PLANTING FOR RESILIENCE:

Selecting Urban Trees in Massachusetts

University of Massachusetts Amherst

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Cover Photos:
Malus spp. surrounding a utility pole, Ashley McElhinney
Deciduous foliage of urban shade trees, Ashley McElhinney
Quercus spp. adorn an urban neighborhood, Ashley McElhinney

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SPECIAL CONSIDERATIONS

We can only conjecture you've heard it before- 'right plant, right place'[10]. This type of proactive planning is a powerful strategy, critical to creating and maintaining a healthy urban forest. A well-placed tree has the ability to provide a number of ecological, economic, and societal benefits throughout its lifetime. Trees reduce atmospheric carbon dioxide[18, 21], levels of airborne pollutants, air temperature[19], stormwater runoff and flooding, and provide other critical ecological services[18]. Trees contribute economically by boosting property values[16] and fostering energy savings from nearby buildings[19]. Within cities, trees increase people's feelings of well-being, minimize noise, and reduce crime[16, 18, 31]. Trees are a growing investment, and over time generate their benefits in greater magnitude as they increase in size and stature[15].

When we hear the term 'urban forest', we tend to picture a sad, lone tree surrounded only by pavement, bustling traffic, and skyscrapers. In this guide, 'urban forest' applies to the entire developed landscape gradient, from a city's core to suburban communities, including trees on streets, public parks, and private landscapes. Tree species growing in these areas are becoming increasingly essential for maintaining environmental quality and human well-being in the face of urbanization and climate change.

However, these areas are not the easiest places for a tree to survive. Currently, the US is losing 36.2 million urban trees each year; the annual loss of ecosystem services from these trees is estimated to be $96 million[20]. The average lifespan of a tree in downtown urban areas ranges from 19-28 years[26], a significantly shorter timespan than their forested counterparts that may live for centuries. To make matters worse, climate change may cause significant stress or even mortality to our trees. The projected changes in climate conditions, such as increased temperatures and altered precipitation patterns, are expected to cause species to either gain or lose suitability to their surrounding environment. This likely means a redistribution of tree species, as well as the potential for significant canopy loss.

Much of this tree mortality can be prevented with proper planning and management that is focused on selecting tree species that are both well-suited to the site's growing conditions and tolerant of the many stress factors found in an urban setting. We created a guide to recommend which species to plant in the urban environments of Massachusetts, taking into account each species' individual environmental preferences, growth characteristics, tolerance to urban conditions, and adaptability to climate change.

This guide aims to act as a resource for anyone interested in planting a tree in Massachusetts – a professional, a volunteer, or a private resident. Although this should not be viewed as the final authority in a tree search, we endeavor to provide readers with the information necessary to confidently choose which species is best for their planting site, and which species best meets their planting objectives, to promote resilient urban forests.

URBAN CONDITIONS

Which species can tolerate urban conditions?

Massachusetts is the most urbanized state in New England, and the third most urbanized in the US, with 40.4% of its land reported as "urban" in the 2010 census. This is expected to increase to 60.7% by 2060. Within the state's urban and community areas, 19.4% of land cover is impervious surface, while tree cover is roughly 45.5% - an estimated 178 million trees. These trees store 34 million metric tons of carbon ($775.2 mil), and annually remove 1.1 million metric tons of carbon ($25.5 mil) and 28,850 metric tons of air pollution ($244.7 mil)[32].

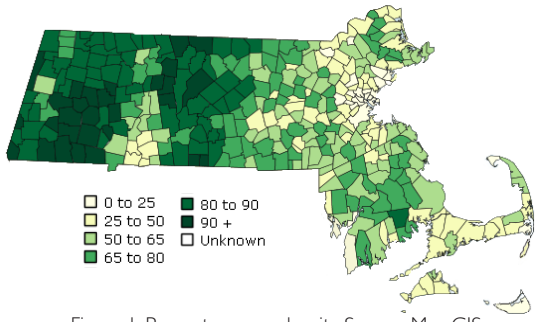


Figure 1: Percent canopy density. Source: MassGIS.

Urban areas can present adverse growing conditions, narrowing the list of species that may otherwise be well-suited to a site's capacity. Not only must urban trees endure the stress factors that forest trees experience, such as natural disasters, diseases, insects, drought, and competition for resources, but they must also tolerate a wide range of anthropogenic challenges. Urban environments have more impervious surfaces than rural environments[3], which can inhibit root growth and limit the infiltration of moisture[23, 5]. With the addition of vehicular and foot traffic, urban soils may be compacted and feature poor drainage, contamination, and altered nutrient composition. The use of de-icing salt and materials containing limestone raise the pH of most urban soils, making them unfavorably alkaline. The elevated levels of air pollution and temperature in urban environments also create unfavorable growing conditions[33].

It is important to note that no tree species prefers adverse conditions, but some species may have a higher threshold or tolerance to them. We sought to select species with an observed tolerance to the conditions they would likely face in the urban environment. An icon (seen on page 15) featured on the applicable species' profiles is used to indicate that the species may be *especially* adaptable to these adverse environmental conditions, and is more likely than other trees to survive if planted in unfavorable conditions (i.e., streets, recent construction sites, etc.).

CLIMATE CHANGE

Which species may be well-suited to our future climate?

The expected changes in climate conditions have the potential to significantly alter the biogeography of our urban forests. Extreme heat events and drought, both of which have been shown to decrease tree growth and cause tree mortality, have been forecast to increase in frequency, duration, and severity[29, 17, 1]. Tree growth and survival are also affected by total seasonal precipitation, which, in Massachusetts, is predicted to decrease in summer and increase in the winter[7]. The increased winter precipitation is expected to be primarily in the form of rain[7], meaning decreased water availability in early spring typically provided by snowmelt. These changes could result in not only direct stress to trees, but will likely act as a threat mutliplier: expanding invasive plants' ranges, encouraging pest outbreaks, and increasing trees' susceptibility to pests. This may compromise the health, and ultimately survival, of many species common to Massachusetts. Therefore, it may be important to consider which species will be able to withstand your future climate.

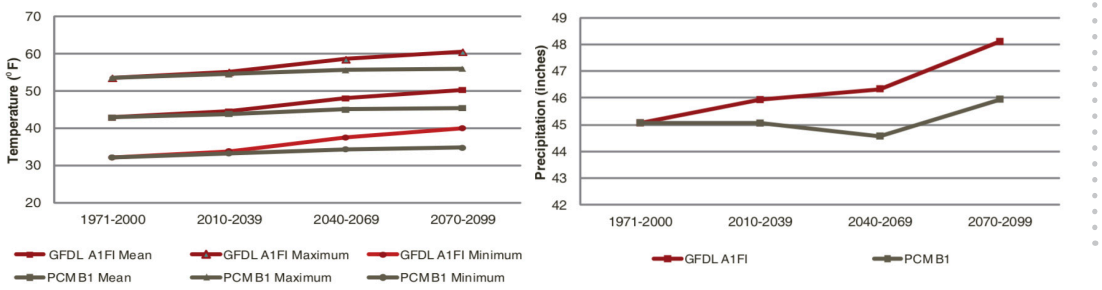


Figure 2: Projected trends in mean, minimum, and maximum temperature (left) and mean precipitation (right) in New England averaged over 30-year periods using two climate model-emissions scenario combinations.
Source: USDA New England and Northern New York Forest Ecosystem Vulnerability Assessment and Synthesis 2018.

This could mean selecting species that can adapt; trees will vary in their response to these changes, but looking for traits such as tolerance to heat or drought could indicate a high adaptive capacity. This could also mean selecting species that are expected to gain habitat suitability in Massachusetts and possibly migrate northwards to establish themselves, or increase in abundance. However, if climate change projections are accurate, trees will have to either adapt, or migrate 3,000 to 5,000 meters (1.86 to 3.1 miles) per year to avoid extinction. This far exceeds the maximum rate of 500 meters (0.31 miles) per year observed for plant species. Trees, being much more long-lived than other plant species, will have an especially challenging time, and could take many centuries to adapt to new climate conditions[34]. The habitat fragmentation common in urban environments exacerbates this issue by limiting species' ability to naturally migrate.

Therefore, we may consider assisted migration when selecting which tree species to plant, in hopes of helping trees keep pace with climate change. This strategy involves planting species either at the northern edge, or just outside of their current range, in a suitable habitat that they are expected to naturally migrate to. An icon (seen on page 15) featured on the applicable species' profiles is used to indicate that the species may be a candidate for assisted migration (more information can be found on page 103). By choosing to plant these species now, we could prevent possible extinction, minimize economic loss, maintain biodiversity, and sustain the benefits that trees provide for years to come.

NATIVE RANGE

Which species are native to the eastern US?

We would like to emphasize the importance of planting native species where appropriate. Native species provide substantially more support to native wildlife when compared to their non-native counterparts. Using native tree species has been shown to support a 50% higher abundance of native birds, 9x higher abundance of rare birds, 3x more butterfly species, and 2x higher abundance of native bees[11].

Non-native plants also present greater risks when planted, as they are 40x more likely to become invasive than native plants[28]. Invasive plants have the potential to displace native species, reduce biodiversity, and completely restructure an ecosystem[14]. The resulting habitat, often a monoculture of a plant unfamiliar to the surrounding wildlife and insects, may not provide suitable food and shelter, especially for specialist species who depend on specific plants for survival. Mosquitoes, ticks, and other pests harmful to human health have been shown to increase in number as a result of non-native, invasive plants such as Japanese barberry (*Berberis thunbergii*) and honeysuckles *(Lonicera* spp.)[14].

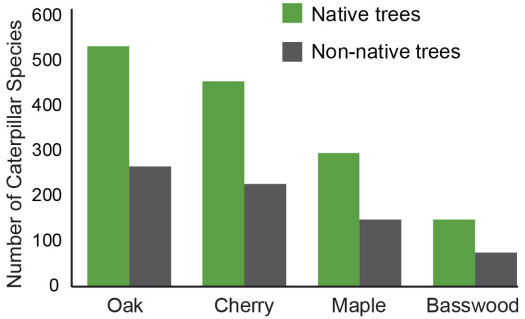


Figure 3: A comparison between the number of caterpillar species native and non-native species of the same genus can support.
Source: Fusco et. al, 2018.

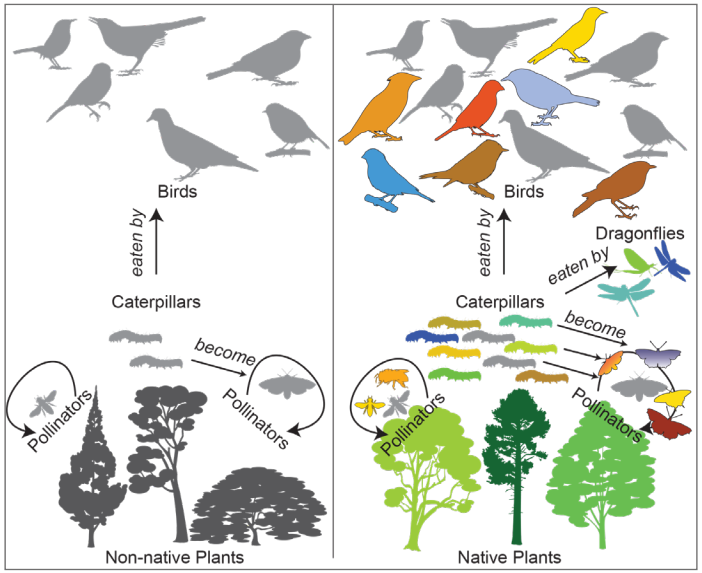


Figure 4: Landscaping with non-native plants (left) vs. with native plants (right).
Source: Fusco et. al, 2018.

Non-native plant imports often act as a Trojan horse for forest pests: an estimated 70% of non-native forest pests, including hemlock woolly adelgid (*Adelges tsugae*), arrived as contaminants on these plant imports. Since many non-native plants are transported from warmer climates[13], global warming may provide further opportunity for these species to invade. The US spends an estimated $20 billion each year to manage and control invasive plants[11]; this includes not only taxpayer dollars, but homeowners who have to pay for tree removal or suffer diminished property value[13].

Not all tree species recommended in this guide are native, as a well-suited non-native species can make a great addition to an urban forest. However, it is recommended to limit the amount of non-native species in the landscape[11]. An icon (seen on page 15) featured on the applicable species' profiles is used to indicate that the species is native to the temperate forests of the eastern US, and may offer more benefits and less risks than the non-native alternatives.

BIODIVERSITY

Which species will increase biodiversity in the community?

Simultaneously, it is critical to maintain a high level of biodiversity among tree species in the urban forest[6]. Biodiversity is essential to almost all ecosystem processes, resilience, and stability[30]. Considering that different tree species are susceptible to different pests, planting a variety of species can help to minimize urban forest canopy loss. The well-known depletion of urban forests across Massachusetts due to Dutch elm disease (DED) (*Ophiostoma novo-ulmi*), exacerbated by to the over-planting of the American elm (*Ulmus americana*), serves as an example of the risk associated with a monoculture[23].

Since 2008, over 30,000 trees have been removed from Worcester County, MA, in an effort to eradicate the invasive Asian longhorned beetle (ALB)[32]. These removals were in primarily urban residential areas, where, in Massachusetts, Maple trees (*Acer* spp.) account for approximately 49% of our street trees[8]. Although the state is making tremendous progress in replacing these trees, a 2013 study showed that a 10% loss in the area's tree canopy cover caused a 1.26°F increase in land surface temperature, and the resulting 10% increase in exposed impervious surface caused a ~3°F increase in land surface temperature[25].

The "10-20-30 guideline" is commonly used to ensure an ideal level of biodiversity; this rule states that in any community, less than 10% of trees should be of the same species, less than 20% should be from the same genus, and less than 30% should be from the same family[27]. However, some experts recommend no more than 10% of trees should be of the same genus, while some even recommend no more than 5%[4].

Table 1
Most common genera on MA urban roadways[8].

Genus	Percent Total
Acer	49
Quercus	15
Pinus	7
Fraxinus	5
Pyrus	4
Prunus	3
Betula	3
Tilia	2
Robinia	1
Gleditsia	1

Maintaining biodiversity can be difficult, as the adverse conditions of the urban environment greatly limits compatible tree species. Additionally, cold temperatures of Massachusetts have been shown to limit diversity; urban tree inventories conducted in warmer cities in California and Florida include more than 2x the amount of species found when compared to urban tree inventories of the northeast[33]. To abide by the "10-20-30 guideline", it may be helpful to consider which trees may be already overplanted in your community, as well as the resources available for urban forest management (i.e., budget, staff, equipment).

We aimed to select a variety of species that are less commonly planted to encourage diverse plantings. In the 'Notes & Limitations' section of applicable species' profiles, the phrase 'may be over-planted' is used to indicate that the species is commonly found in the urban forest, and a site's surrounding biodiversity should be carefully assessed before a final selection is made.

Table 2
An excerpt of tree species excluded from this guide as a result of compatibility and management-related issues.

Common Name	Scientific Name	Issue
Amur Maple	*Acer ginnala*	Potentially invasive
Norway Maple	*Acer platanoides*	Invasive- prohibited in MA
Sycamore Maple	*Acer psuedoplatanus*	Invasive- prohibited in MA
Silver Maple	*Acer saccharinum*	Incompatibile to the urban environment
Tartarian Maple	*Acer tartaricum*	Potentially invasive
Tree of Heaven	*Ailanthus altissima*	Invasive- prohibited in MA
Common Alder	*Alnus glutinosa*	Potentially invasive
Russian Olive	*Elaeagnus angustifolia*	Potentially invasive
Ash species	*Fraxinus* spp.	Emerald ash borer
Amur Corktree	*Phellodendron amurense*	Invasive- prohibited in MA
Eastern White Pine	*Pinus strobus*	Incompatibile to the urban environment
Callery Pear	*Pyrus calleryana*	Potentially invasive
Common Buckthorn	*Rhamnus cathartica*	Invasive- prohibited in MA
Glossy Buckthorn	*Rhamnus frangula*	Invasive- prohibited in MA
Black Locust	*Robinia pseudoacacia*	Invasive- prohibited in MA
Mountainash species	*Sorbus* spp.	Susceptible to many pests

SITE ASSESSMENT

It is critical to analyze below & above ground conditions before selecting which species to plant.

SITE COMPATABILITY

1a.) USDA hardiness zone:

___5a ___5b ___6a
___6b ___7a ___7b

1b.) Microclimate factors:

___Wind exposure
___Frost pocket

1b.) Daily sun exposure:

___Full sun (>6hrs direct light)
___Partial shade (3-6hrs direct light, or >6hrs filtered light)
___Full shade (<3hrs direct light, or <6hrs filtered light)

2a.) Limitations to rooting space:

___Physical barriers or compact soil
___Underground utilities
___Available rooting space

2b.) Limitations to overhead space:

___Wires
___Proximity to buildings/structures

MANAGEMENT CONSIDERATIONS

3.) Water availability:

___Supplemental irrigation during establishment & drought

4.) Pests significant in the community:

_____
_____
_____

5.) Biodiversity:

___Highest % of same tree family in area
___Highest % of tree genus in area
___Highest % of tree species in area

SOIL CONDITIONS

7a.) Soil pH range:

___pH

4.) Road salt & pollutants:

___Distance to road (Exposure & damage is highest within 25 ft)
___Speed limit (Salt damage intensity & range increases with speed)

7b.) Soil drainage: Fill 12x12" hole with water & observe drainage rate.

___Fast (6+"/hr)
___Moderate (1-6"/hr)
___Slow (<1"/hr)

7c.) Soil structure:

___Bulk density (Higher density= more compact)
___Presence of earthworms? (May indicate favorable soil)
___Indicator plants (Wet, well-drained, or dry)

7d.) Soil texture:

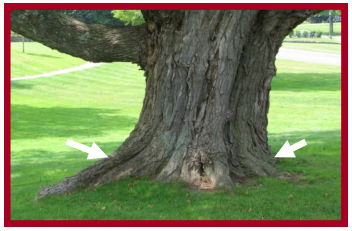
___Sandy (Feels gritty)
Drains well, resists compaction, can be nutrient poor and moisture deficient
___Loamy (Feels both smooth & gritty)
Drains well, retains moisture and nutrients, resists compaction
___Clay (Feels smooth)
Retains moisture and nutrients, prone to compaction, poor drainage

6.) Other (Energy conservation opportunities, existing easements, wildlife, aesthetic concerns)

_____
_____
_____
_____

TREE PLANTING 101

The saying goes, “The best time to plant a tree was 20 years ago, but the next best time is now.” Planting your tree properly is one of the best things you can do to ensure the successful establishment of your tree in the landscape. Prior to planting, treat your tree gently and protect it during transport. Keep it in a cool, shaded place and keep the root ball moist. Plant the tree as soon as possible. Follow these steps for a successful planting. And remember, call Dig Safe® at 811before you dig.



