

Flood-Tolerant Trees



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Flood-Tolerant Trees

We all recognise the welfare benefits that trees and shrubs provide in urban environments. The climatic conditions of recent years – prolonged heat and drought periods combined with increasingly frequent heavy rainfall events – have pushed the concept of the “sponge city” into the focus of sustainable urban development. Municipalities and planners are working with various concepts to retain water in the city and create cooling effects. The aim is to make strongly overheated urban areas more liveable and reduce health impacts.

With the restart of the “Natural Climate Protection in Municipalities” action programme and its funding measures, important stimuli are being created for implementing nature based solutions for climate adapted and water sensitive urban design. Trees play a decisive role, as they contribute significantly to cooling through transpiration and shading, counteracting the urban heat island effect.

If large quantities of rainwater are to be directed into swales and infiltration trenches where shrubs and trees are planted, this water causes waterlogging and oxygen deficiency. From an arboriculture perspective, this is unacceptable, because infiltration systems are not tree sites, and tree sites are not infiltration systems.

To create a sound basis for future planning and implementation, the biological requirements of trees and the interests of water management must be carefully examined and weighed. This is all the more urgent because different interests collide in this field, and incorrect decisions often result from lack of experience, misjudgements or economic reasons. This brochure is intended to help planners identify which trees show a certain degree of flood tolerance.

Flood tolerance in trees refers to the ability to survive temporary soil saturation or flooding (1–3 days) without significant impairment of growth, vitality or regeneration. Timing is also crucial: flooding during the growing season is more harmful than during dormancy. Longer phases of waterlogging lead to severe damage and even tree death.

This compilation does not claim completeness and is intended as support for selecting woody plants for such sites. The information is based on practical experience from nurseries and municipal horticultural departments.

IMPORTANT

The list assesses the flood tolerance of the trees exclusively and does not deal in detail with their specific usability at the particular location. Furthermore, it is only predominantly species of trees that are described. There are variations in the list only for poplars and elms because an increased number of cultivars of these are used. Criteria such as locational requirements, suitability for an urban climate, the maintenance effort required or suitability as street trees are not dealt with explicitly.

Content

A

Acer negundo and cultivars
page 6

Acer rubrum and cultivars
page 7

Acer saccharinum and cultivars
page 8

Acer saccharum
page 9

Acer x freemanii and cultivars
page 10

Alnus glutinosa and cultivars
page 11

Alnus incana and cultivars
page 12

Amelanchier lamarckii
page 13

B

Betula nigra
page 14

Betula pubescens
page 15

C

Fraxinus excelsior and cultivars
page 16

Fraxinus pennsylvanica and cultivars
page 17

G

Gleditsia triacanthos and cultivars
page 18

Gymnocladus dioicus
page 19

L

Liquidambar styraciflua
page 20

M

Metasequoia glyptostroboides
page 21

N

Nyssa in Arten and cultivars
page 22

P

Platanus x hispanica
page 23

Populus alba ‚Nivea‘
page 24

Populus berolinensis
page 25

Populus canadensis ‚Robusta‘
page 26

Populus canescens
page 27

Populus nigra and cultivars
page 28

Populus simonii and cultivars
page 29

Populus tremula and cultivars
page 30

Prunus padus
page 31

Pterocarya fraxinifolia
page 32

Q

Quercus palustris
page 33

Quercus robur
page 34

S

Salix alba uand cultivars
page 35

T

Taxodium distichum
page 36

Thuja plicata
page 37

Tilia cordata
page 38

U

Ulmus carpinifolia
page 39

Ulmus glabra and cultivars
page 40

Ulmus laevis
page 41



Acer saccharum, page 9

Acer negundo and cultivars

Box Elder



ORIGIN North America, Canada

HEIGHT 15–20 m (species), cultivars vary

SPREAD Up to 15 m (species), cultivars vary

GROWTH Broad, more or less rounded, semi open crown, cultivars vary

LEAVES Irregularly pinnate, fresh green up to 20 cm, green, cultivars with different variegations

BARK Young shoots glossy, glaucous

FLOWERS March–April, whitish-yellow

SPECIAL CHARACTERISTICS Undemanding, pioneer species, very hardy, bee friendly, many cultivars with different heights and leaf colours

