. pennsylvanica* – Green and Red ash
- *F. profunda* (6n) – Pumpkin ash

# Polyploid complex

*F. americana* s.s (2n)



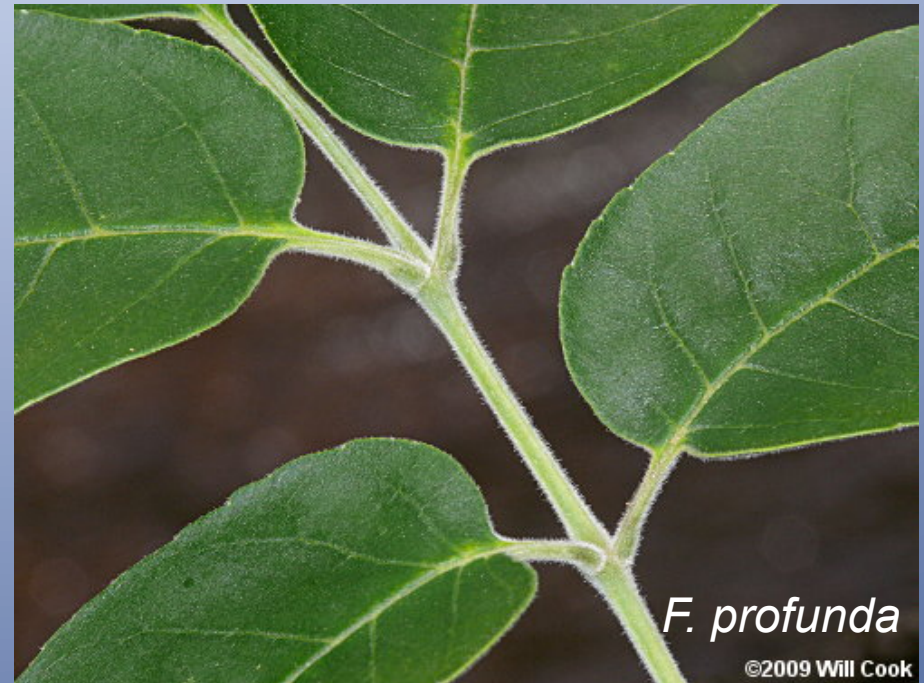
*F. smallii* (4n)



*F. biltmoreana* (6n)



# Eastern ashes



# Section Dipetalae

- 3 American species
- *F. anomala* and *F. dipetala*, small trees in SW USA and Mexico
- *F. quadrangulata*, large tree in C and E USA and Canada
- Hermaphrodite flowers in lateral inflorescences
- Quadrangular shoots



*Fraxinus dipetala*  
Two-petal ash



*Fraxinus anomala*  
Single-leaf ash



*F. quadrangulata* - Blue ash



# *Fraxinus anomala*

- Deserts of Utah, Arizona, Nevada, Colorado, New Mexico, California and Mexico
- Small tree or shrub, 2-5 m, crown round-topped, with contorted branches
- var. *anomala* unifoliate, var. *lowellii* trifoliate





# *Fraxinus dipetala*

- Dry areas of Utah, Arizona, Nevada, California
- Small tree or shrub
- Only ash with two petals, sweet fragrance
- Trifoliate variety



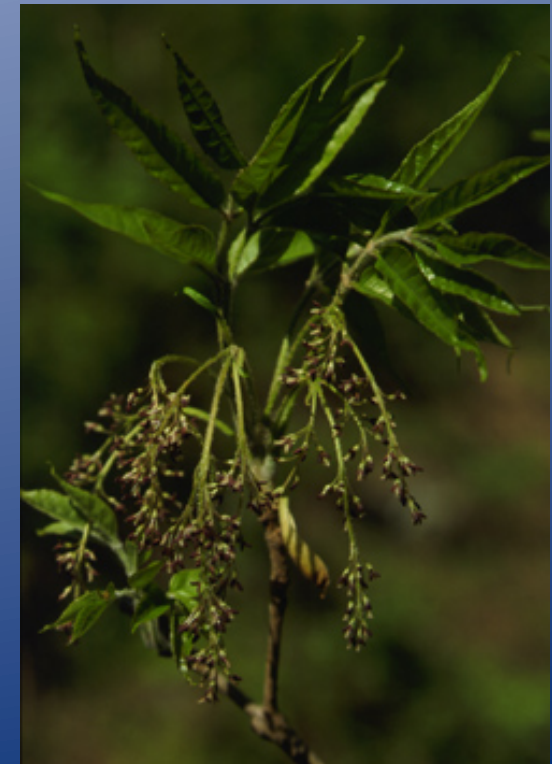
*var. dipetala*



*var. trifoliata*

# Section Ornus

- 16 Eurasian species
- Terminal inflorescences and leaf shoots
- Flowers with the leaves
- Two morphological groups:
  - Insect pollinated, four showy white petals, scented, but no nectar, hermaphrodites or androdioecious
  - Wind-pollinated apetalous flowers, delayed leafing, androdioecious or dioecious (*F. baroniana*, *F. chinensis*, *F. longicuspis*, *F. micrantha*)