Trunk flare on mature tree

1. **Take Stock!** Examine your tree and remove packaging around trunk and branches.
2. **Find your Flare!** Locate the trunk flare (also called root flare or the root collar). The ANSI A300 defines this as “the area of transition between the root system and the trunk,” and it should be at or just above the finished grade. It is where the trunk will typically start to curve and where structural roots become distinct from the trunk. This is often highly visible on trees in the woods, and can be less conspicuous on young, nursery-grown trees. There may be excess soil on top of the trunk flare, so you may have to remove soil from the top of the root ball to identify the flare. You can gently probe the root ball with a chaining pin, skewer, screwdriver, or wire in order to locate structural roots.

Removing excess soil from the top of the root ball using a hand cultivator

3. **Determine the size of the planting hole.** Measure the width and depth of the root ball and use this to determine how wide and deep to dig, keeping in mind that the flare should be at or just above grade. The hole should be 2 to 3 times as wide as the root ball. In hard, compacted soil, the hole should be closer to 3 times as wide.
4. **Get digging!** Dig a wide hole with sloped sides. If the sides appear smooth or “glazed,” use a shovel to rough up the sides. Dig only as deep as the root flare. Periodically check your depth and width by comparing with the root ball.
5. **Remove packaging from the root ball.** For container trees, this means removing the tree from the container. For balled and burlapped trees (B&B), this means removing the burlap and wire basket. For in-ground fabric, this means removing all of the bag. If it seems like the root ball of a B&B tree will fall apart, you may want to place the tree in the hole and then remove packaging. For all trees, remove trunk wrap and check the canopy for flagging tape, rope, or other items, and remove.

B&B trees with trunk wrap

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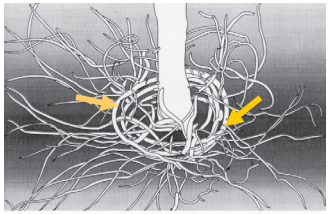
TREE PLANTING 101

6. **Examine the roots!** For all trees, cut circling roots. For container trees, remove roots growing against the container and remove a thin layer of roots from the side and bottom. For B&B trees, straighten, cut, or remove circling roots. If you plant trees a lot, you may want to dedicate a pair of cheap hand pruners for this purpose.
7. **Place the tree in the hole.** Roll or place the tree in the center of the hole. Check the depth of the root flare and adjust hole depth, if necessary.
8. **Check the placement of the tree.** Examine the tree from two sides, 90° apart. Is the trunk straight? Are branches facing the way you want? You can backfill with a little soil to help stabilize the tree as you check the placement.
9. **Backfill and water**. Once the tree is stabilized, continue to backfill with the soil that you dug out. Halfway through the backfilling process, water the tree to help remove air pockets and reduce future settling. Continue to backfill. To aid in watering, you can build a low dirt berm around the edge to help guide water to the root ball. Water thoroughly after planting.
10. **Mulch.** Use an organic mulch in a ring around the tree. Mulch should be 2 to 4 inches high. Once mulch has settled, the depth should not be greater than 2 inches. Keep mulch 3 inches away from the trunk. Do not apply mulch against the trunk of the tree so that it appears like a volcano; this is incorrect and detrimental to the tree, though is often observed in the landscape.



Circling roots

Correct mulch technique. Wide ring, away from trunk.

Improper mulch technique

Caring for your New Tree

The next two years are critical for the successful establishment of your tree. Make sure you water your tree, but be careful not to overwater. During hot, summer months, your tree may need 10 gallons per caliper inch per week. When it is cooler, that amount may be 5 gallons per caliper inch per week. You can check the soil moisture of the root ball by probing the soil with a chaining pin or stiff wire. If the rod goes in easily, there is likely adequate moisture, but if it is difficult, that may indicate the soil is dry. As you remove the rod or chaining pin, if you notice suction has developed, that may indicate the soil is too wet; likewise, if the leaves are wilting, but you are watering regularly, you may be watering too much. Newly-planted trees typically do not need to be fertilized or pruned.

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CARING FOR NEW TREES

Congratulations! If you are reading this, it means you are caring for a newly-planted tree. Your actions over the next two to three years will help your tree become established in the landscape and survive for years to come. What should you be doing?

WATERING

New trees need water, especially during hot summer weather! Watering with a garden hose at low volume or utilizing a soaker hose is ideal since it allows water to slowly infiltrate the soil while minimizing the potential for root ball erosion. Less frequent, but thorough, watering is more beneficial to root development than more frequent, but shallow, watering. Remember that tree roots need oxygen and over-watering is just as problematic as under-watering.

It is hard to say exactly how much to water your tree. Natural rainfall and specific soil conditions can vary, but newly-planted trees need approximately 1.5 inches of rain per week. This translates to about 10 gallons per caliper inch, per week, from spring through autumn.

Watering technique using one-gallon jugs

Watering bag

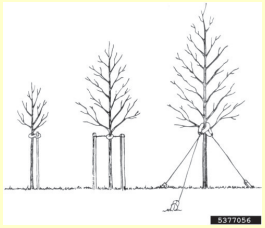
An Easy Watering Technique

Using 10 one-gallon plastic jugs, carefully perforate the bottom of the jugs and place them around the base of the tree tied together and then fill them with water. This will allow the water to slowly seep out and water the tree.

You can also purchase watering bags that you fill, using a hose to allow for a slow soaking.

TREE STABILIZATION

Tree stabilization may be necessary in areas with high winds, where mower or string trimmer damage is likely, for high-traffic areas, or for trees that do not have an adequate root system. Tree stabilization may consist of stakes, guys, and other materials. Here we describe a method using stakes, but there are a variety of systems out there, with varying costs and amounts of labor required. If you are using stakes, use 2 to 3 stakes, placed just inside the edge of the mulch ring and wide nylon or canvas straps, tied loosely around the trunk. For an unstable root ball, use 1-3 stakes attached low on the trunk. Remove after 1 year.



Staking techniques, ISA, bugwood.org

TRUNK GUARDS

If winter damage to the trunk by rodents is a concern, install a trunk guard made of plastic tubing, hardware cloth, or wire fencing. Allow 1-4 inches of space around the trunk and ensure it is tall enough to protect in snow. Remove in the spring.

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CARING FOR NEW TREES

MULCHING

Mulch is any woody or herbaceous material applied over the root zone that improves tree health by replicating the forest floor. Mulch can be aged wood chips, shredded bark, pine needles, composted leaves, composted grass clippings, and other organic material.

Why mulch? Mulching your new tree is important and serves more than just an aesthetic function. Mulch reduces the shortcomings of urban sites by replicating natural processes occurring in the forest. Mulch increases available nutrients and water retention, buffers soil temperatures, and provides root protection. Mulch also reduces root-zone erosion potential, soil compaction, and weed growth, and prevents lawnmower and other machinery damage.

|———*Root Zone*———|

Correct mulch technique

How to use mulch. Place mulch in a ring at least 3 inches away from the tree trunk, at a depth of 2-4 inches, and ideally out to the tree crown. Raking away old mulch before applying new mulch helps maintain correct mulch depth. Occasionally, you may need to pull mulch away from the trunk of the tree as the mulch settles around.

Improper mulch technique—piled on trunk and does not cover whole root zone

FERTILIZING

Fertilizer should only be used if a soil test indicates a deficiency. New trees typically do not require fertilization. For information on testing your soil, contact the UMass Soil and Plant Nutrient Testing Lab, https://soiltest.umass.edu/ or 413-545-2311. Improper use of fertilizer can damage your tree.

PRUNING AND PERIODIC INSPECTION

Prune dead and broken branches at planting. After 2 years, you may begin structural pruning. Your tree will likely require pruning every 1-2 years to establish and maintain proper structure. If your tree is within 10 feet of utility lines, or you need to use a ladder or chainsaw, contact an arborist. For guidance on tools, techniques, and safety, see *The Tree Owner's Manual*, pages 18-23. Periodically, inspect the tree for insect and disease problems. Protect the tree from human activities such as construction, soil compaction, and road salt.

REFERENCES: *Tree Owner's Manual*, www.treeownersmanual.info ♦ *Tree Planting Best Management Practices*. 2014. 2nd ed. Champaign, IL: International Society of Arboriculture ♦ *New Tree Planting*. 2011. International Society of Arboriculture, www.treesaregood.com/treecare/resources/new_treeplanting.pdf

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NAVIGATING TREE SPECIES PROFILES

Scientific & Common Name	At the top of each profile is the tree's genus (i.e., *Quercus*) and epithet (i.e., *bicolor*), followed by its common name (i.e., Swamp White Oak).
Environmental Conditions	Although all trees prefer what are almost universally considered favorable growing conditions (consistently moist, well-drained soil with a pH ranging from 6.2 – 6.8; adequate light and space), it is rare to find them all in the urban environment. In this section, we present species' adaptability to extreme temperatures (hardiness zones), light levels, soil pH, and soil moisture.
Zone	Based on average annual extreme minimum temperatures as designated by the USDA's Plant Hardiness Zone Map; each zone differs by 10°F, and each subzone, ("a" or "b"), differs by 5°F. In Massachusetts, hardiness zones range from 5a in the Berkshire mountains to 7b on Cape Cod. If you're planting in zone 6b, select a species hardy to zone 6b or below (6a, 5b, 5a, etc.). Plants hardy to zone 7a+ may not be able to survive. A landscape's microclimate may affect its hardiness zone: for example, if a planting site in zone 6b is sunny and protected from wind, it could be categorized as zone 7a. Alternatively, if a planting site within the same landscape is in an exposed, low-lying area, it may be categorized as zone 6a.
Light	Preference for full sun (>6 hrs direct light daily), partial shade (3-6 hrs direct light daily, or filtered light for most of the day), or full shade (<3 hrs direct light or <6 hrs filtered light daily).
Soil pH	Adaptability to soil pH, which is often alkaline in urban environments. ≤7.0 indicates species that do not tolerate alkaline soil, ≤7.5 indicates species that moderately tolerate alkaline soil, and ≤8.2 indicates species that tolerate alkaline soil.
Moisture	Adaptability to varying levels of soil moisture, described as 'tolerant' or 'intolerant' of 'occasional periods' or 'prolonged periods' of dry and/or saturated soil. Urban sites typically do not receive adequate water, and although established trees often become acclimated to less than optimal moisture, newly transplanted trees need several years of supplemental watering. Species that can tolerate saturated soils are typically well-suited for areas prone to flooding and sites featuring poorly-drained soils.
Characteristics	This section explores tree species' growth and ornamental characteristics. To account for variation and influence from a number of factors (i.e., soil moisture, light, etc.), a range is assigned for most characteristics. Growth characteristics and space requirements should usually be given higher priority than ornamental characteristics.
Height	Species' height in feet at maturity. A species may grow taller in its natural setting, but the range given is its expected height in the landscape. The height of utility lines is typically 25-30', so an icon (seen on page 15) is used to indicate low-growing species that are compatible to plant in the vicinity of these lines.
Width	Species' canopy width in feet at maturity. A species may grow wider in its natural setting, but the range given is its expected canopy width in the landscape.
Growth	Based on annual branch growth, 'Slow' species grow at a rate of <2", 'Medium' grow 2-6", and 'Fast' grow >6" per year.
Form	Often includes form in both juvenile and mature stages; 'single- or multi-stemmed' is included if relevant. Form is especially important to consider for street tree selection.
Flower	Species' flower shape, color, size, and/or scent at maturity, and if it is considered 'showy' or ' inconspicuous'.
Fruit	Species' fruit shape, color, size, and/or scent at maturity; see 'Limitations' section for indication of potentially messy fruit.
Foliage	Summer and fall color, and includes emerging leaf color description, if of interest.
Bark	Appearance and texture in juvenile and mature stages. 'Ornamental' is used to describe a bark of particular interest, especially in wintertime with no leaf cover.

NAVIGATING TREE SPECIES PROFILES

Planting Considerations	This section aims to address various details that may be important to consider while making a species selection.
Pests	Select insects or diseases of importance.
Tolerates	Species' observed tolerances, including drought, flooding, salt, pollution, poor drainage, shearing, and wind/storm damage. 'Shade' and 'alkaline soil' are not included in this section, as the species' tolerance to each are listed in 'Environmental Conditions'. These tolerances apply to trees that are established in the landscape, as newly transplanted trees are more vulnerable to stress. These qualities are difficult to quantify, and can be inconsistent between sources, but should serve as a general guidance. • *Soil compaction vs. poor drainage:* Both are classified as tolerant to 'poor drainage', as soil compaction falls under this umbrella, and other factors can cause soils to be poorly drained. This is especially important to consider in areas with vehicular or foot traffic. • *Salt spray vs. soil salt:* Both modes of salt injury are classified as 'salt' tolerant, as they are rarely differentiated in the literature. Salt spray is damaging to plant stems and buds, while soil salt applied during the months when soil is warmer and roots are active (due to snow event on the extreme shoulders of the growing season) may also damage trees. Species with a reported tolerance may still be damaged by heavy salt applications.
Transplant	The main methods of transplanting recommended here are balled and burlapped (B&B), bare root (BR), and container grown (CG)[2]. 'Easy' may indicate that a species takes less time to establish compared to 'difficult' species. The amount of time a tree takes to establish may also be influenced by its size: the larger the caliper at transplant, the longer it will typically take to establish. A general guideline is to allow one year for every inch caliper before the tree is considered established and able to grow without supplemental watering (i.e., if you plant a 2" caliper tree, provide supplemental watering for two years after planting). Choosing small caliper trees when possible is advised, generally avoiding trees larger than 3" in caliper.
Cultivars	Several commonly available cultivated varieties may be listed. These "cultivars" may have certain tolerances that the species do not, or feature improved characteristics (i.e., ornamental foliage, specific growth form, thornless).
Notes & Limitations	This section includes specific benefits, management recommendations, and any other miscellaneous information pertaining to the tree species in question. This section also includes warnings regarding potential health, growth, and management issues that should be considered before selecting the tree species in question. For instance, a species' messy fruit or tendency towards branch failure presented here indicates that it may not be the best selection for street use, but may be suitable in a park.


Native to the Eastern US

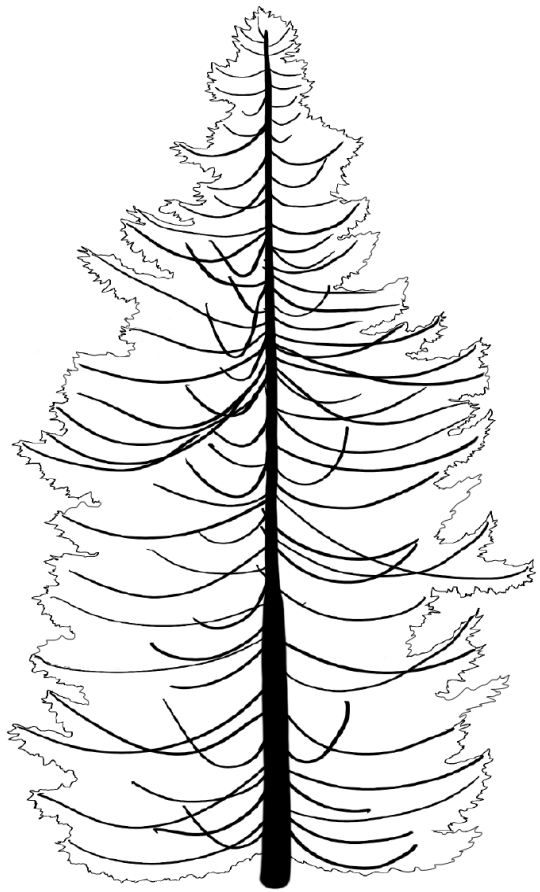

Compatibility to planting near utility lines- mature height of ≤30'


Notably adaptable to adverse conditions


Candidate for assisted migration

WHITE FIR

Abies concolor



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 30-50'

WIDTH 15-30'

GROWTH Slow - medium

FORM Pyramidal

FLOWER Inconspicuous

FRUIT Upright, oblong cones, green turns to brown or purple

FOLIAGE Green to blue-green needles emit a lemon scent when crushed

BARK Ashy gray, irregularly furrows with age

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, heat, pollution

TRANSPLANT Easy

CULTIVARS 'Blue Cloak', 'Candicans', 'Violacea' have desirable silver-blue needles

NOTES & LIMITATIONS

A highly regarded ornamental, White Fir provides year-round beauty. Native to the Western US, it is considered the most tolerant fir, and is reportedly gaining popularity in Massachusetts.

TRIDENT MAPLE

Acer buergerianum

ENVIRONMENTAL CONDITIONS

ZONE 6A

LIGHT Full sun

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-25'

GROWTH Slow - medium

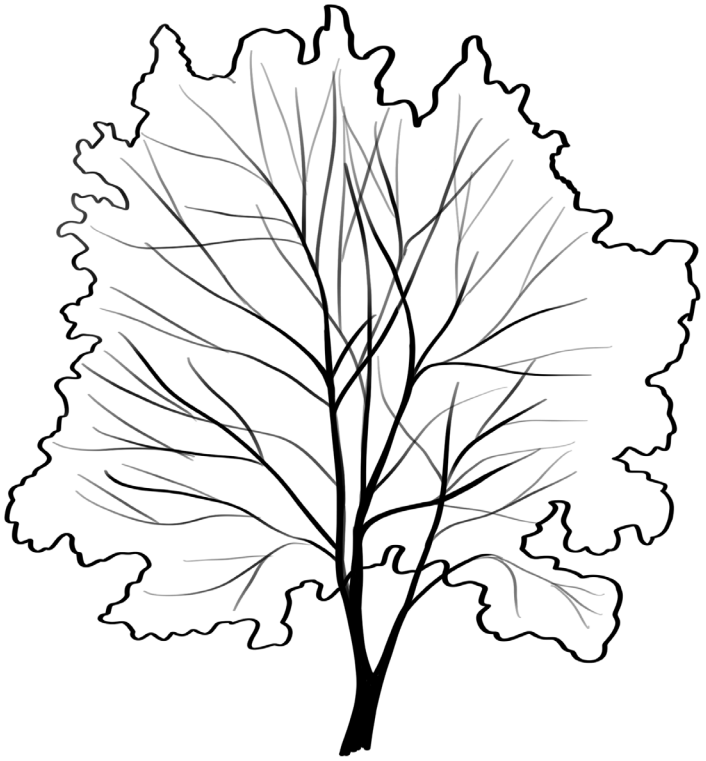
FORM Oval to rounded, low branching tendency

FLOWER Inconspicuous, greenish-yellow clusters

FRUIT Samara

FOLIAGE Glossy dark green turns to variable, excellent, yellow or red in late fall

BARK Ornamental mix of gray, brown, and orange, exfoliating in scales and plates



PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES Drought, heat, pollution

TRANSPLANT Moderately easy

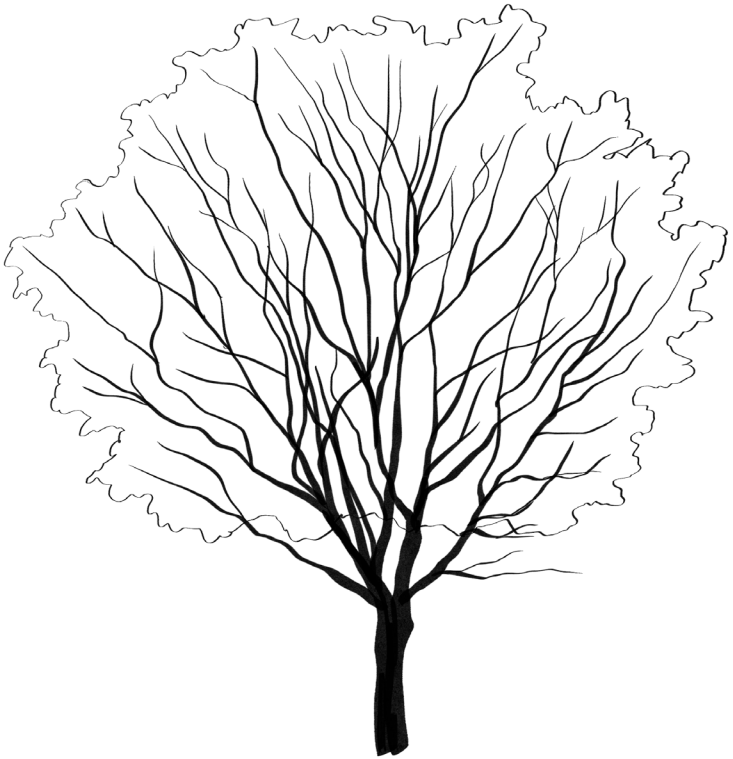
CULTIVARS Street Wise® 'ABTIR' can easily be trained into a single leader, burgundy fall color; Raising Blaze™ 'EOAB-1' has great heat tolerance, a reduced fruit crop, and notable orange to red fall color; 'Mino-yatsubusa' has a graceful form, grows to be only 4' x 10'

NOTES & LIMITATIONS

This small, adaptable, and ornamental maple makes a great street tree, although its low branches may require pruning. Young trees may experience twig dieback in harsh winters.