Acer rubrum and cultivars

Red Maple

ORIGIN North America, Canada

HEIGHT 10–20 m (species), cultivars vary

SPREAD 6–14 m (species), cultivars vary

GROWTH Conical or rounded, cultivars vary

LEAVES 3–5 lobes, up to 10 cm, scarlet autumn colour, cultivars vary

BARK Silvery grey

FLOWERS Before leaf emergence, orange to red colour

SPECIAL CHARACTERISTICS Very frost hardy, many different cultivars



Acer saccharinum and cultivars

Silver Maple



ORIGIN North America

HEIGHT 20–30 m, cultivars vary

SPREAD 15–20 m, cultivars vary

GROWTH High arched, main branches spreading, cultivars also hanging more deeply

LEAVES Deciduous and five lobed, yellow autumn colour, also more deeply-cut cultivars

BARK Smooth reddish-brown branches, silvery grey and fissured bark, cultivars vary

FLOWERS Before leaf emergence greenish-yellow to red

SPECIAL CHARACTERISTICS Frost-hardy, tolerates occasional dry spells, smoke-tolerant, prone to wind breakage, many cultivars different

Acer saccharum

Sugar Maple

ORIGIN North America

HEIGHT 20–25 m

SPREAD 8–15 m

GROWTH Oval to rounded, closed crown

LEAVES Five lobed, yellowish-orange to fiery reddish-orange autumn colour

BARK Branches brown, bark grey brown

FLOWERS Before leaf emergence greenish yellow

SPECIAL CHARACTERISTICS Very frost-hardy, moderately salt-tolerant, very shade tolerant



Acer × freemanii and cultivars

Autumn Blaze Maple



ORIGIN Hybrid

HEIGHT 12–25 m depending on cultivar

SPREAD Up to 15 m depending on cultivar

GROWTH Depending on cultivar, narrow and rounded to broad and upright crown

LEAVES Deciduous, deeply cut, five-lobed, orange autumn colour

BARK Silvery grey

FLOWERS Inconspicuous, male

SPECIAL CHARACTERISTICS Frost-hardy

Alnus glutinosa and cultivars

Black Alder

ORIGIN Europe to Asia

HEIGHT 15–20 m (species), cultivars remain smaller

SPREAD 8–14 m (species), cultivars narrower

GROWTH Straight trunk, narrow conical crown, cultivars vary

LEAVES Obovate to rounded, cultivars different, partly incised

BARK Young shoots greenish-brown, bark later dark grey and fissured

FLOWERS March, conspicuous male catkins

SPECIAL CHARACTERISTICS Pioneer species, very long-lasting and wind-resistant, nitrogen fixer



Alnus incana and cultivars

Grey Alder



ORIGIN Europe to Asia

HEIGHT 15–20 m (species), cultivars vary

SPREAD Up to 12 m (species), cultivars vary

GROWTH Narrow conical, later broad to rounded, cultivars vary

LEAVES Ovate, underside hairy, cultivars vary

BARK Young shoots grey, bark silvery grey, remain smooth for a long time

FLOWERS March, conspicuous male catkins

SPECIAL CHARACTERISTICS Very frost hardy, wind resistant, salt-tolerant, nitrogen fixer

Amelanchier lamarckii

Juneberry

ORIGIN Eastern North America

HEIGHT 6–8 m

SPREAD 4–6 m

GROWTH Loosely upright, more rounded when more mature

LEAVES Elongated, green, copper red when emerging

BARK Olive brown to reddish brown, fissured

FLOWERS April, creamy white upright racemes

SPECIAL CHARACTERISTICS Very frost-hardy, wind-resistant, urban tolerant



Betula nigra

River Birch



ORIGIN Eastern North America

HEIGHT 15–20 m

SPREAD 6–12 m

GROWTH Usually multi stemmed, arching, weeping tips

LEAVES Ovate, glossy green, underside grey

BARK Light reddish brown to silvery grey, dark brown when mature, curling edges

FLOWERS April, yellowish-green catkins

SPECIAL CHARACTERISTICS Very frost hardy

Betula pubescens

Downy Birch

ORIGIN Central Europe to Siberia

HEIGHT 5–15 m

SPREAD 3–5 m

GROWTH Medium height, rounded to oval

LEAVES Rounded to ovate

BARK Greyish white to dark, fissured, peeling transversely

FLOWERS March–May, yellowish catkins

SPECIAL CHARACTERISTICS Very undemanding, frost hardy, wind-resistant



Fraxinus excelsior and cultivars

Common Ash



ORIGIN Europe to Asia Minor

HEIGHT 25–40 m (species), cultivars vary

SPREAD 20–30 m (species), cultivars vary

GROWTH Tall, fast-growing species with oval to rounded, light crown, cultivars vary