# Section Ornus

## Central Asia

*F. raibocarpa* (C Asia)  
*F. floribunda* (Afghanistan through Himalaya to SE Asia)

## Europe

*F. ornus* (C and E  
Mediterranean)

## Himalaya

*F. micrantha*  
*F. paxiana* (+ China)

## East Asia

*F. apertisquamifera* (Japan)  
*F. baroniana* (China)  
*F. bungeana* (China)  
*F. chinensis* (China, Japan, Korea, SE Russia, Vietnam)  
*F. griffithii* (SE Asia)  
*F. hopeiensis* (China)  
*F. lanuginosa* (Japan)  
*F. longicuspis* (Japan)  
*F. malacophylla* (China, Thailand)  
*F. sieboldiana* (China, Japan, Korea)  
*F. trifoliolata* (China)



# *Fraxinus ornus* - Manna ash

- Distributed in C & E Mediterranean
- Small tree (up to 10 m)
- Both wind- and insect-pollinated flowers, fragrant
- Androdioecious (separate male and hermaphrodite trees)



# *Fraxinus chinensis* – Chinese ash

- Deciduous tree, 3-20 m
- Functionally dioecious
- *ssp. chinensis* distributed in China, Korea, Vietnam, Thailand
- *ssp. rhynchophylla* distributed in China, Korea, Japan, SE Russia



Hermaphrodite

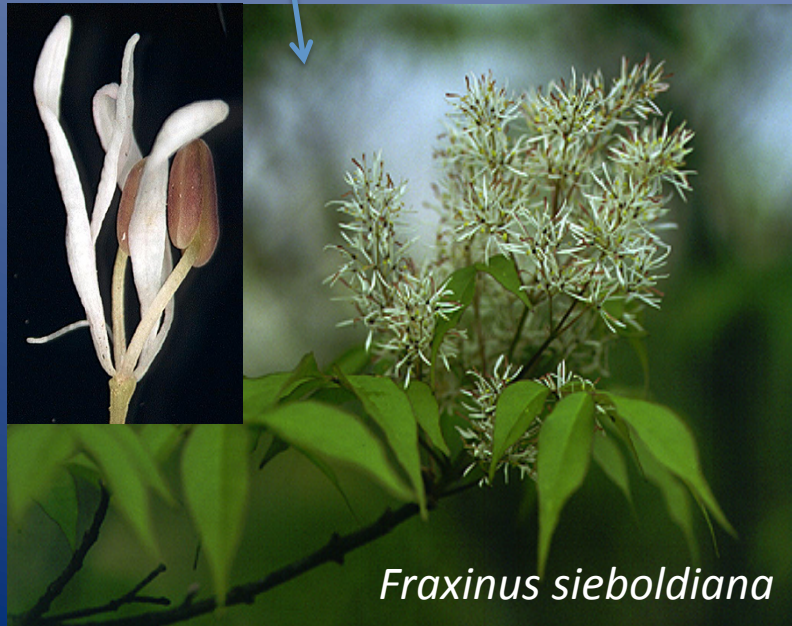


Male

*Fraxinus longicuspis*



# Other species of section Ornus



# More species of section Ornus



The rare *F. baroniana*



# Incertae sedis

- *F. spaethiana* (Japan)
- *F. chiisanensis* (Korea)
- *F. cuspidata* – Fragrant ash – a small tree in arid areas of SW USA and Mexico





# Uncertainties remaining

- Position of the three *incertae sedis*
- *F. platypoda* = *F. spaethiana*?
- *F. pringlei*? (Mexico)
- Delimitations and synonyms in the Pauciflorae
- Status of *F. papillosa*
- *F. angustifolia* complex
- *F. chinensis* complex

# Thank you for your attention!

Photos: Eva Wallander

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Various internet sources (Wikipedia, CalPhotos, [plant.ac.cn](http://plant.ac.cn), [asianflora.com](http://asianflora.com))