HEDGE MAPLE

Acer campestre



ENVIRONMENTAL CONDITIONS

ZONE	5B	**SOIL PH**	≤8.2
LIGHT	Full sun	**MOISTURE**	Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT	25-35'	**FLOWER**	Inconspicuous green clusters
WIDTH	25-35'	**FRUIT**	Samara
GROWTH	Slow - medium	**FOLIAGE**	Dark green turns to variable yellow in late fall
FORM	Rounded, low branching tendency	**BARK**	Gray-black with shallow ridges and furrows giving corky appearance

PLANTING CONSIDERATIONS

PESTS	Typically few, but susceptible to ALB	**CULTIVARS**	Queen Elizabeth™ 'Evelyn' is more vigorous and has a more upright, oval habit; 'Schichtel's Upright' has a more narrow form; Metro Gold® 'Panacek' is a notably tough urban tree with a narrow form, fewer seeds, and an improved yellow color
TOLERATES	Drought, heat, pollution, poor drainage, shearing		
TRANSPLANT	Easy B&B or ≤2" caliper BR		

NOTES & LIMITATIONS

This small, adaptable maple makes a great street tree, although its low branches may require pruning. Its common name is derived from its use as a hedge, especially in its native range of Europe.

PAPERBARK MAPLE

Acer griseum

ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 10-30'

GROWTH Slow

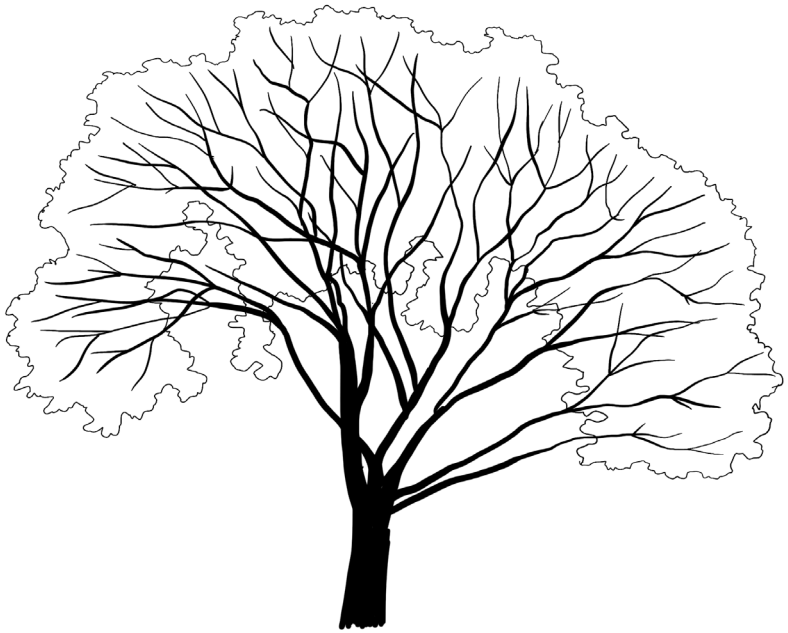
FORM Oval to rounded

FLOWER Inconspicuous

FRUIT Samara

FOLIAGE Dark blue-green turns to brilliant red in fall

BARK Ornamental, exfoliating cinnamon-brown, peels into thin sheets, has polished smooth patches



PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES -

TRANSPLANT Difficult- B&B or CG recommended

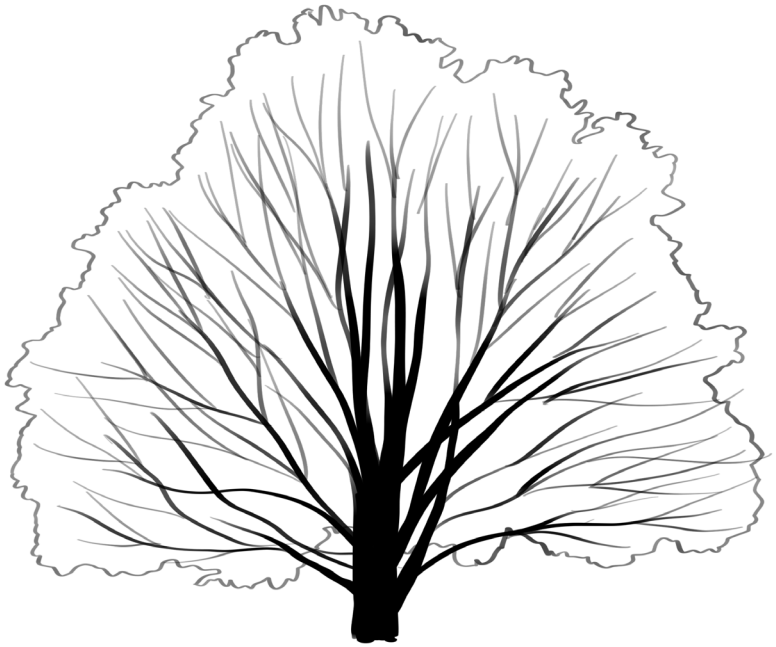
CULTIVARS *A. griseum* x *A. nikoense*: Gingerbread™ 'Ginzam' is faster growing, may be more heat tolerant; 'Cinnamon Flake' has bark that flakes in smaller strips

NOTES & LIMITATIONS

Although it does not tolerate tough urban sites, this small maple makes a great addition to the landscape, with its extraordinary bark giving it year-round ornamental value. May have limited availability, and is quite slow growing.

MIYABE MAPLE

Acer miyabei



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 30-45'

WIDTH 30-40'

GROWTH Medium

FORM Upright oval to rounded, low branching tendency

FLOWER Inconspicuous greenish-yellow pyramidal clusters

FRUIT Samara

FOLIAGE Semi-glossy, dark green turns to short-lived yellow in late fall

BARK Dark gray with rough, corky appearance

PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES Drought

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS State Street™ 'Morton' has an upright oval form, good golden fall color, reportedly heat tolerant; Rugged Ridge® 'JFS-KW3AMI' is notably tough and adaptable, with more ornamental bark

NOTES & LIMITATIONS

Often compared to *A. campestre*, this adaptable maple is recommended for landscapes, or on streets if planting site is large. May have limited availability.

RED MAPLE

Acer rubrum

ENVIRONMENTAL CONDITIONS

ZONE 3B

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 30-70'

GROWTH Medium - fast

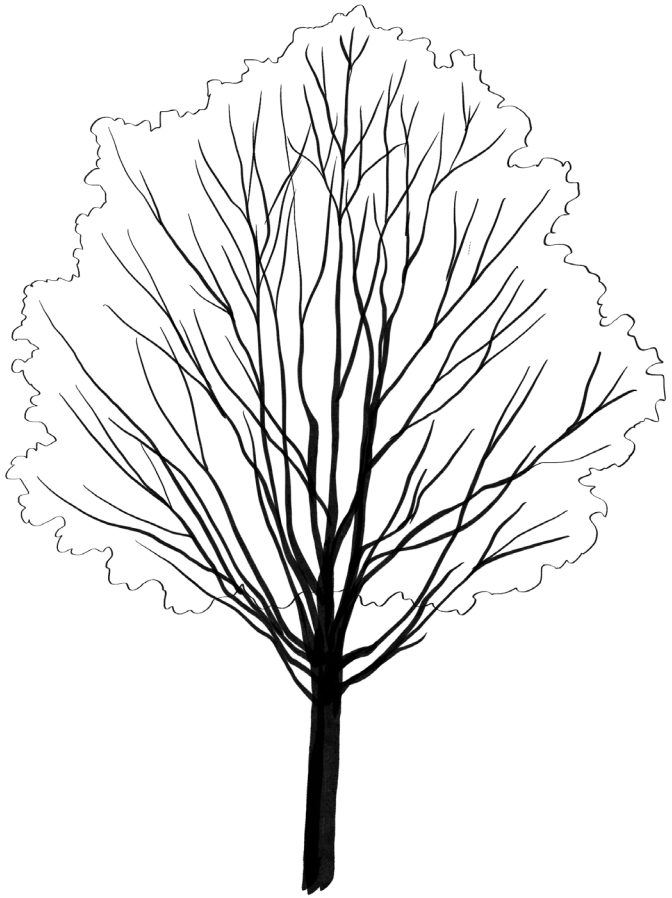
FORM Often pyramidal in youth, narrow upright to rounded at maturity

FLOWER Showy reddish flowers in clusters, monoecious

FRUIT Samara, often red

FOLIAGE Medium green turns to variable, often excellent, yellow, orange, or red in early fall

BARK Ornamental silver-gray in youth turns to scaly gray-brown



PLANTING CONSIDERATIONS

PESTS Verticillium wilt, borers, leaf hoppers, ALB

TOLERATES Pollution, flooding, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

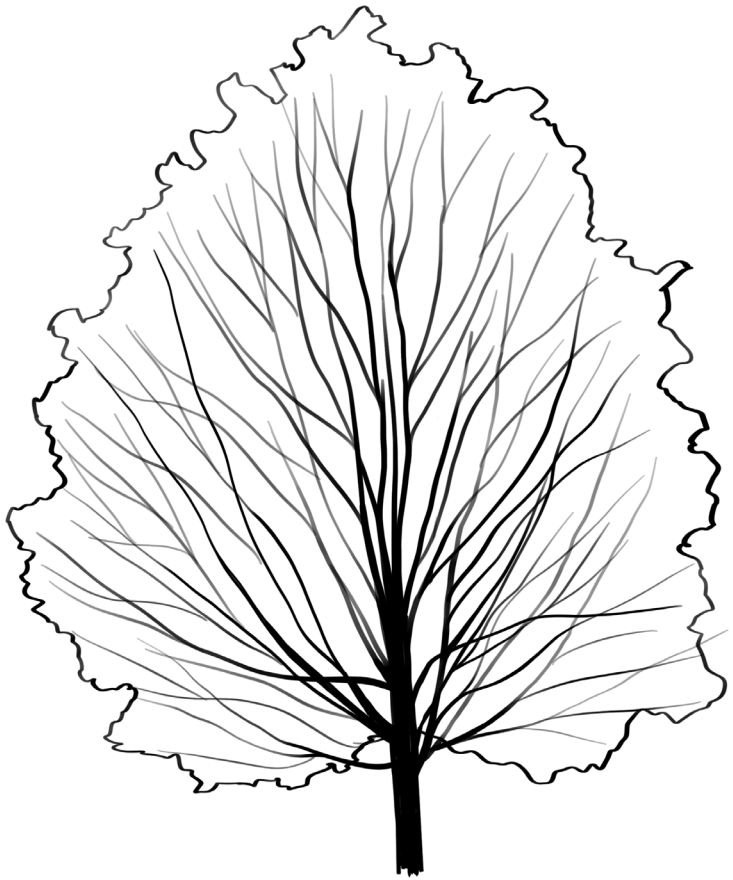
CULTIVARS Many available: Northwood® 'Northwood' tolerates harsh winter conditions, has less dependable color; Red Sunset® 'Franks Red' has great early fall color; 'Bowhall' better tolerates flooding, has pale orange flowers; 'New World' is upright and more narrow

NOTES & LIMITATIONS

Although over-planted in Massachusetts, this adaptable maple can make a great addition to just about any large site. Traits, including cold hardiness, is heavily dependent on seed source. Chlorosis may be exhibited when growing in alkaline soils, and may be susceptible branch breakage.

SUGAR MAPLE

Acer saccharum



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, tolerates shade

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 45-75'

WIDTH 35-70'

GROWTH Slow - medium

FORM Upright oval to rounded, dense branching

FLOWER Greenish-yellow pendulous clusters

FRUIT Samara

FOLIAGE Medium to dark green turns to varying, brilliant yellow, orange, or red in fall

BARK Smooth, gray-brown in youth, deeply furrowed with long scaly plates at maturity

PLANTING CONSIDERATIONS

PESTS Verticillium wilt, leaf scorch, ALB

TOLERATES -

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS Many available: Apollo®, 'Fairview', Fall Fiesta®, 'Green Mountain', and Unity® are most cold hardy; Adirondak®, Crescendo™, Fiddler's Creek™, 'Legacy', and Steeple™ are reportedly drought tolerant, 'Caddo' is extremely drought tolerant; 'Sugar Cone' grows to be only 25' x 13'

NOTES & LIMITATIONS

Although over-planted in Massachusetts, this stately maple is can provide beauty and shade for landscapes with enough space for its wide rooting system. Reportedly sensitive to heat, salt, and pollution, so planting in high-stress environments is not recommended.

PURPLEBLOW MAPLE

Acer truncatum

ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 25-30'

WIDTH 25-30'

GROWTH Slow

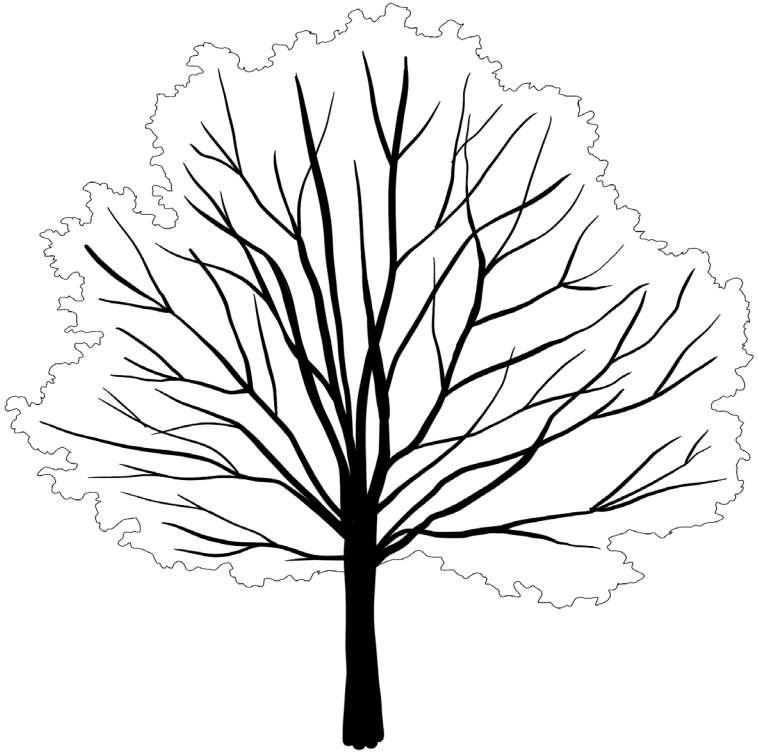
FORM Rounded with a broad crown and low branching tendency

FLOWER Small, bright yellow flowers emerge in spring before leaves

FRUIT Samara

FOLIAGE Emerging purplish-red, glossy green leaves turn to showy yellow-orange and red in fall

BARK Gray-brown, rough and fissured at maturity



PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES Drought

TRANSPLANT Easy B&B or ≤2" caliper BR

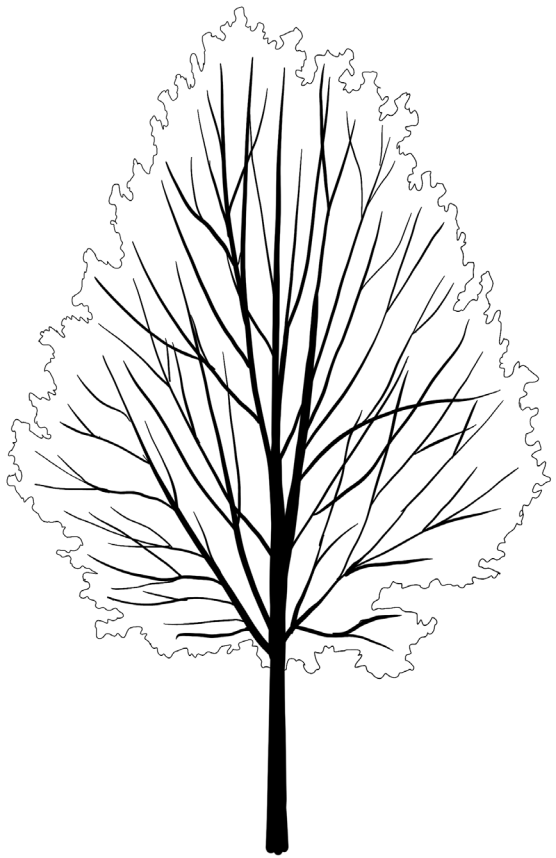
CULTIVARS Main Street® 'AT-WF1' has an oval-rounded form and brilliant orange-red fall color; 'Fire Dragon' reportedly very heat tolerant

NOTES & LIMITATIONS

Also known as Shantung Maple, this species is reportedly adaptable and quite tolerant of the adverse conditions found in the urban environment, but data is limited due to its rareness. May have limited availability. Lower branches may require pruning for street use.