LEAVES Odd-pinnate

BARK Olive to greyish green, later grey, remain smooth for a long time

FLOWERS Before leaf emergence, lateral panicles 10 cm long

SPECIAL CHARACTERISTICS Shade tolerant, thermophilic, wind resistant

Fraxinus pennsylvanica and cultivars

Green Ash

ORIGIN North America

HEIGHT 15–18 m, depending on cultivar

SPREAD 6–12 m, depending on cultivar

GROWTH Broadly ovate, depending on cultivar, very uniform

LEAVES Unevenly pinnate, 5 to 9 small leaves, glossy green, 20 to 30 cm, vivid yellow autumn colour

BARK Smooth, brown to grey, branches from green to brown to grey

FLOWERS April–May, inconspicuous panicles

SPECIAL CHARACTERISTICS Frost-hardy, very wind-resistant, urban tolerant



Gleditsia triacanthos and cultivars

Honey Locust



ORIGIN North America

HEIGHT 25–40 m (species), cultivars vary

SPREAD 8–15 m (species), cultivars vary

GROWTH Broadly ovate, open, later umbraculiform, cultivars vary

LEAVES Deciduous (species), alternate, simple or double pinnate, early yellow autumn colour, cultivars also have different colours

BARK Reddish brown (species), later greyish-brown, thorns unbranched or branched on branches and trunk, cultivars vary

FLOWERS June–July, yellowish-green, scented

SPECIAL CHARACTERISTICS Frost-hardy, urban-resistant, radiation-resistant, drought resistant, undemanding, bee-friendly

Gymnocladus dioicus

Kentucky Coffee Tree

ORIGIN North America

HEIGHT 15–20 m

SPREAD 15–20 m

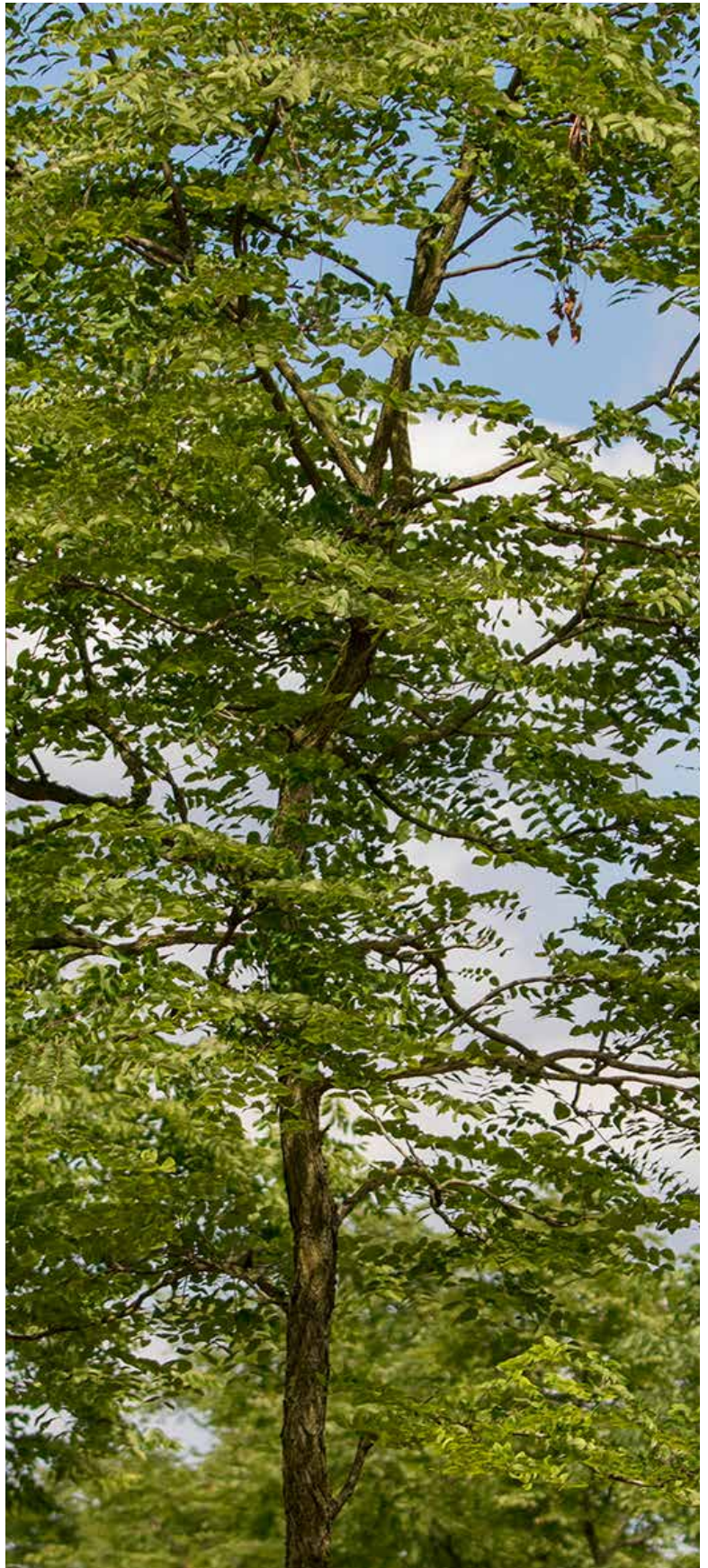
GROWTH Irregularly ovate, later antler like