FREEMAN MAPLE

Acer x freemanii



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 40-75'

WIDTH 20-40'

GROWTH Medium - fast

FORM Varies by cultivar

FLOWER Greenish-yellow to red clusters, inconspicuous to showy

FRUIT Samara, sometimes red turning to brown, seedless forms available

FOLIAGE Varies by cultivar, often good red fall color

BARK Ornamental silvery-gray

PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES Flooding, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS Many available: Armstrong Gold® columnar form grows 15-20' wide, with brighter foliage; Sienna Glen® 'Sienna' grows 35' wide, pyramidal; Autumn Blaze® 'Jeffersred' grows 40' wide, is broadly oval, has great orange-red fall color, Society of Municipal Arborists' 2004 Urban Tree of the Year

NOTES & LIMITATIONS

Species is a cross between *A. rubrum* and *A. saccharinum*. Is said to have the strong branching attachment of *A. rubrum* with the fast growth of *A. sachharinum*, and less possibility of chlorosis than *A. rubrum*.

RED HORSECHESTNUT

Aesculus x carnea

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 30-50'

WIDTH 30-40'

GROWTH Slow

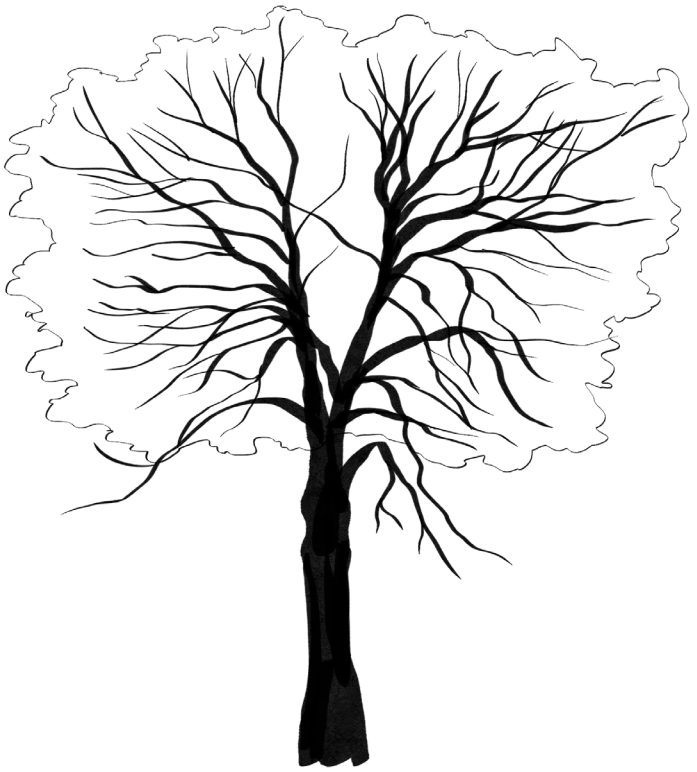
FORM Rounded to broad-rounded, often dense

FLOWER Upright pyramidal clusters of showy pink to red flowers

FRUIT Glossy brown nuts with slightly prickly husks

FOLIAGE Dark green turns to brown in fall

BARK Dark gray-brown, potentially becoming platy and exfoliating



PLANTING CONSIDERATIONS

PESTS ALB; Fungal blight can cause browning leaves; less susceptible to leaf scorch, blotch, & mildew than *A. hippocastanum*

CULTIVARS 'Briotii' is smaller, nearly fruitless, has bright red flowers; 'Fort McNair' is reportedly less susceptible to leaf blight; 'O'Neill' is rarely available, but has large, rose-red flowers

TOLERATES Variety of soil conditions

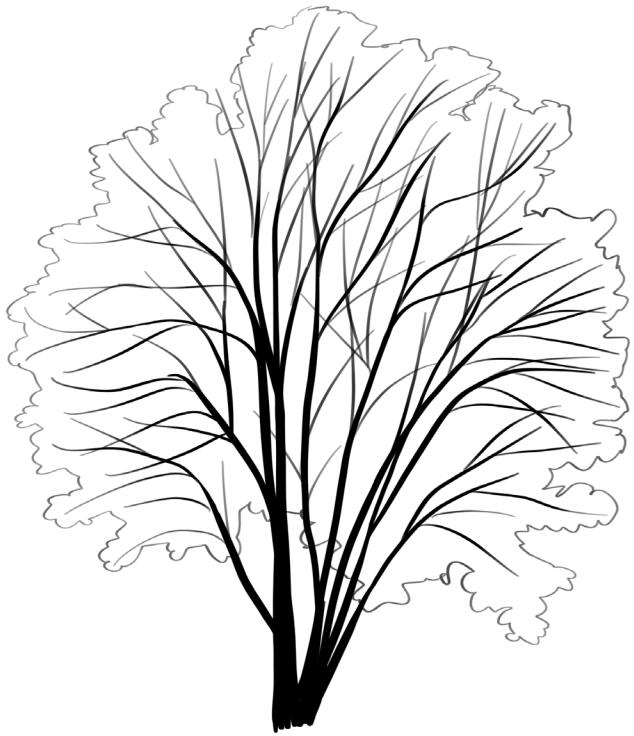
TRANSPLANT Easy B&B or ≤2" caliper BR

NOTES & LIMITATIONS

A hybrid superior to its parents, *A. pavia* and *A. hippocastanum*, Red Horsechestnut is reportedly adaptable to a variety of soils, boasts extremely ornamental flowers, and causes less litter.

SERVICEBERRY

Amelanchier spp.



ENVIRONMENTAL CONDITIONS

ZONE	4A	**SOIL PH**	≤7.5
LIGHT	Full sun, partial shade	**MOISTURE**	Sensitive to dry soil conditions

CHARACTERISTICS

HEIGHT	15-25'	**FLOWER**	White, fragrant, showy
WIDTH	15-30'	**FRUIT**	Edible purplish-blue to black berries
GROWTH	Medium	**FOLIAGE**	Emerging purple, dark green turns to good yellow-orange or red in early fall
FORM	Upright-oval; grown as a small tree or multi-stemmed shrub	**BARK**	Ornamental, smooth, dull gray with dark, horizontal fissures

PLANTING CONSIDERATIONS

PESTS	None serious, but is susceptible to rusts, scales, aphids, mildew	**CULTIVARS**	Spring Flurry® 'JFS-Arb' may be suitable for street sites; 'Autumn Brilliance' has much better heat and drought tolerance than species; 'Majestic' shows heat tolerance; 'Ballerina' is reportedly resistant to leaf spot and fire blight
TOLERATES	Poor drainage		
TRANSPLANT	Easy B&B or ≤2" caliper BR		

NOTES & LIMITATIONS

Serviceberry species, such as *A. arborea, A. laevis, A. canadensis,* and *A. grandiflora* are highly interchangeable. They prefer moist growing conditions, and although they may not be well-suited for highly stressful sites, this native species can provide year-round ornamental value to landscapes and sites under utility lines.

RIVER BIRCH

Betula nigra

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates dry and saturated soil

CHARACTERISTICS

HEIGHT 40-70'

WIDTH 40-60'

GROWTH Medium - fast

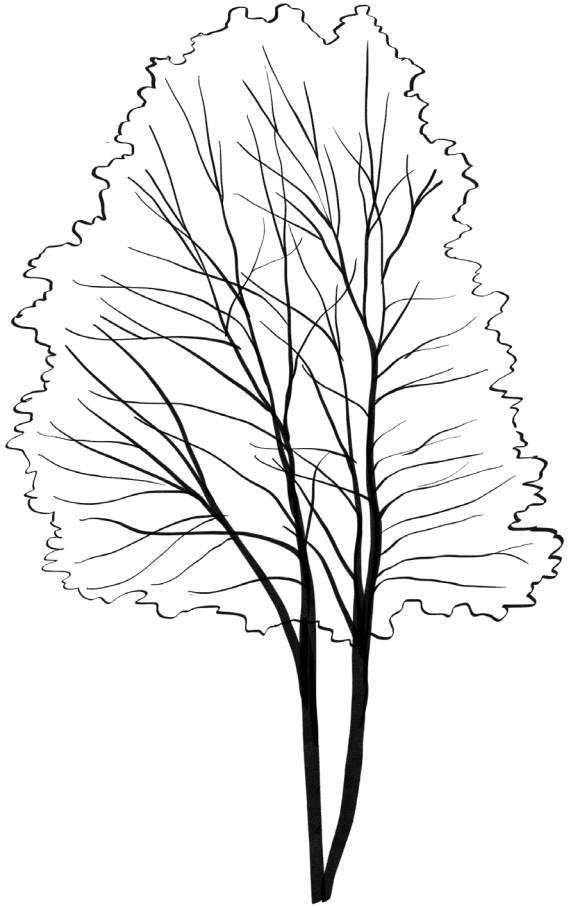
FORM Pyramidal to oval in youth, rounded with maturity; often multi-stemmed

FLOWER Catkins

FRUIT Inconspicuous, small nutlets inside catkins

FOLIAGE Medium green occasionally turns to yellow in fall

BARK Notably ornamental; thin, shiny red-brown in youth, orange-brown and exfoliating at maturity



PLANTING CONSIDERATIONS

PESTS Typically few, but susceptible to ALB

TOLERATES Flooding, heat, salt, poor drainage

TRANSPLANT Moderately difficult BR, easier B&B or CG

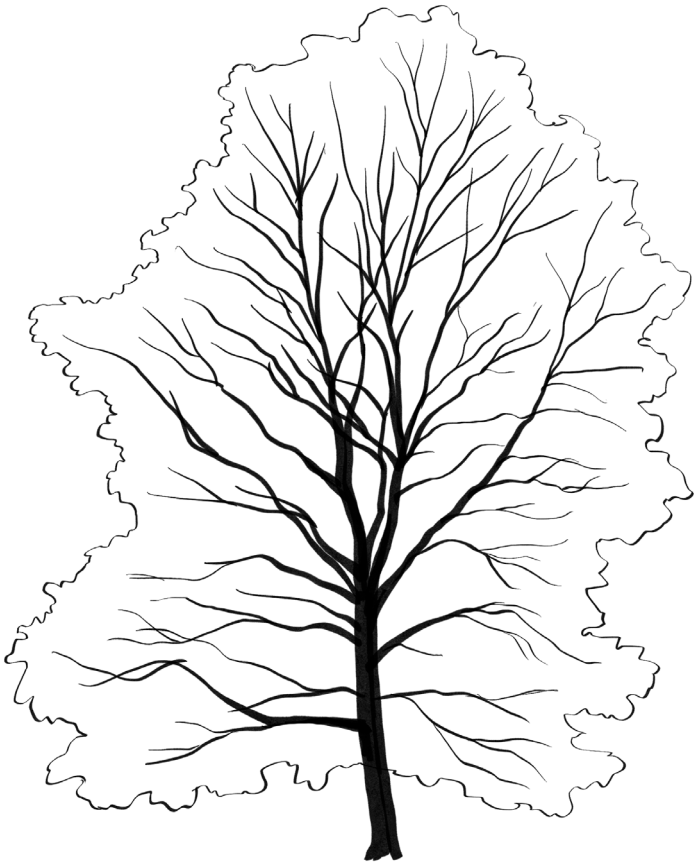
CULTIVARS Dura Heat® 'Moonshine' grows to be 45' x 35'; Fow Valley® 'Little King' only grows to be 15' x 15'; Heritage® 'Cully' named Society of Municipal Arborists' 2002 Urban Tree of the Year

NOTES & LIMITATIONS

This ornamental, adaptable species can be used for sites along streams and naturalized areas, as well as urban sites. Leaves may prematurely drop under drought conditions, may be susceptible to branch breakage, and chlorosis may be exhibited when growing in alkaline soil.

COMMON HORNBEAM

Carpinus betulus



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 35-60'

WIDTH 30-40'

GROWTH Slow - medium

FORM Pyramidal-oval to oval-rounded

FLOWER Catkins

FRUIT Green to brown nutlets in chain-like clusters

FOLIAGE Dark green turns to yellowish-green in fall

BARK Smooth, dark gray

PLANTING CONSIDERATIONS

PESTS Generally pest-free, but susceptible to Japanese beetle

TOLERATES Pollution, shearing

TRANSPLANT Difficult BR, easier B&B or CG

CULTIVARS 'Fastigiata' is more common than the species in commerce, develops a dense, pyramidal form; 'Globosa' is a rounded, dense and only grows 15-20' tall

NOTES & LIMITATIONS

This adaptable species is especially useful for hedging. However, its low branches may require pruning for street use, it may be susceptible to branch breakage, and it may have limited availability.

AMERICAN HORNBEAM

Carpinus caroliniana

ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Prefers partial shade, tolerates full sun and shade

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 20-30'

GROWTH Slow

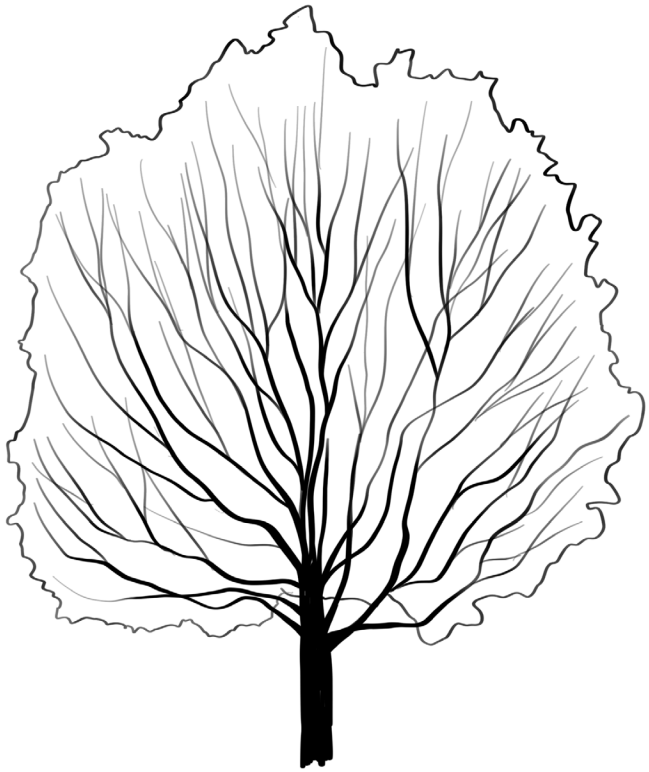
FORM Upright-spreading, round or flat-topped

FLOWER Pendulous clusters of 3-winged leafy bracts

FRUIT Small nutlets in pendulous clusters, green turns to brown in fall

FOLIAGE Dark green turns to brilliant red, yellow, or orange in fall

BARK Ornamental, smooth, gray, and irregularly fluted



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Flooding, pollution, poor drainage, shearing

TRANSPLANT Difficult B&B and BR, slow to establish

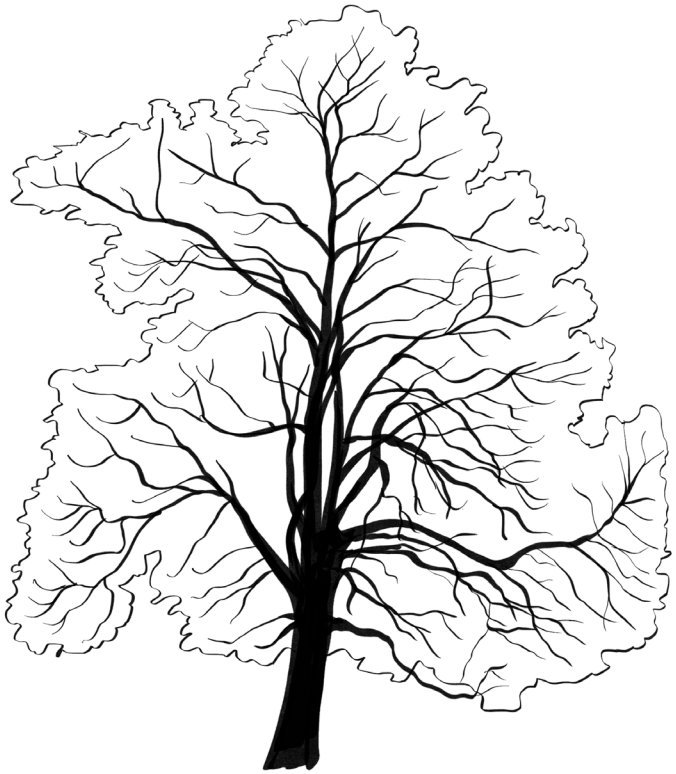
CULTIVARS Native Flame® 'JFS-KW6' is a top choice due to its dependable, excellent red fall color and upright form; Palisade® 'CCSQU' has a more narrow, oval, dense form; Rising Fire® 'Uxbridge' has a columnar form and vigorous growth rate

NOTES & LIMITATIONS

This native species is great for a variety of sites - in naturalized areas along streams, under utility lines, or along your yard as a hedge.

NORTHERN CATALPA

Catalpa speciosa



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 20-40'

GROWTH Medium - fast

FORM Irregular, open-rounded to narrow-oval

FLOWER Showy, white, bell-shaped in upright clusters with yellow and/or purple spots inside

FRUIT Thin, bean-like capsule, green turns to brown, persists through winter

FOLIAGE Bright green turns to poor yellow-green in fall

BARK Grayish-brown with scaly, flat ridges at maturity

PLANTING CONSIDERATIONS

PESTS Typically not serious, but susceptible to leaf spots, powdery mildew, twig blight, verticillium wilt

TOLERATES Drought, heat, poor drainage, pollution

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS Heartland® 'Hiawatha 2' has a more narrow, upright form; 'Pulverulenta' has speckled variegation on foliage

NOTES & LIMITATIONS

This species is both native and tolerant to the adverse conditions found in the urban environment, but has begun to cause concern related to invasive potential - recommended to not plant near natural settings where they could invade and to monitor. Fruit can be a litter issue, and it may have limited availability.