LEAVES Very large, double pinnate

BARK Conspicuously rough, scaly

FLOWERS June, small white panicles

SPECIAL CHARACTERISTICS Hardy, drought resistant



Liquidambar styraciflua and cultivars



ORIGIN North America

HEIGHT 10–20 (max. 30) m (species), cultivars vary

SPREAD 6–12 m (species), cultivars vary

GROWTH Narrow (species), conical, later highly-arched and ovate, cultivars vary

LEAVES Alternate, similar to maple, 5–7 lobes, up to 15 cm wide, long-lasting, yellow to deep orange-red autumn colour

BARK Strong cork strips when mature

FLOWERS April–May, male flowers have upright ears, female flowers have hanging globular heads

SPECIAL CHARACTERISTICS Drought tolerant, frost sensitive in some areas when young, bee-friendly, urban-tolerant

Metasequoia glyptostroboides

Dawn Redwood

ORIGIN Central China

HEIGHT 25–40 (max. 40) m

SPREAD 7–10 m

GROWTH Conical, broader when more mature

LEAVES Deciduous, needle-shaped, approx. 2 cm long, yellowish-brown to reddish-brown autumn colour

BARK Longitudinal fissures, reddish brown to greyish-brown, peels off in longer strips

FLOWERS Male flowers in 5 to 10 cm long catkin like ears, female flowers yellowish-green, terminal

SPECIAL CHARACTERISTICS Frost-hardy, soil-tolerant, wind resistant, urban-tolerant



Nyssa species and cultivars

Tupelo



ORIGIN Eastern North America

HEIGHT Approx. 15–20 m (genus), species and cultivars vary

SPREAD Approx. 8–12 m (genus), species and cultivars vary

GROWTH Perfectly straight, conical, open

LEAVES Elliptical, red autumn colour, species and cultivars vary

BARK Shoots light brown, bark later grey

FLOWERS May–June rather inconspicuously greenish

SPECIAL CHARACTERISTICS Frost-hardy

Platanus x hispanica

London Plane

ORIGIN England, hybrid of American plane and Oriental plane

HEIGHT 20–40 (max, 40) m

SPREAD 15–25 m

GROWTH Tall and fast-growing, crown rounded to domed

LEAVES Deciduous, alternate, maple like, upper side smooth, underside hairy axils and veins, light yellow to light brown autumn colour

BARK Light brown, later yellowish-green, peels off in scales

FLOWERS May, yellowish-green buds

SPECIAL CHARACTERISTICS Frost-hardy, thermophilic, smoke-tolerant, pollution and radiation-tolerant



Populus alba ,Nivea‘

White Poplar



ORIGIN Species native to Southern Europe, North Africa to Central Asia

HEIGHT 20–30 m

SPREAD 15–18 m

GROWTH Broad crown, spreading, rounded

LEAVES 3 to 5 lobes, coarsely serrate, upper side green, underside white, felted

BARK Young shoots white, felted, bark whitish-grey and fissured

FLOWERS Male flowers in yellowish-green catkins

SPECIAL CHARACTERISTICS Frost-hardy, heat-tolerant, wind resistant

Populus berolinensis

Berlin Poplar

ORIGIN Hybrid created in Botanic Gardens in Berlin in 1870

HEIGHT 20–25 m

SPREAD 10 m

GROWTH Narrow and conical to broad and columnar

LEAVES Ovate, long and pointed, upper side fresh green, underside whitish-green

BARK Greyish-yellow angular shoots, buds pointed and sticky, scent of balsam, old bark dark grey and fissured

FLOWERS Plant is male, catkins

SPECIAL CHARACTERISTICS Frost-hardy, smoke tolerant



Populus x canadensis 'Robusta'

False Lombardy Poplar



ORIGIN Hybrid

HEIGHT 30+ m

SPREAD 15–20 m

GROWTH Very straight trunk, conical and closed crown

LEAVES Dark green, shiny, almost triangular leaves, stalk turns red

BARK Shoots reddish-brown and slightly angular, bark grey and fissured

FLOWERS Male cultivar with catkins

SPECIAL CHARACTERISTICS Frost-hardy, smoke-resistant, salt tolerant

Populus canescens

Grey Poplar

ORIGIN Hybrid (*P. alba* × *P. tremula*)

HEIGHT 20–30 m

SPREAD 15–20 m

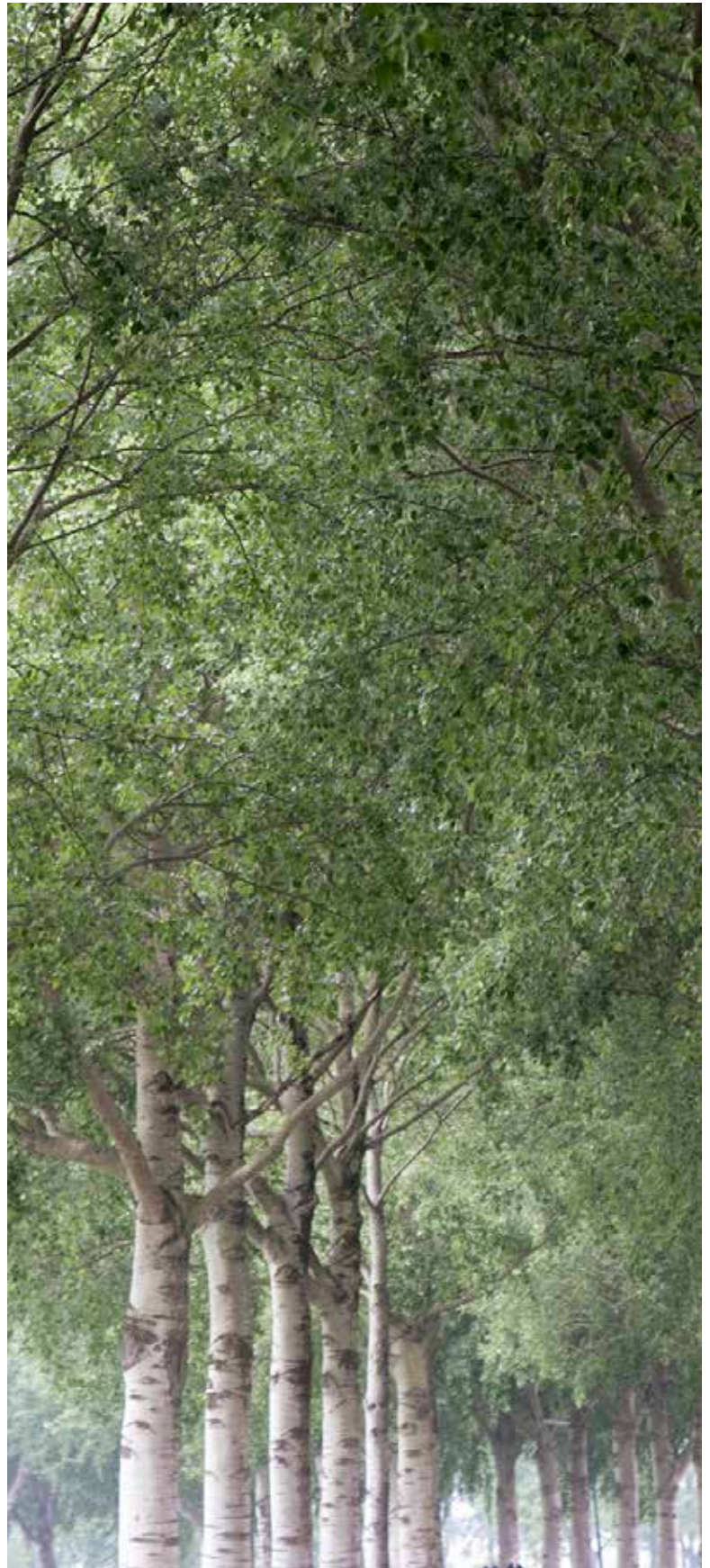
GROWTH Irregularly conical, spreads wide when mature

LEAVES Triangularly ovate, upper side dark green, underside grey and felted

BARK Young shoots grey, bark remains smooth for a long time

FLOWERS Greenish-yellow catkins

SPECIAL CHARACTERISTICS Frost-hardy, wind resistant



Populus nigra and cultivars

Black Poplar



ORIGIN Europe

HEIGHT 25–30 m (species), cultivars vary

SPREAD 15–20 m (species), cultivars vary

GROWTH Broad, open crown

LEAVES Deciduous, opposite

BARK Branches yellowish-brown with lenticels, bark blackish and thick, furrowed lengthways, deeply fissured