SUGAR HACKBERRY

Celtis laevigata

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 60-80'

WIDTH 50'

GROWTH Medium - fast

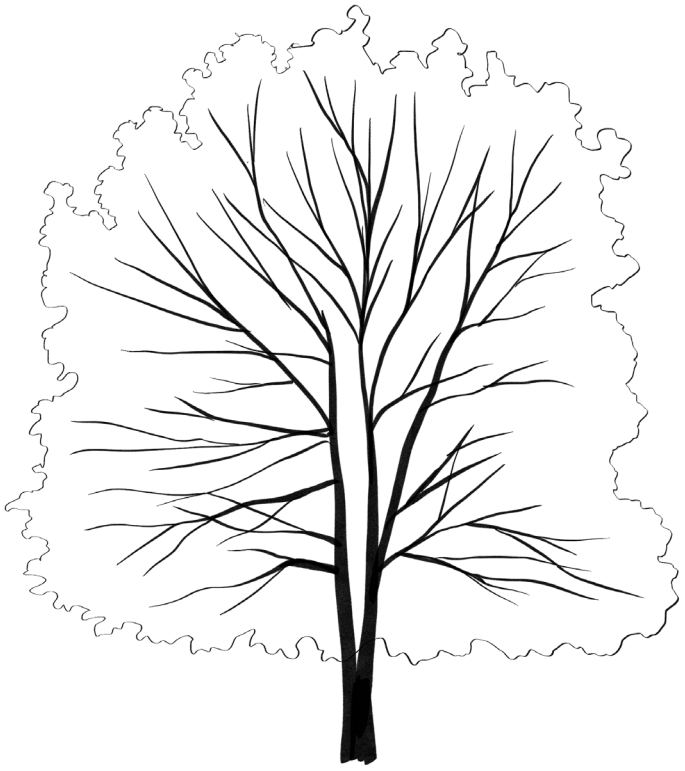
FORM Broadly rounded with spreading, pendulous branches

FLOWER Inconspicuous clusters

FRUIT Edible, small orange-red to blue-black drupes in fall

FOLIAGE Light green turns to unimpressive yellow in fall

BARK Light gray, can be smooth or covered with corky ridges



PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to ALB, scale, leaf spot; resistant to witches' broom & nipple gall

TOLERATES Drought, heat, salt, poor drainage, pollution, wind

TRANSPLANT B&B recommended, slow to establish

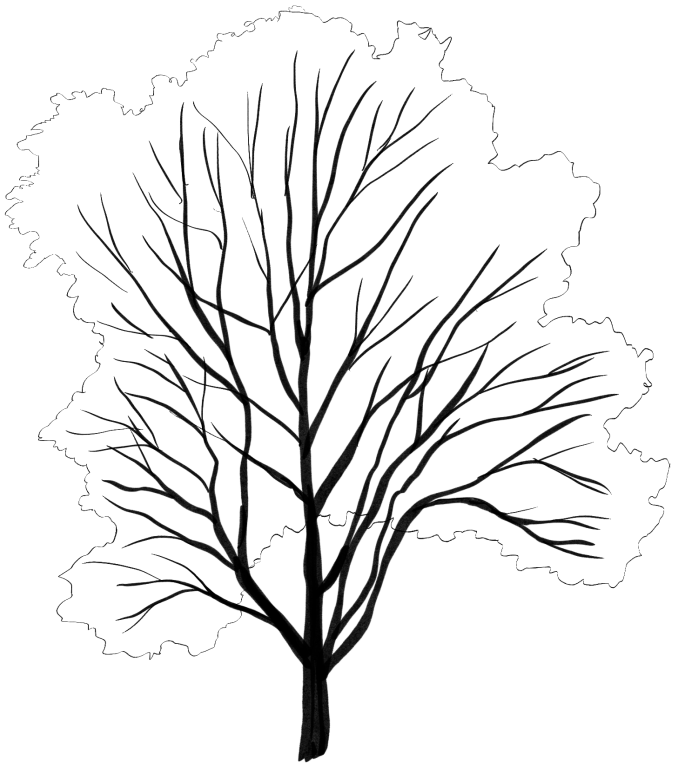
CULTIVARS May have limited availability: 'All Seasons' is slightly smaller and faster growing; 'Magnifica' is a *C. occidentalis* and *C. laevigata* hybrid, yields little to no fruit, and is resistant to leafhoppers

NOTES & LIMITATIONS

Although not known for its ornamental value, this native species is treasured for its adaptability to adverse conditions. Birds enjoy its fruit, which has a sweet, date-like taste.

COMMON HACKBERRY

Celtis occidentalis



ENVIRONMENTAL CONDITIONS

ZONE 3B

LIGHT Full sun, partial shade, shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 40-60'

GROWTH Medium - fast

FORM Pyramidal in youth, rounded at maturity with ascending-arching branches

FLOWER Small, greenish-yellow inconspicuous clusters

FRUIT Yellow or orange-red, fleshy drupe; edible, sweet date taste

FOLIAGE Medium green turns to yellow in fall

BARK Gray, rough and corky ridges, stems have zig-zag appearance

PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to ALB, witches broom, nipple gall, powdery mildew

TOLERATES Drought, flooding, heat, pollution, poor drainage

TRANSPLANT Difficult BR, B&B recommended, may be slow to establish

CULTIVARS 'Praire Pride' produces less fruit, does not develop witches broom or gall, has a compact uniform crown; Prairie Sentinel® 'JFS-KSU1' is 10' wide, great for street tree use

NOTES & LIMITATIONS

Great for large urban sites, this tolerant species' deep rooting tendency will rarely lift sidewalks and can help control soil erosion. May be susceptible to branch breakage, and its overall attractiveness can greatly vary.

KATSURA TREE

Cercidiphyllum japonicum

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates only occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 25-60'

GROWTH Medium - fast

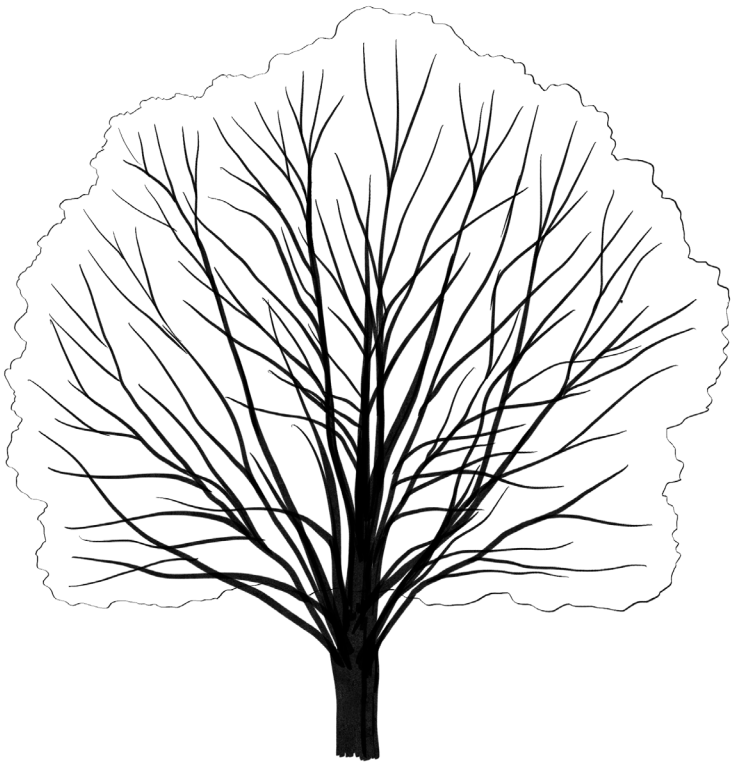
FORM Upright pyramidal in youth, rounded with age with a dense crown; single- and multi- stemmed forms

FLOWER Inconspicuous green flowers emerge before leaves in spring

FRUIT Small banana-shaped pods in clusters

FOLIAGE Emerging vibrant red-purple, blue-green in summer, outstanding yellow-orange in fall with a sweet scent

BARK Brown, slightly exfoliating with age



PLANTING CONSIDERATIONS

PESTS Susceptible to ALB; resistant to verticillium wilt

TOLERATES Flooding, poor drainage

TRANSPLANT Difficult

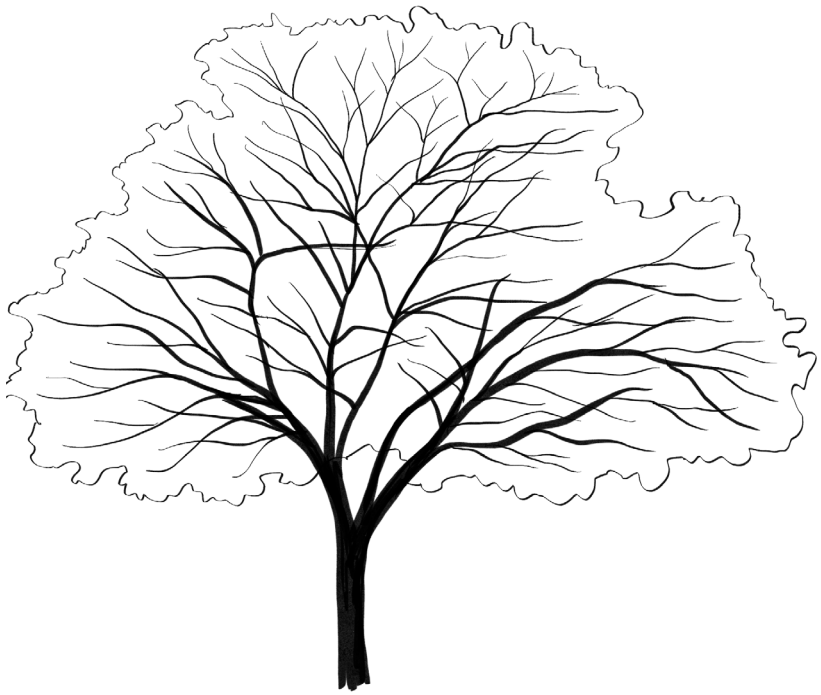
CULTIVARS 'Red Fox' and 'Rotfuchs' have red foliage and are slower growing than species; 'Amazing Grace' has weeping form, grows to be 25' tall, and more wide than high; 'Heronswood Globe' has globe-shaped form, grows to be 15' tall

NOTES & LIMITATIONS

This species boasts attractive bark, an elegant form, and excellent fall color that gives off a pleasant aroma. However, several management concerns may not make it the best suited for tough urban sites: may be susceptible to branch breakage, trunk can sunscald easily in youth, sensitive to drought, and requires ample moisture during establishment years. Provides prolific surface-roots.

EASTERN REDBUD

Cercis canadensis



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil, avoid any periods of saturated soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 25-35'

GROWTH Medium

FORM Rounded to vase-shaped; multi- stemmed or has low branching

FLOWER Showy and profuse, purple-pink, pea-like, bloom early spring

FRUIT Flat green pods, light green turns to brown

FOLIAGE Emerging glossy red-purple, dark green turns to greenish-yellow to golden in fall

BARK Gray-brown in youth, ornamental at maturity with dark brown scales exposing inner cinnamon color

PLANTING CONSIDERATIONS

PESTS Cankers and verticillium wilt can be serious when tree is stressed

TOLERATES Drought

TRANSPLANT B&B or CG recommended, BR may be moderately difficult, establishment can be difficult

CULTIVARS 'Appalachian Red' have beautiful bright pink flowers; 'Forest Pansy' suitable for zone 5b or 6, slightly smaller than species, slow growth rate; 'Northern Strain' is often more cold hardy; 'Alba' sometimes called Whitebud, has fast growth rate, lighter green foliage, white flowers

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2010 Urban Tree of the Year, this native species is known as the champion of all small, flowering landscape trees. Paying close attention to selecting proper choice of genetic material is recommended for survival in zones <6a.

ATLANTIC WHITE CEDAR

Chamaecyparis thyoides

ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 10-20'

GROWTH Medium

FORM Narrowly columnar

FLOWER Not ornamentally important

FRUIT Small brown cones

FOLIAGE Blueish-green needles turn bronze in winter and persist

BARK Light gray to reddish-brown, irregularly furrowed

PLANTING CONSIDERATIONS

PESTS Generally pest-free

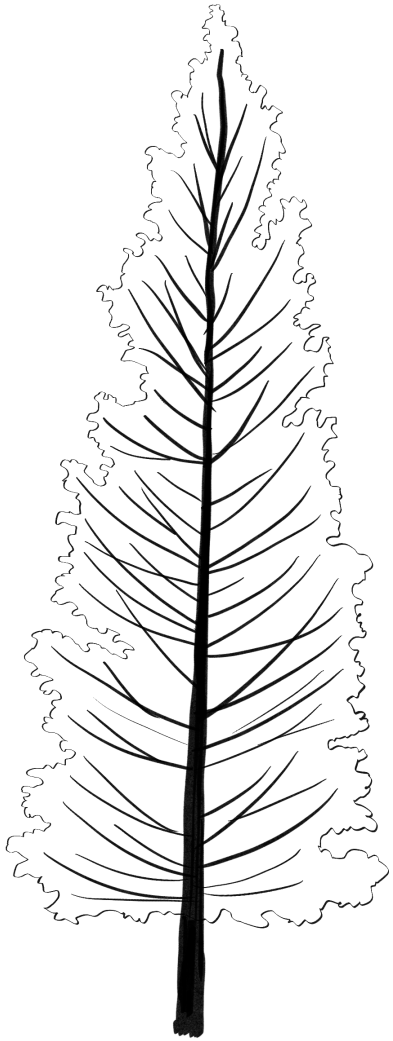
TOLERATES Flooding, poor drainage

TRANSPLANT Difficult BR

CULTIVARS 'Andelyensis' has a wide pyramidal habit, grows to be 10' tall, and has purple needles in winter; 'Aurea' has a dense, conical form and grows to be 15' tall; 'Red Star' has a compact, dense columnar form, with red or purple needles in winter

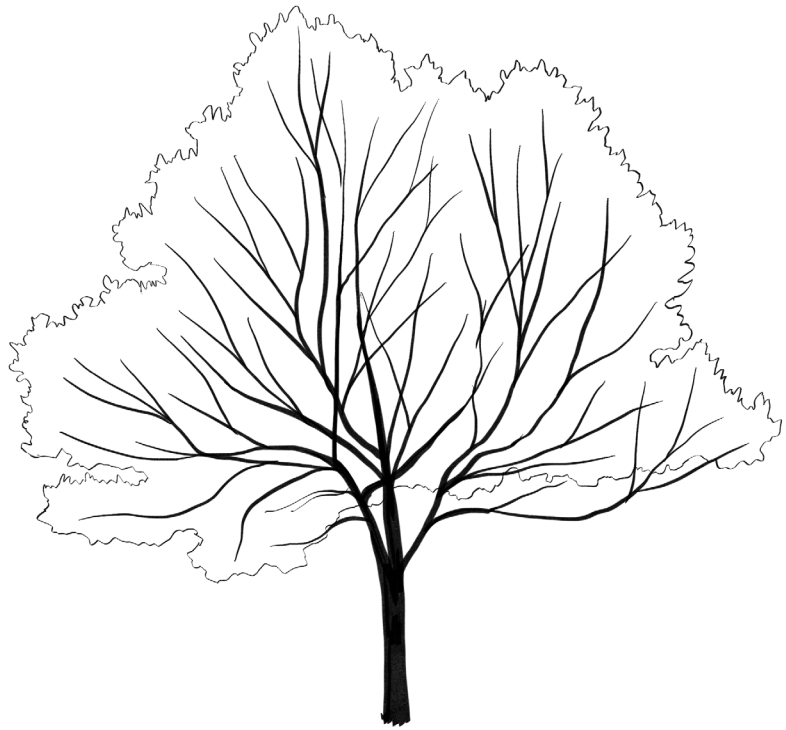
NOTES & LIMITATIONS

This native evergreen is especially useful for coastal or wet planting sites. It typically does best with protection from strong winds and deer browsing, and it may have limited availability.



WHITE FRINGETREE

Chionanthus virginicus



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade, shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 15-25'

WIDTH 10-25'

GROWTH Slow

FORM Varies from irregular and open to dense and rounded; often multi-stemmed

FLOWER Showy white, slightly fragrant, fringe-like, low-hanging

FRUIT Blue-black, olive-like

FOLIAGE Medium to dark green turns to excellent yellow-green-brown in fall

BARK Light gray-brown, smooth in youth to slightly ridged in maturity

PLANTING CONSIDERATIONS

PESTS Generally pest-free, but reportedly susceptible to Emerald Ash Borer

TOLERATES Drought, flooding, poor drainage, pollution

TRANSPLANT Possibly difficult; small B&B or CG recommended

CULTIVARS 'Emerald Knight' (male) has long glossy green foliage and upright form, 15-20' high; 'Spring Fleecing' (male) has a loose, graceful form with shiny dark green leaves and abundant flowers; Prodigy® 'CVSTF' has a rounded form with many cloud-like white flowers

NOTES & LIMITATIONS

Although this tree's traits are reportedly quite variable within the species, it typically is adaptable and requires little maintenance once established.

YELLOWWOOD

Cladrastis kentukea

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 30-50'

WIDTH 40-55'

GROWTH Medium - fast

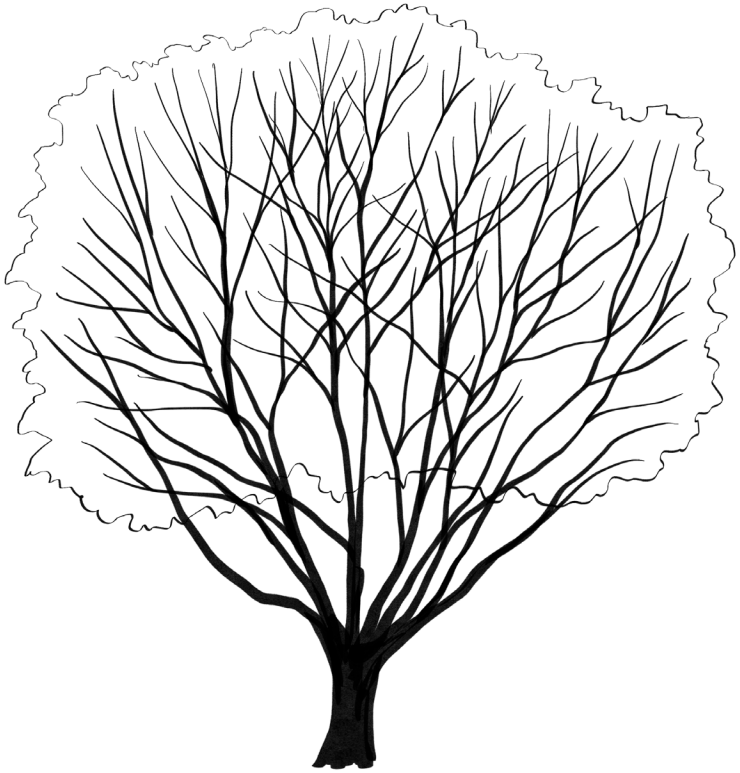
FORM Broad-rounded with low, gracefully arching branches

FLOWER Clusters of fragrant, showy white pea-like flowers; blooms heavily every 2-3 years

FRUIT Flat seed pods, green ripens to brown in fall

FOLIAGE Bright green in summer turns to brilliant yellow in fall with sweet scent

BARK Ornamental, smooth light gray



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Variety of soil conditions

TRANSPLANT B&B or ≤2" caliper BR recommended

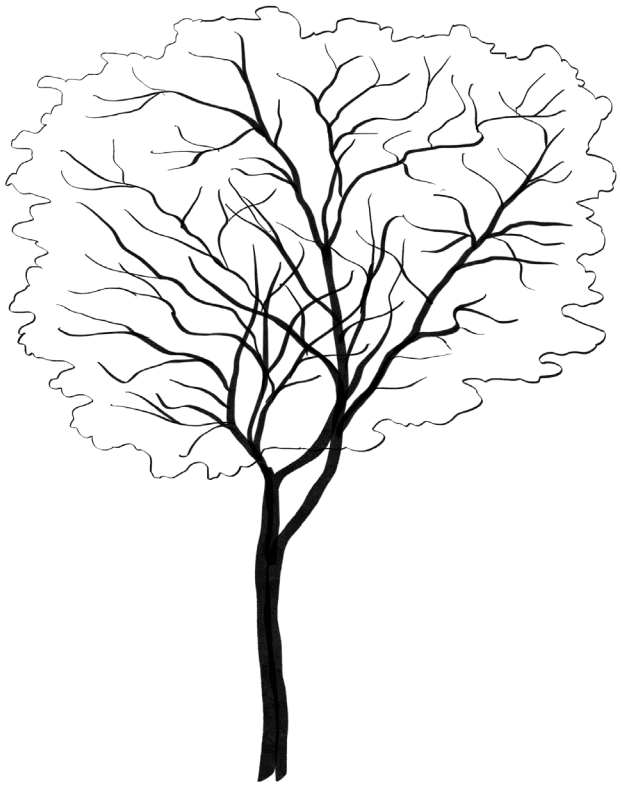
CULTIVARS 'Rosea', also known as 'Perkins Pink', has a pink flowering form, notable drought tolerance, but may be hard to find

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2015 Urban Tree of the Year, this native species makes an attractive addition to the landscape. It may be susceptible to branch breakage, and its thin bark is sensitive to damage and sun scald.

JAPANESE CLETHRA

Clethra barbinervis



ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Prefers partial shade

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry or saturated soil

CHARACTERISTICS

HEIGHT 10-20'

WIDTH 10-20'

GROWTH Fast

FORM Rounded; grown both as a small tree or a multi-stemmed shrub

FLOWER Showy, slightly fragrant, white flowers; attracts butterflies

FRUIT Small capsules, turn brown in fall

FOLIAGE Dark green turns to bronze-red in fall

BARK Ornamental, rich gray-brown to cinnamon- brown, smooth, exfoliating

PLANTING CONSIDERATIONS

PESTS Mites can be an issue in hot, dry environments

TOLERATES Flooding, salt

TRANSPLANT B&B or CG recommended, may be slow to establish

CULTIVARS First Snow® 'Takeda Nishiki' has variegated foliage and polished, tricolored bark

NOTES & LIMITATIONS

This ornamental species is most successful when planted in a moist, shady location. It may have limited availability, and may experience twig tip dieback during its first winter.

KOUSA DOGWOOD

Cornus kousa

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 15-30'

WIDTH 15-30'

GROWTH Slow

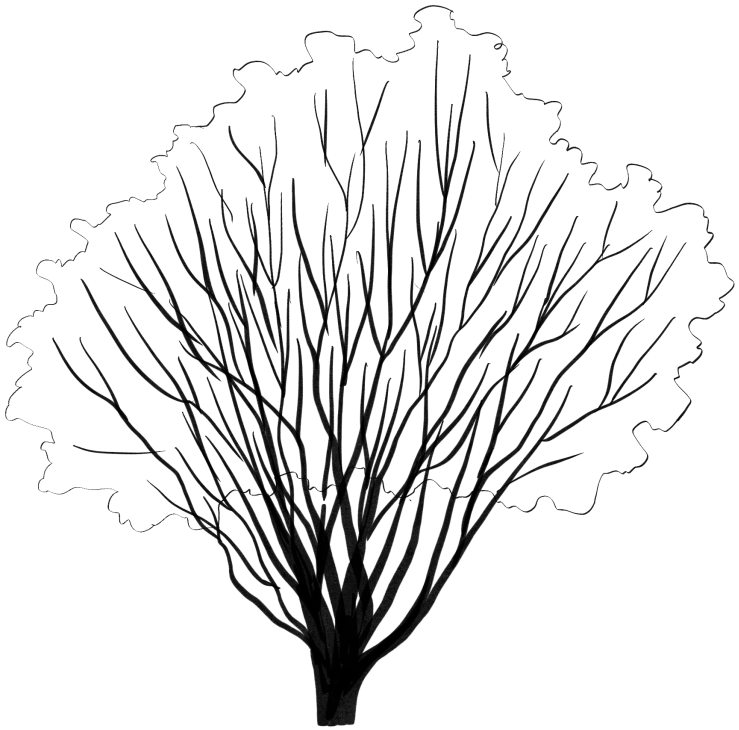
FORM Vase-shaped with upright branches in youth, rounded with horizontal, layered branches at maturity

FLOWER Small, greenish-yellow, upright flowers held by four large, showy creamy white bracts

FRUIT Potentially showy, red, raspberry-like, edible

FOLIAGE Dark green turns to impressive deep red or red-purple

BARK Variable, but often ornamental; exfoliates to reveal mix of gray-tan and mahogany brown inner bark



PLANTING CONSIDERATIONS

PESTS Resistant to dogwood anthracnose

TOLERATES Variety of soil conditions

TRANSPLANT Moderately easy

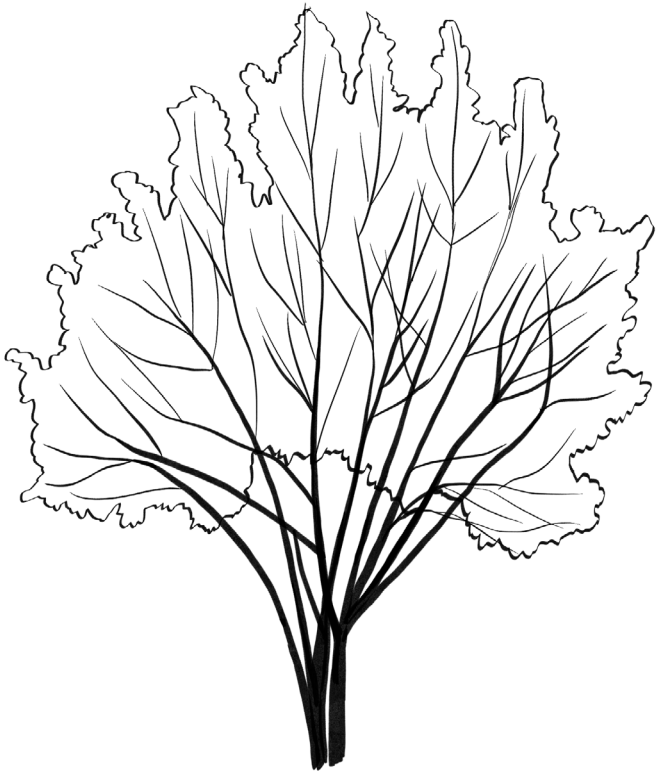
CULTIVARS Many available: common cultivars with shorter height and colorful flower displays include 'Milky Way', 'Satomi', and 'Beni Fuji'

NOTES & LIMITATIONS

This ornamental species is reportedly resistant to the many pests that the *Cornus* spp. is susceptible to, and is more adaptable to a variety of dificult soil conditions. May require pruning for street use.

CORNELIANCHERRY DOGWOOD

Cornus mas



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 15-25'

WIDTH 15-20'

GROWTH Slow - medium

FORM Rounded to oval with a short trunk and spreading, upright branching; often multi-stemmed

FLOWER Showy, small yellow flowers emerge in early spring

FRUIT Bright red, edible, cherry-like fruit

FOLIAGE Glossy, dark green in summer turns to green-yellow with purplish-red highlights in fall

BARK Ornamental brown and gray, exfoliating

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Salt

TRANSPLANT B&B or ≤2" caliper BR recommended, may be slow to establish

CULTIVARS 'Golden Glory' has a more narrow and upright form, more abundant flowers, larger leaves and fruit, but may be less cold hardy; Saffron Sentinel™ 'JFS PN4Legacy' has a columnar form

NOTES & LIMITATIONS

A beautiful, adaptable dogwood that is reportedly underutilized in the landscape. Although fruit can be a litter issue, it is valuable to birds and can be used for syrups and preserves. Proper pruning can help to better reveal exfoliating bark and make it more suitable for street use.

FLOWERING DOGWOOD HYBRIDS

Cornus x rutgersensis (C. florida x C. kousa)

ENVIRONMENTAL CONDITIONS

ZONE Varies 5A - 6A

LIGHT Full sun, partial shade, shade

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 10-20'

WIDTH 10-20'

GROWTH Medium - fast

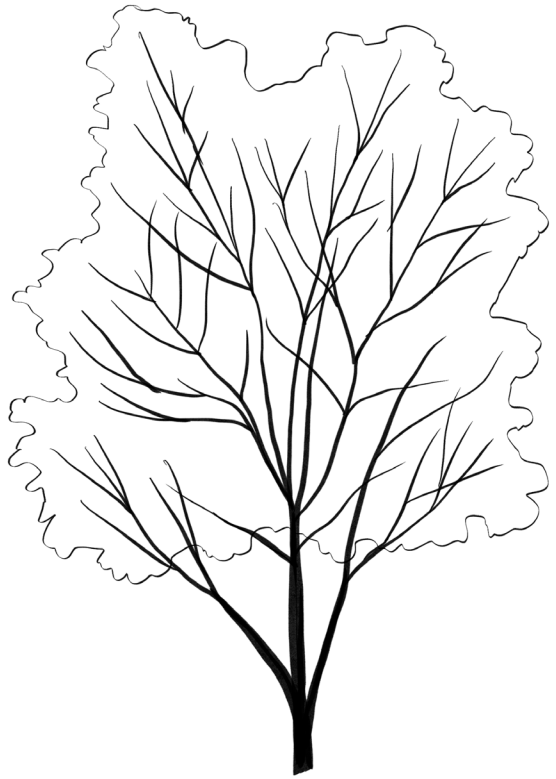
FORM Varies; typically dense and upright

FLOWER Showy, clusters in center of four white or pink bracts

FRUIT Clusters of bright red fruit ripen in fall

FOLIAGE Dark green turns to variable, often great fall color

BARK Gray-brown



PLANTING CONSIDERATIONS

PESTS Resistant to powdery mildew, dogwood borer, and dogwood anthracnose

TOLERATES Varies

TRANSPLANT Moderately easy

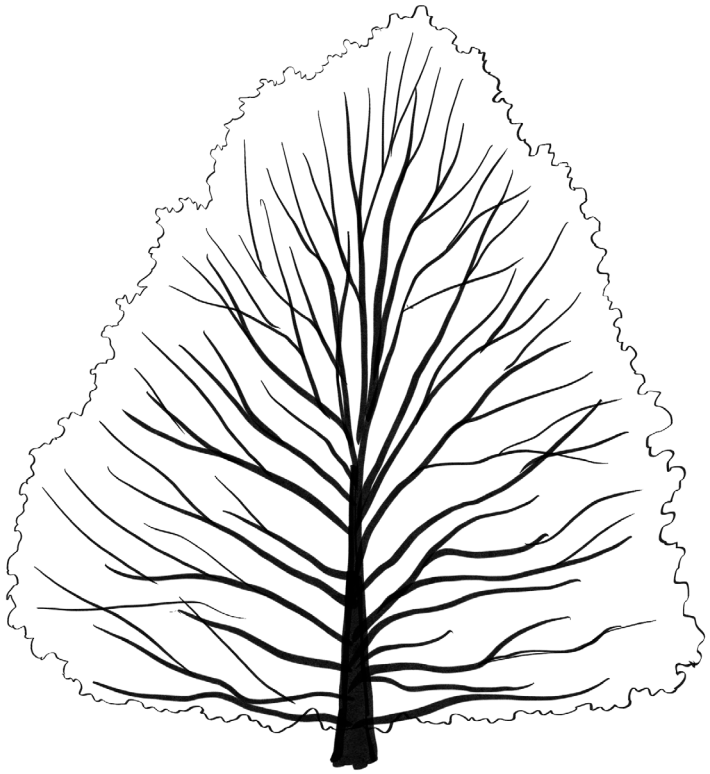
CULTIVARS The Stellar® Series, from Rutgers University, all show good resistance to powdery mildew and dogwood anthracnose: Aurora®, Celestial®, Constellation®, Stellar Pink®, Ruth Ellen®, and Stardust®

NOTES & LIMITATIONS

Popular in the landscape due to its outstanding ornamental traits, this species is susceptible to numerous pests and diseases. The use of resistant cultivars is strongly recommended; listed here are several improved hybrids from Rutgers University.

TURKISH FILBERT

Corylus colurna



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 40-50'

WIDTH 15-35'

GROWTH Medium

FORM Broadly pyramidal with strong central leader

FLOWER Inconspicuous

FRUIT Small, edible nuts inside fringed husks

FOLIAGE Dark green in summer may turn to yellow or purple-red in fall, but often drop yellow-green

BARK Pale gray-brown bark exfoliates with age, exposing orange-brown inner bark

PLANTING CONSIDERATIONS

PESTS Eastern filbert blight can occasionally be a serious issue

TOLERATES Drought, heat, pollution

TRANSPLANT BR may be difficult, B&B is recommended, may be slow to establish

CULTIVARS -

NOTES & LIMITATIONS

Although well-suited for urban environments, watering is essential during establishment. This species' fruit can be a litter issue, and it may have limited availability.

AMERICAN SMOKETREE

Cotinus obovatus

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-30'

GROWTH Medium

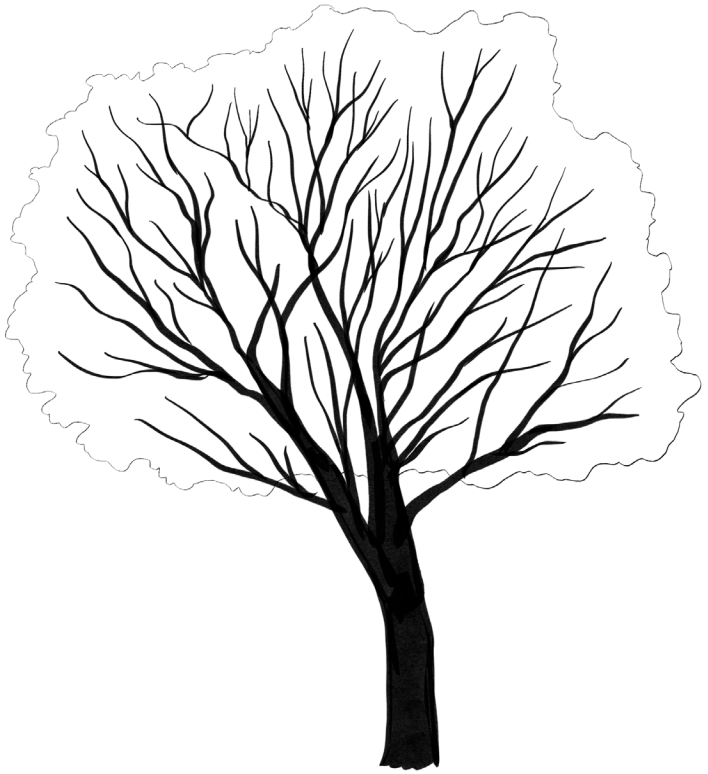
FORM Oval to rounded, low branching and absent central leader creates short trunk; single-stem form is rare

FLOWER Green to purple pyramidal

FRUIT Often sparse, but attractive tan clusters; silky hairs give 'smoky' appearance

FOLIAGE Emerging bright light green, blue-green turns to showy yellow-orange-red or red-purple in fall

BARK Attractive gray to gray-brown, scaly with age; stems often orange



PLANTING CONSIDERATIONS

PESTS Verticillium wilt

TOLERATES Drought

TRANSPLANT Difficult B&B or BR

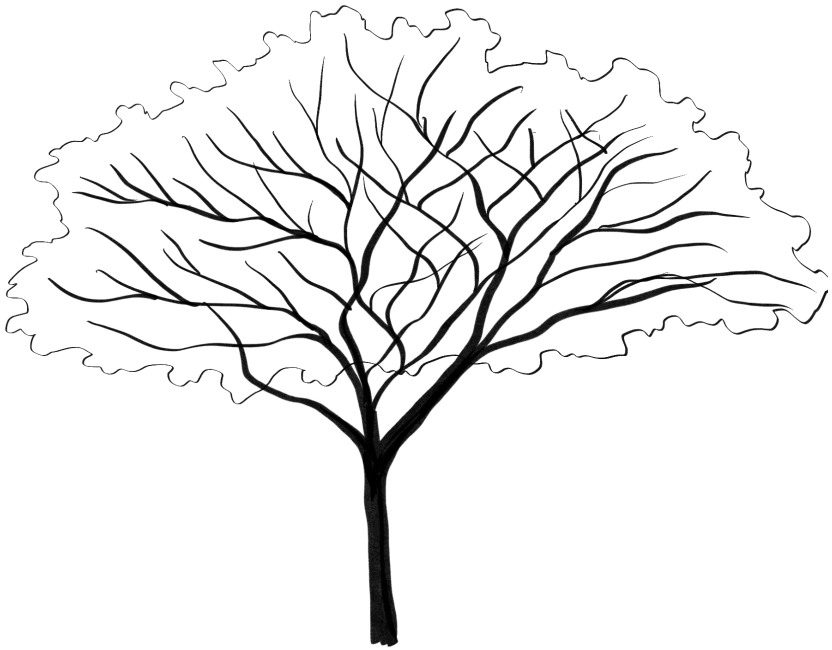
CULTIVARS 'Grace' and 'Red Leaf' may have limited availability

NOTES & LIMITATIONS

Although this native species' low branching may require pruning for street use, its impressive drought tolerance make it a promising choice for urban landscapes.

THORNLESS COCKSPUR HAWTHORN

Crataegus crus-galli var. inermis



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 20-35'

GROWTH Medium

FORM Rounded, with horizontally spreading branched; single- and multi-stemmed forms

FLOWER Showy white clusters, unpleasant odor, short-lived bloom

FRUIT Showy clusters of bright red berry-like fruit, persist into late fall or winter

FOLIAGE Glossy dark green turn to showy orange or red in fall

BARK Silvery-gray

PLANTING CONSIDERATIONS

PESTS Susceptible to many- aphids, scales, fireblight, leaf blight, mildews, rusts

TOLERATES Drought, heat, salt, pollution

TRANSPLANT B&B and BR difficult, may be slow to establish

CULTIVARS Crusader™ 'Cruzam' known for disease resistance, 15' x 15' wide

NOTES & LIMITATIONS

This species boasts a strong adaptability to adverse conditions; its thornless variety is recommended for areas with foot traffic.