FLOWERS Male yellowish-red catkins before leaf break, female catkins yellowish-green, dioecious

SPECIAL CHARACTERISTICS Frost-hardy, thermophilic

Populus simonii and cultivars

Simon's Poplar

Origin: Northern China

Height: 12–15 m (species), cultivars vary

Spread: 6–8 m (species), cultivars vary

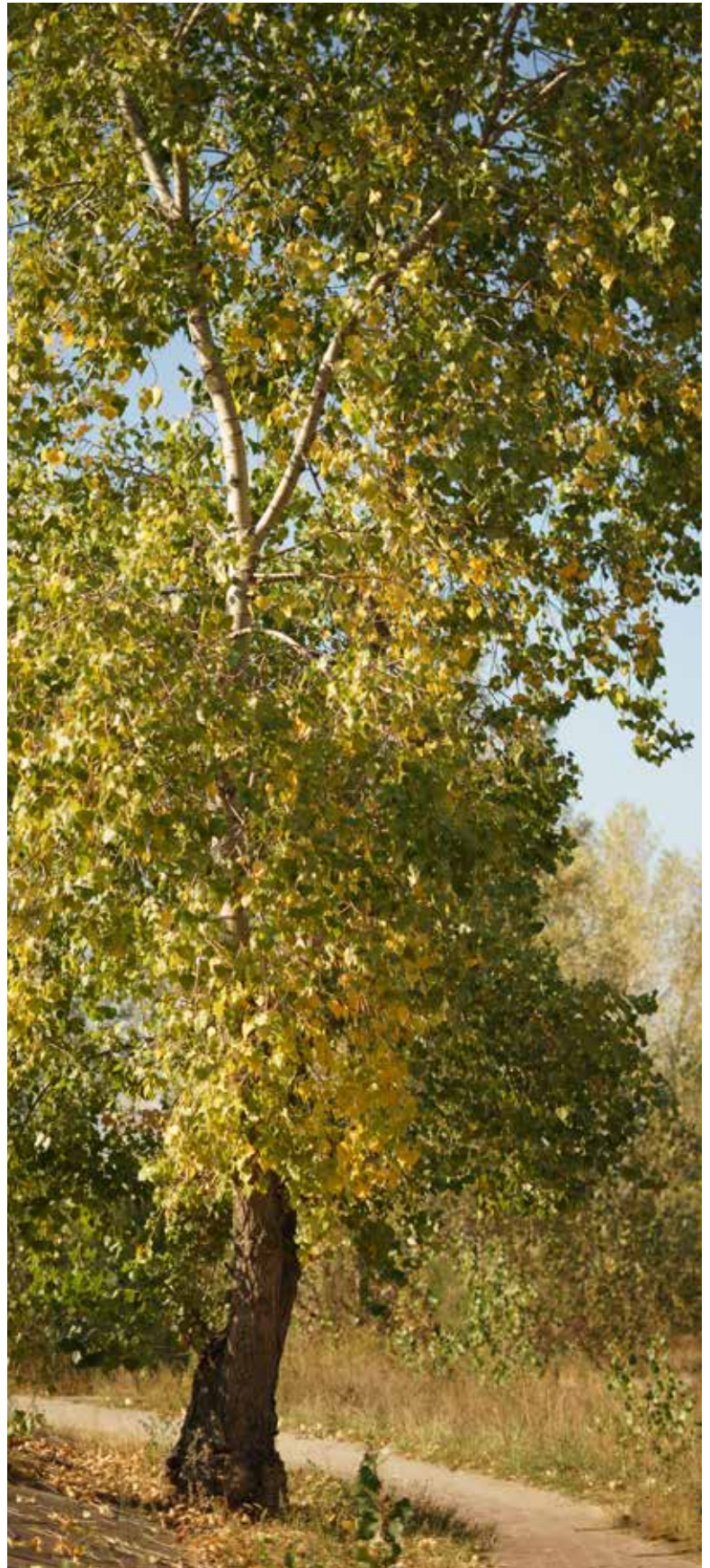
Growth: Narrowly arching, ovate, lightly overhanging

Leaves: Obovate to spatulate, edges serrated

Bark: Shoots square with white lenticels, bark grey green and fissured lengthways

Flowers: Catkins 2–3 cm long

Special characteristics: Frost-hardy, heat tolerant



Populus tremula and cultivars

Aspen



ORIGIN Europe, North Africa, Asia Minor, Siberia

HEIGHT 10–25 m (species), cultivars vary

SPREAD 7–10 m (species), cultivars vary

GROWTH Crooked, irregular trunk, loose, ovate, cultivars vary

LEAVES Ovate to round, scalloped and serrated

BARK Yellowish-brown, shiny branches, bark remains smooth for a long time, fissured when mature

FLOWERS Catkins 4 to 10 cm long

SPECIAL CHARACTERISTICS Frost-hardy, urban tolerant

Prunus padus

Bird Cherry

ORIGIN Europe, Northern Asia to Korea and Japan

HEIGHT 8–15 m

SPREAD 6–8 m

GROWTH Large shrub or small tree with narrowly ovate to rounded, closed crown

LEAVES Elongated and elliptical

BARK Blackish-grey, scent of bitter almonds exudes if damaged

FLOWERS April–May, open, strongly scented clusters

Special characteristics: Frost-hardy, temporarily drought-resistant



Pterocarya fraxinifolia

Caucasian Wingnut



ORIGIN Caucasus

HEIGHT 15–25 m

SPREAD 15–25 m

GROWTH Usually multi-trunked, broadly arched, rounded

LEAVES Odd-pinnate

BARK Branches olive-green to greenish-grey, old bark dark grey with bright lengthways furrows

FLOWERS 4 green hanging catkins

SPECIAL CHARACTERISTICS Frost-hardy, drought-resistant, heat tolerant, wind-resistant

Quercus palustris

Pin Oak

ORIGIN North America

HEIGHT 15–25 m

SPREAD 10–15 m

GROWTH Regular, broadly conical

LEAVES Deciduous, obovately lobed

BARK Young shoots greenish to greenish-brown, bark greyish brown to dark grey

FLOWERS Male flowers in yellowish-green catkins

SPECIAL CHARACTERISTICS Frost-hardy



Quercus robur

English Oak



ORIGIN Europe to Asia Minor

HEIGHT 25–40 m

SPREAD 15–25 m

GROWTH Conical, massive when mature, arched

LEAVES Obovately lobed

BARK Young shoots olive green, later brownish, old bark dark grey to blackish, deeply furrowed

FLOWERS Male flowers in yellowish-green catkins, female flowers in long-peduncled spikes

SPECIAL CHARACTERISTICS Frost-hardy, undemanding, drought tolerant, smoke-resistant

Salix alba and cultivars

White Willow

ORIGIN Europe, Western Asia,
North America

HEIGHT 10–15 m (species), cultivars vary

SPREAD 10–15 m (species), cultivars vary

GROWTH Conical, later rounded and open

LEAVES Lanceolate

BARK Young shoots yellowish and elastic,
old trunks grey and deeply fissured

FLOWERS April–May, yellow catkins

SPECIAL CHARACTERISTICS Frost-hardy,
wind resistant, smoke-resistant, radiation-
resistant



Taxodium distichum

Bald Cypress



ORIGIN Eastern North America

HEIGHT 30–40 m

SPREAD 8–10 m

GROWTH Regular, pointed and conical, open and broad when mature

LEAVES Needles, alternate

BARK Light brown, later reddish brown, bark fissured

FLOWERS March–April with inconspicuous, greenish-yellow flowers

SPECIAL CHARACTERISTICS Frost-hardy, wind resistant

Thuja plicata

Western Red Cedar

ORIGIN Western North America

HEIGHT 10–15 m

SPREAD 4–5 m

GROWTH Conical

LEAVES Scales, evergreen

BARK Widely furrowed bark begins darkly reddish-brown, later grey

FLOWERS March to April, small cones

SPECIAL CHARACTERISTICS Frost-hardy, wind resistant



Tilia cordata

Small Leaved Lime



ORIGIN Europe

HEIGHT 18–30 m

SPREAD 10–20 m

GROWTH Broadly conical, later also arched to rounded

LEAVES Rounded to heart shaped, often slanted, regularly serrated edges

BARK Brownish red, bright lenticels

FLOWERS Early July, yellowish-white hanging corymbs, scented

SPECIAL CHARACTERISTICS Very frost-hardy, thermophilic, drought tolerant, wind-resistant, urban-tolerant