WINTER KING HAWTHORN

Crataegus viridis 'Winter King'

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 20-30'

GROWTH Slow - medium

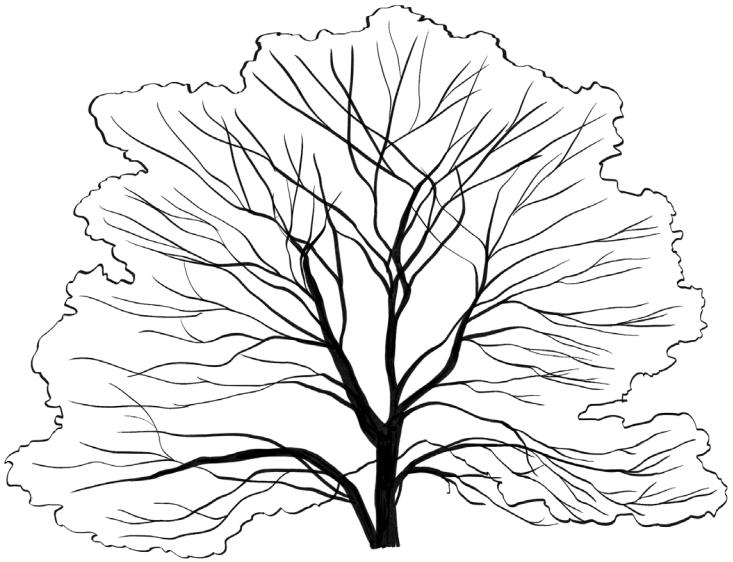
FORM Rounded, vase-shaped branching

FLOWER Showy white clusters

FRUIT Showy, bright red, persists through winter

FOLIAGE Glossy green turns to variable, yet excellent, fall color, often purple-red or gold

BARK Thorny; ornamental, gray, exfoliates with age to expose orange-brown inner bark



PLANTING CONSIDERATIONS

PESTS Shows good resistance to cedar-hawthorn rust, less susceptible to pests than the *Crataegus* species

CULTIVARS Information is cultivar-specific

TOLERATES Salt, shearing

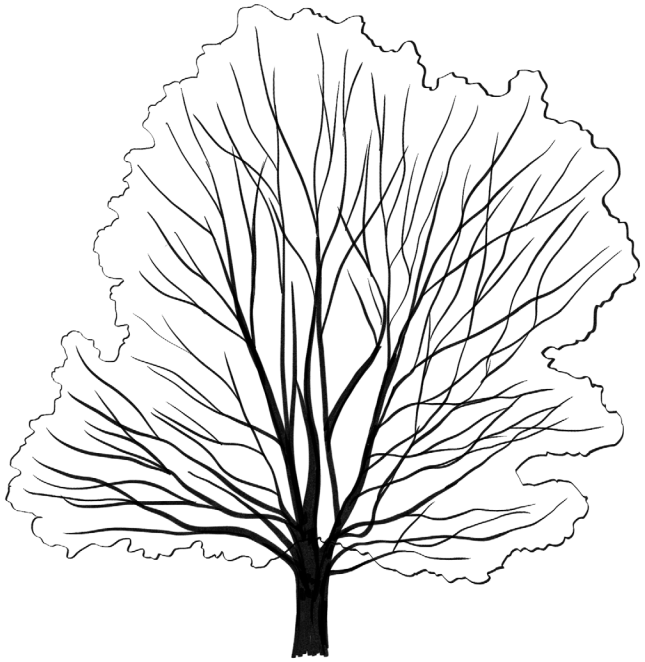
TRANSPLANT Difficult B&B or BR, somewhat slow to establish

NOTES & LIMITATIONS

'Winter King' is the most common (and beloved) *C. viridis* cultivar, making a beautiful addition to the landscape. However, thorns should be considered in relation to planting location before selection.

HARDY RUBBER TREE

Eucommia ulmoides



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade, shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 40-60'

GROWTH Medium

FORM Sparse branching in youth, dense and rounded to broad and spreading at maturity

FLOWER Inconspicuous blooms

FRUIT Small winged capsules

FOLIAGE Attractive glossy dark green turns pale yellow-green in early fall

BARK Gray-brown, ridged and furrowed at maturity

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, heat, pollution, poor drainage

TRANSPLANT Easy B&B

CULTIVARS Emerald Point™ 'Empozam' has a columnar to narrow oval form, with smaller, heavily textured leaves

NOTES & LIMITATIONS

Although this species is quite adaptable, it reportedly is rarely used in urban plantings, possibly due to its limited availability. Requiring overall little maintenance, it would make a great addition to a landscape.

GINKGO

Ginkgo biloba

ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 50-80'

WIDTH 30-40'

GROWTH Slow

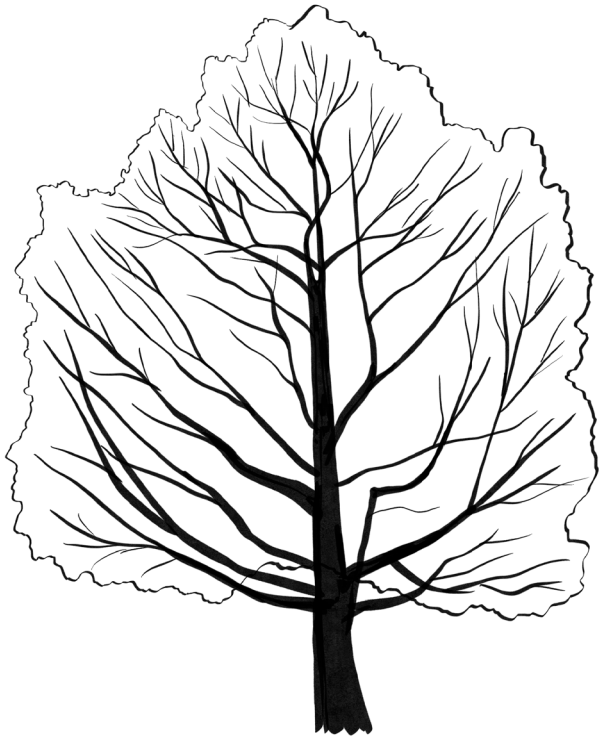
FORM Sparse and irregular in youth, dense and pyramidal in maturity often with large, spreading branches

FLOWER Inconspicuous

FRUIT Noxious smelling on female trees

FOLIAGE Bright green turns to brilliant yellow in fall

BARK Light gray-brown, ridged



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, heat, pollution, salt, wind and snow damage

TRANSPLANT Difficult BR, B&B recommended

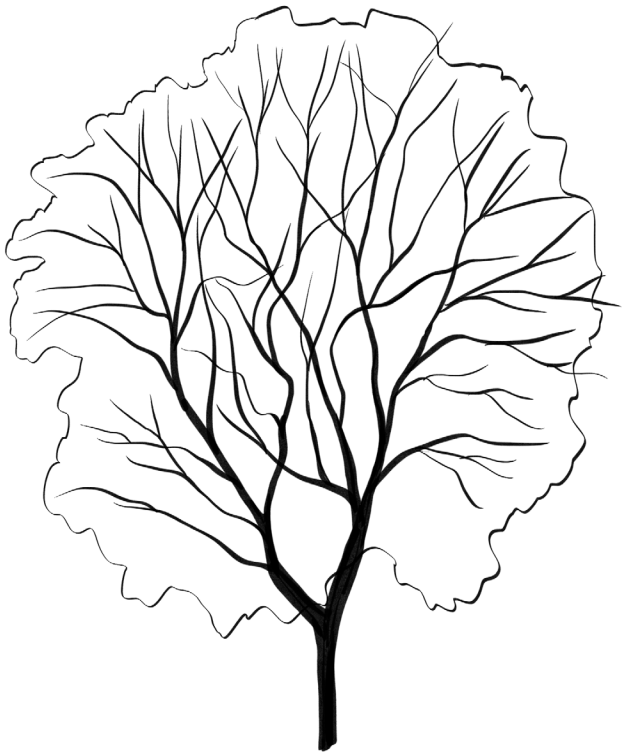
CULTIVARS 'Fastigiata' has an upright, columnar form; 'Autumn Gold' (male) has a broad-spreading habit; Golden Colonnade™ 'JFS-UGA2' (male) has a narrow, columnar form and strongly ascending branches; 'Princeton Sentry' has an upright habit, named Society of Municipal Arborists' 1996 Urban Tree of the Year

NOTES & LIMITATIONS

This species is iconic for not only its fan-shaped leaves, but its adaptability to adverse conditions. Choosing male species is strongly recommended, as female trees produce noxious smelling fruit. May be over-planted.

THORNLESS HONEYLOCUST

Gleditsia triacanthos var. inermis



ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-80'

WIDTH 30-70'

GROWTH Fast

FORM Graceful, oval to rounded, upright-spreading to almost horizontal branching

FLOWER Not ornamentally important

FRUIT Long, flat brown pods

FOLIAGE Glossy light green turns to showy yellow in fall, drop early

BARK Ornamental dark gray-brown with plate-like patches separated by furrows at maturity

PLANTING CONSIDERATIONS

PESTS Overuse has encouraged severe issues: borers, leaf spot, webworm, powdery mildew, cankers

TOLERATES Drought, flooding, salt, pollution, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS Street Keeper® 'Draves' is narrow, tightly pyramidal, great for street use; Imperial® 'Impcole' grows to be less than 30' tall; Skyline® 'Skycole' is common, great for street use, named Society of Municipal Arborists' 1999 Urban Tree of the Year

NOTES & LIMITATIONS

Although possibly already over-planted, this native species is quite adaptable and attractive; its thornless variety is recommended for areas with foot traffic.

KENTUCKY COFFEETREE

Gymnocladus dioicus

ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 50-75'

WIDTH 40-50'

GROWTH Medium

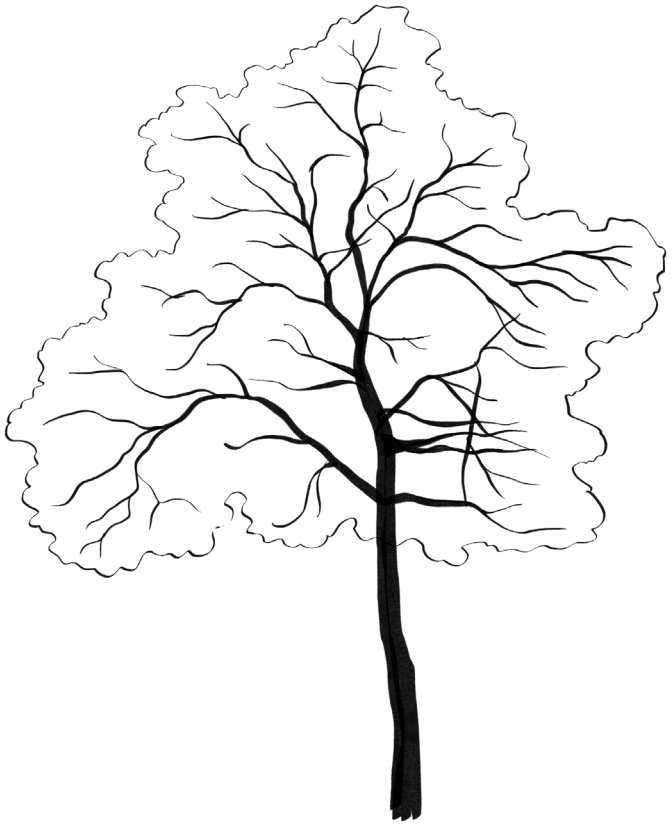
FORM Sparse branching in youth, oval to vase shaped at maturity, upward arching branches

FLOWER Greenish-white pyramidal clusters

FRUIT Leathery, brownish-black pods persist through winter

FOLIAGE Emerging pinkish-purple, blue-green turns to potentially good fall yellow

BARK Gray-brown to dark brown, rough, with thin and scaly ridges curling out to expose orange-brown



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, salt

TRANSPLANT B&B or ≤2" caliper BR, slow to establish

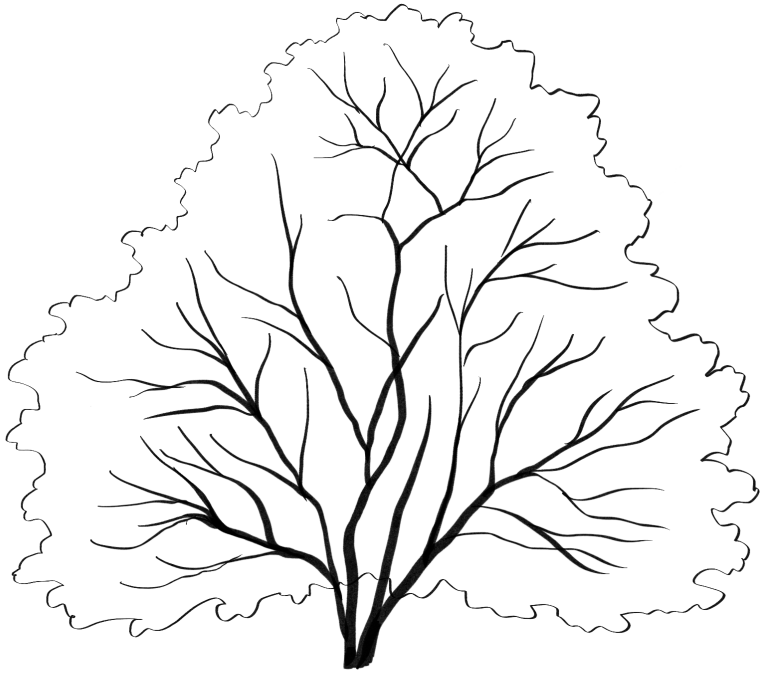
CULTIVARS 'Stately Manor' is noted as the best of the male non-fruiting cultivars, grows to be 40' x 35'; Espresso™ 'Espresso-JFS' and Titan® 'J.C. McDaniel' are also male non-fruiting form

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2006 Urban Tree of the Year, this reportedly underutilized species can tolerate extremely adverse conditions. The pods on female species can be a litter issue.

CAROLINA SILVERBELL

Halesia carolina



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade, shade

SOIL PH ≤7.0

MOISTURE Intolerant of periods of dry soil

CHARACTERISTICS

HEIGHT 20-40'

WIDTH 20-35'

GROWTH Medium

FORM Rounded, with low branches, often multi-stemmed; single-stemmed specimens are pyramidal to oval

FLOWER Showy white, bell-shaped and in clusters

FRUIT Oval with four wings

FOLIAGE Dark green turns to yellow-green in fall

BARK Brown in youth, gray-brown-black and striated at maturity

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Salt, pollution

TRANSPLANT Difficult, CG recommended over B&B

CULTIVARS 'UConn Wedding Bells' is more compact, heavier flowering; 'Rosy Ridge' and 'Arnold Pink' have beautiful pink flowers

NOTES & LIMITATIONS

Especially useful for plantings along streams and in naturalized areas, this uncommon species is valued for its beautiful flowers. Not well-suited for tough sites; may exhibit chlorosis when growing in alkaline soil.

WITCHHAZEL

Hamamelis virginiana

ENVIRONMENTAL CONDITIONS

ZONE 3B

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates only very occasional periods of dry soil

CHARACTERISTICS

HEIGHT 10-30'

WIDTH 15-20'

GROWTH Slow - medium

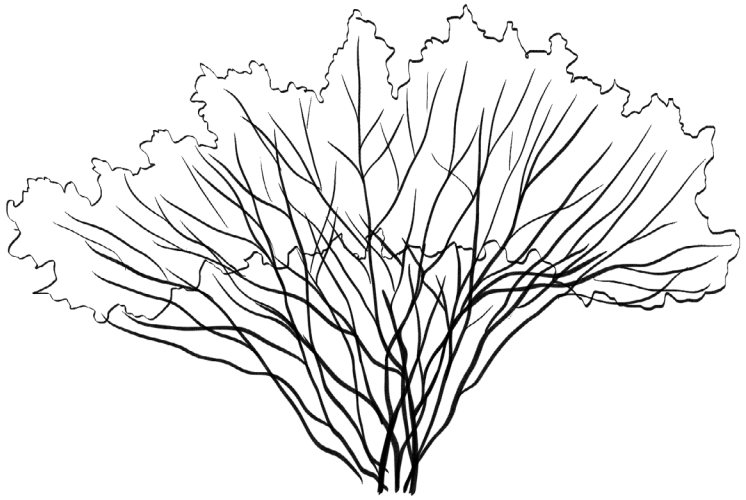
FORM Short trunk with spreading, crooked branches; grown as a small tree or multi-stemmed shrub

FLOWER Fragrant, yellow, blooms in fall

FRUIT Woody capsule containing 2-4 seeds

FOLIAGE Bright to dark green turns to brilliant yellow in fall

BARK Smooth, gray to gray-brown



PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to insect galls and Japanese beetles on foliage

TOLERATES Salt, poor drainage, pollution

TRANSPLANT B&B or CG recommended

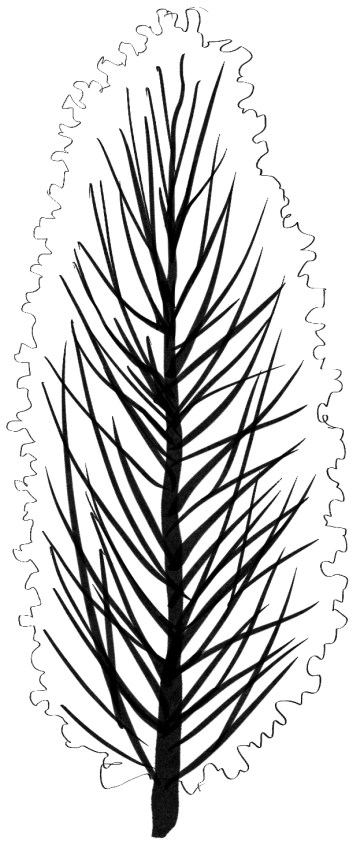
CULTIVARS 'Green Thumb' is variegated, 8' x 8'; 'Lemon Lime' is also variegated; 'Harvest Moon' has showier flowers and grows to be 18' in height

NOTES & LIMITATIONS

This native species provides fragrant flowers to the landscape each fall, and although it is sensitive to drought, it has been shown to be otherwise quite adaptable.

EASTERN RED CEDAR

Juniperus virginiana



ENVIRONMENTAL CONDITIONS

ZONE 3B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 40-50'

WIDTH 8-20'

GROWTH Medium

FORM Densely columnar to broad-pyramidal

FLOWER Male flowers are yellow, females are green, blooms in late winter

FRUIT Waxy, bluish cones

FOLIAGE Medium green needles turn bronze in winter

BARK Reddish-brown, exfoliates in long strips

PLANTING CONSIDERATIONS

PESTS Susceptible to mites, bagworms, phomopsis blight, cedar-apple rust

TOLERATES Drought, salt, pollution, shearing

TRANSPLANT B&B or CG recommended

CULTIVARS 'Burkii', 'Canaertii', 'Grey Owl', and 'Emerald Sentinel' are all lower-growing, 'Pendula' refers to many cultivars, all of which have spreading limbs and pendulous branchlets

NOTES & LIMITATIONS

This native evergreen can thrive under a wide variety of conditions, from urban sites to naturalized areas along the coast.