Ulmus carpinifolia

Field Elm

ORIGIN Europe to Western Asia, North Afrika

HEIGHT 20–35 m

SPREAD 12–15 m

GROWTH Broadly spreading, domed

LEAVES Elongated, sometimes rounded, edges double serrated, asymmetric leaf base

BARK Brown to russet, cork ridge formation

FLOWERS March–April, reddish bushes

SPECIAL CHARACTERISTICS Frost hardy, thermophilic, heat-tolerant



Ulmus glabra and cultivars

Wych Elm



ORIGIN Europe to Western Asia

HEIGHT 20–25 m (species), cultivars vary

SPREAD 8–10 m (species), cultivars vary

GROWTH Species with rounded, broadly spreading, dense crown, cultivars vary

LEAVES Ovate, double serrated, asymmetric leaf base

BARK Shoots greenish-grey, whitish hair, bark later greyish brown and fissured

FLOWERS Brownish-purple tufts

SPECIAL CHARACTERISTICS Frost-hardy

Ulmus laevis

European White Elm

ORIGIN Central to Eastern Europe

HEIGHT 15–30 m

SPREAD 10–20 m

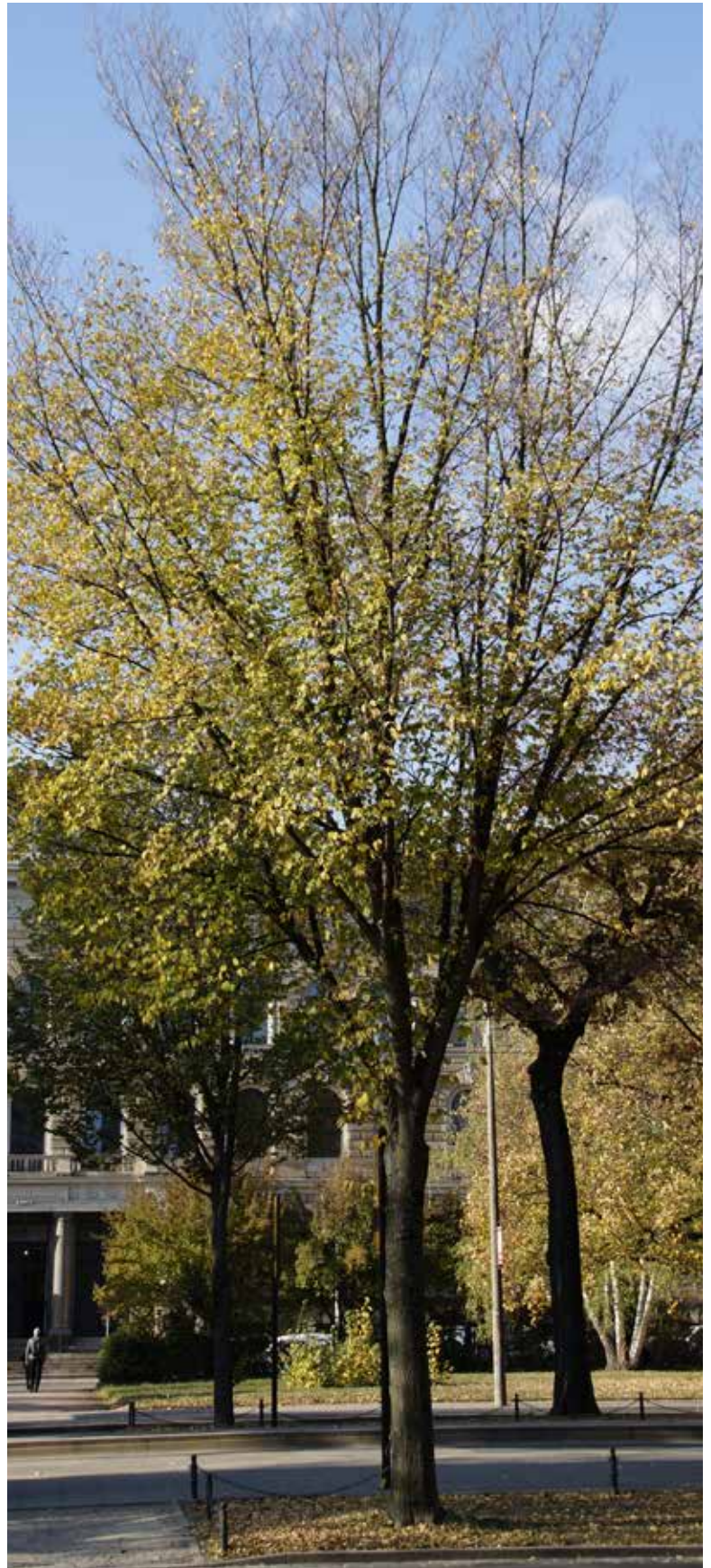
GROWTH Broadly columnar to broadly ovate

LEAVES Ovate to rounded, double-serrated edges, asymmetric leaf base

BARK Brown shoots, underside yellowish-green, bark grey and lightly furrowed

FLOWERS Purple stalked tufts

SPECIAL CHARACTERISTICS Frost-hardy, thermophilic, wind resistant



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