GOLDENRAIN TREE

Koelreuteria paniculata

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 30-40'

WIDTH 30-40'

GROWTH Medium - fast

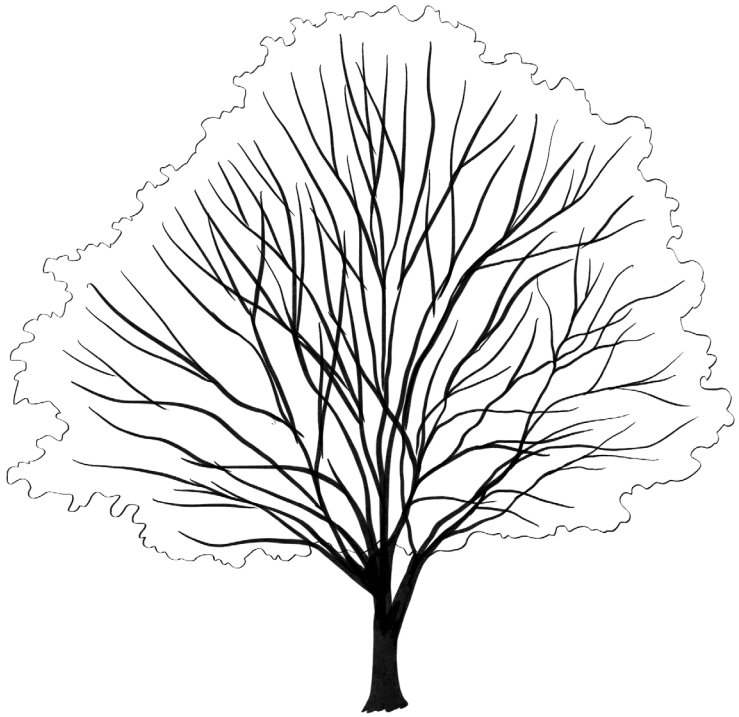
FORM Rounded with upright-spreading, often sparse branches

FLOWER Showy yellow flowers in large, upright pyramidal clusters

FRUIT Papery capsules, green turns to yellow then to brown, persists through winter

FOLIAGE Emerging purplish-red, bright or dark green turns to golden, yellow, or yellow-green in fall

BARK Light gray-brown, ridged and furrowed



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, heat, salt, pollution

TRANSPLANT Easy B&B or ≤2" caliper BR

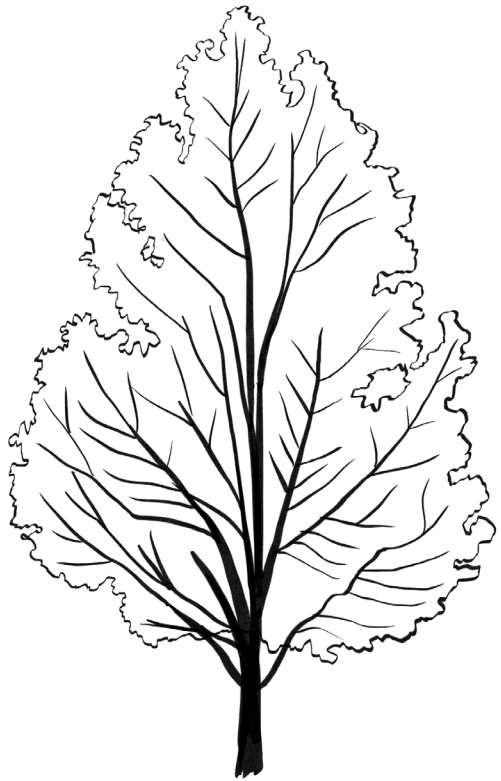
CULTIVARS 'September' is hardy to zone 6a, provides late summer/ fall flowering; 'Fastigiata' grows 25' x 4-6', making it useful near utility, but less ornamental

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2011 Urban Tree of the Year, this impressive urban species has begun to cause concern related to invasive potential - recommended to not plant near natural settings, where they could invade, and to monitor.

AMERICAN SWEETGUM

Liquidambar styraciflua



ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry or saturated soil

CHARACTERISTICS

HEIGHT 50-75'

WIDTH 40-65'

GROWTH Medium - fast

FORM Pyramidal in youth, oval to rounded at maturity

FLOWER Small, green, inconspicuous

FRUIT Woody, pendulous, burr-like and contain small seeds in capsules

FOLIAGE Glossy green turns to variable but excellent yellow, orange, red, and purple

BARK Gray-brown, with rough, deep furrows

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Flooding, poor drainage

TRANSPLANT B&B recommended over BR, may be slow to establish

CULTIVARS Emerald Sentinel® 'Clydesform' is ideal for street-use with a narrow and compact form, slow growing; 'Moraine' is commonly used, has a upright rounded habitat and great red fall color

NOTES & LIMITATIONS

Boasting excellent fall foliage, this common native species is especially useful for planting along streams. Although it has been shown to tolerate dry soils, it may not be well-suited to tough sites, as its fruit can be a litter issue, and it may exhibit chlorosis when growing in alkaline soil.

TULIPTREE

Liriodendron tulipifera

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates only occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 70-90'

WIDTH 35-50'

GROWTH Fast

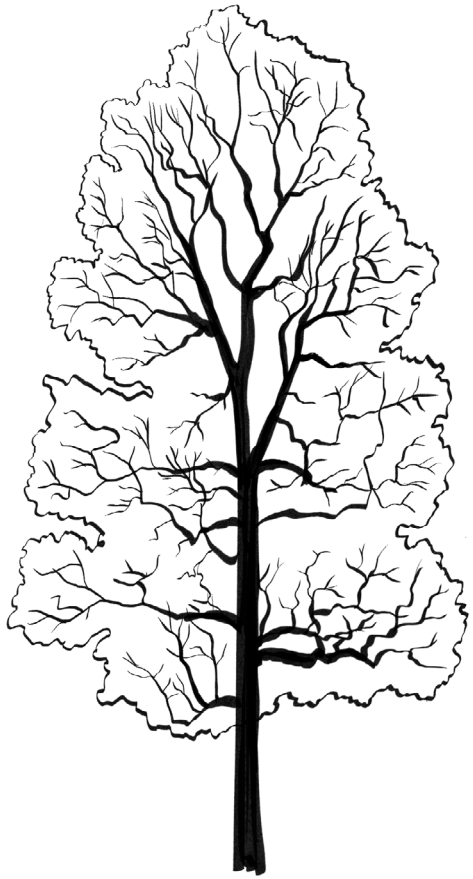
FORM Pyramidal in youth, oval-rounded at maturity

FLOWER Showy, tulip-shaped, yellow-green petals with an orange base

FRUIT Cone-shaped clusters of woody samaras, persists through winter

FOLIAGE Bright green turns to nice golden-yellow in fall

BARK Ornamental, gray, furrowed with round to flat ridges



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Flooding, poor drainage

TRANSPLANT Difficult B&B or BR, small caliper B&B recommended

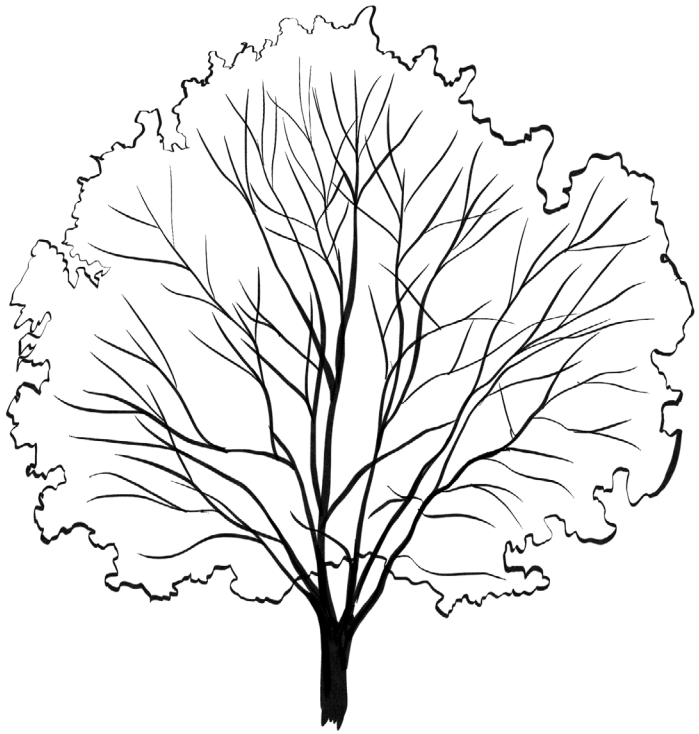
CULTIVARS May have limited availability: 'Fastigiatum' and 'Arnold' have a more narrow form, grows to be 50-60' tall and 15-25' wide; 'Aureomarginatum' has ornamental, variegated foliage; Emerald City® 'JFS-Oz' is more straight and upright

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2018 Urban Tree of the Year; this species is sensitive to drought, and it may be susceptible to branch breakage, yet it still makes a great addition to almost any large, urban site.

AMUR MAACKIA

Maackia amurensis



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 20-30'

GROWTH Slow

FORM Symmetrical, rounded crown, upright-arching branches

FLOWER Small, dull white, pea-like flowers in upright clusters, may not bloom well every year

FRUIT Flat pods turn from green to brown

FOLIAGE Gray-green turns to yellow to brown in fall

BARK Ornamental, amber to copper color, shiny and exfoliating in curls

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, salt, pollution

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS 'MaacNificent' is slightly larger, with a spike-like racemens of white flowers and silvery-green foliage, known for being vigorous

NOTES & LIMITATIONS

This small, adaptable species may have limited availability, but is a good selection for small, urban areas and landscapes alike.

THORNLESS OSAGE ORANGE

Maclura pomifera var. *inermis*

ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 20-50'

WIDTH 20-50'

GROWTH Fast

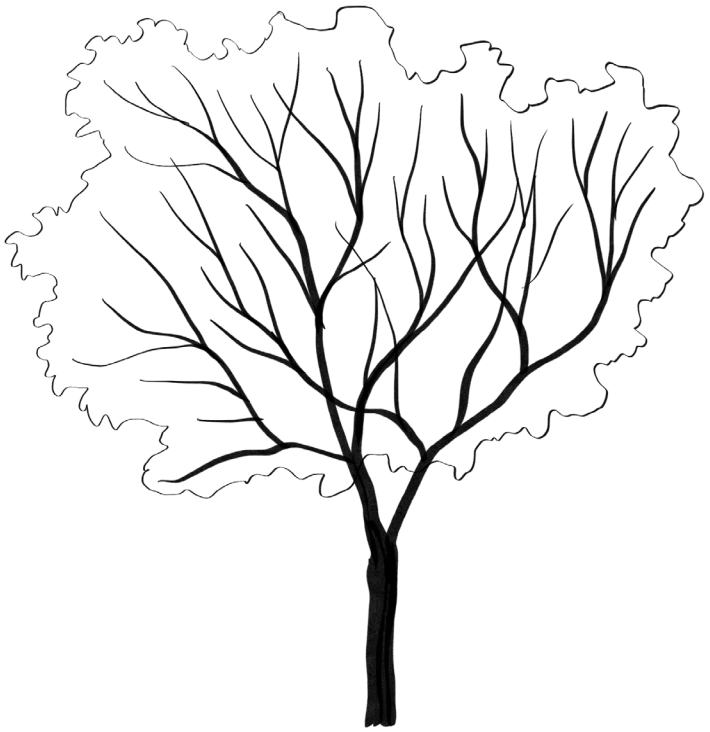
FORM Rounded with several low, prominent limbs and upward-arching branches

FLOWER Green, hairy, petal-less flowers in short cylindrical clusters

FRUIT Fruitless

FOLIAGE Bright, glossy green turn to yellow-green or golden in fall

BARK Ornamental, orange inner bark visible through exfoliating gray-brown outer bark



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Drought, heat, salt

TRANSPLANT Easy B&B

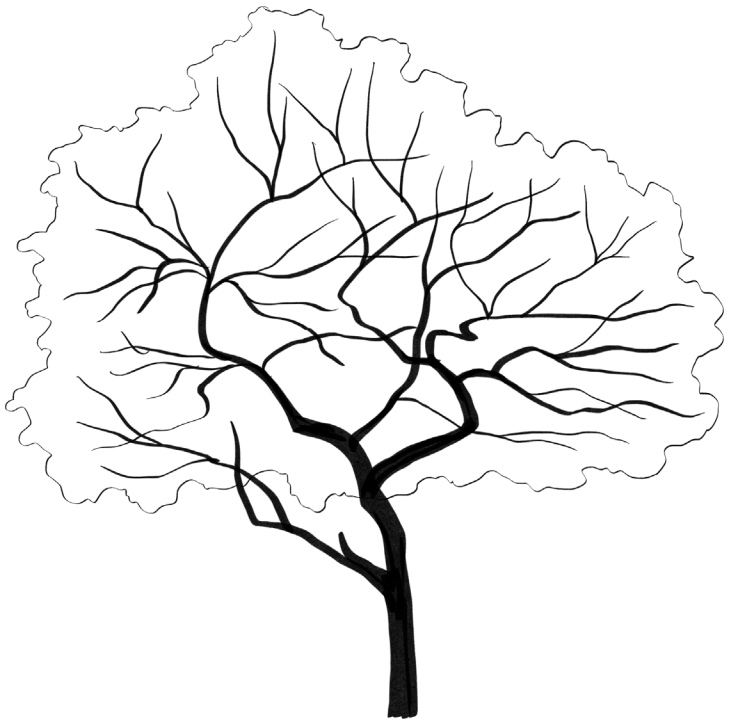
CULTIVARS Limited availability: 'Wichita' (male) has an upright-spreading form with a dense canopy; 'Whiteshield' (male) has an upright oval form

NOTES & LIMITATIONS

This adaptable native species is often met with apprehension, due to its thorns and large, messy fruit; the selection of fruitless, thornless male forms is strongly recommended.

FLOWERING CRABAPPLE

Malus spp.



ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun for best flowering

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 10-25'

WIDTH 10-25'

GROWTH Varies

FORM Rounded

FLOWER Varies by cultivar; showy

FRUIT Showy, cherry-like

FOLIAGE Varies by cultivar; often great fall color

BARK Varies by cultivar

PLANTING CONSIDERATIONS

PESTS Cultivars listed show great resistance to pests that species is highly susceptible to: cedar-apple rust, mildew, scab, and fire-blight

TOLERATES Drought, salt

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS Numerous, with many new selections added each year; several highly disease-resistant cultivars: Royal Raindrops®, Centurion® 'Centzam', 'Donald Wyman', Harvest Gold® 'Hargozam', 'Praire-fire', Sugar Tyme® 'Sutyzam'

NOTES & LIMITATIONS

This species is well-known for its beautiful spring flowers, but is often discarded due to its susceptibility to numerous insects and diseases. The use of new, resistant cultivars is strongly recommended. Fruit can be a litter issue on older varieties.

DAWN REDWOOD

Metasequoia glyptostroboides

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 70-100'

WIDTH 25-50'

GROWTH Fast

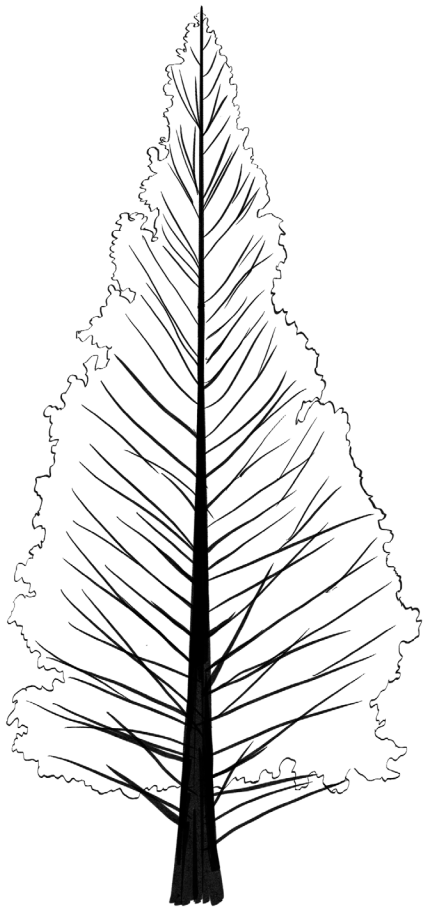
FORM Uniformly pyramidal and feathery, with horizontal branching, base becomes buttressed with age

FLOWER Not ornamentally important

FRUIT Small pendulous cones

FOLIAGE Bright green needles turn to pinkish-brown to reddish-bronze in fall

BARK Red-brown in youth turns darker and fissured at maturity, slightly exfoliating



PLANTING CONSIDERATIONS

PESTS Mites can cause defoliation under drought conditions

TOLERATES Flooding, pollution, poor drainage

TRANSPLANT Easy B&B

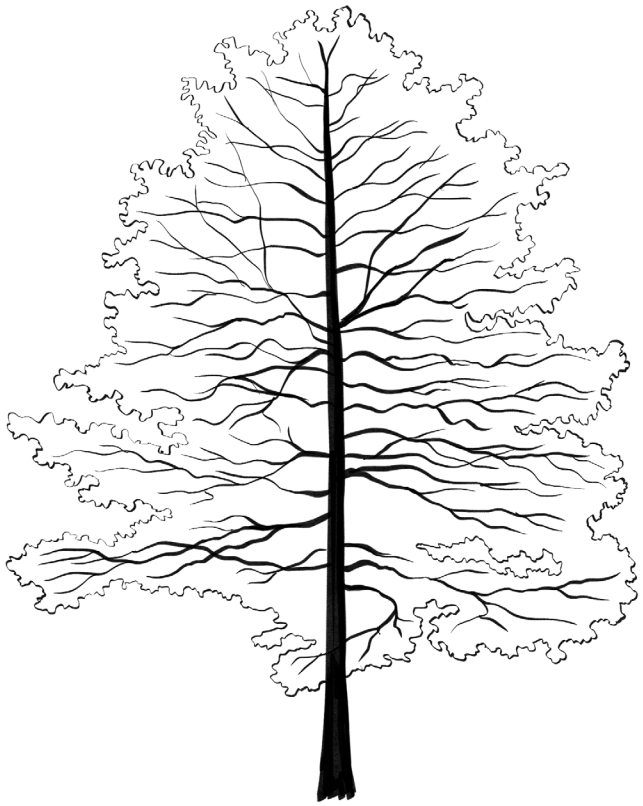
CULTIVARS 'National' and 'Sheridan Spire' are more narrowly upright than species, but 'National' may be more susceptible to canker problems than species

NOTES & LIMITATIONS

This deciduous conifer is best suited for large landscapes. Fairly adaptable, it is reportedly sensitive to salt, and may have limited availability.

BLACK GUM

Nyssa sylvatica



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤7.5

MOISTURE Tolerates only occasional periods of dry soil

CHARACTERISTICS

HEIGHT 30-60'

WIDTH 20-40'

GROWTH Slow - medium

FORM Pyramidal in youth, varies in maturity between a pyramidal or rounded form

FLOWER Not ornamentally important

FRUIT Inconspicuous blue-black drupes in pairs or clusters on female trees

FOLIAGE Glossy green in summer turns to brilliant yellow-orange-red-purple

BARK Dark gray to brown, scaly texture to irregular, block-like ridges

PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES Flooding, pollution, poor drainage

TRANSPLANT Difficult, small caliper B&B recommended, may be slow to establish

CULTIVARS Afterburner® 'David Odom' and Firestarter® 'JFS-red' have a symmetrical, upright branching structure good for street-use; Green Gable™ 'NSUHH' and Red Rage® 'Haymanred' have a more broadly pyramidal form, shows leaf spot resistance

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2008 Urban Tree of the Year, this native species provides excellent fall foliage, but is sensitive to drought, and may have limited availability.

AMERICAN HOPHORNBEAM

Ostrya virginiana

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 25-40'

WIDTH 20-40'

GROWTH Slow

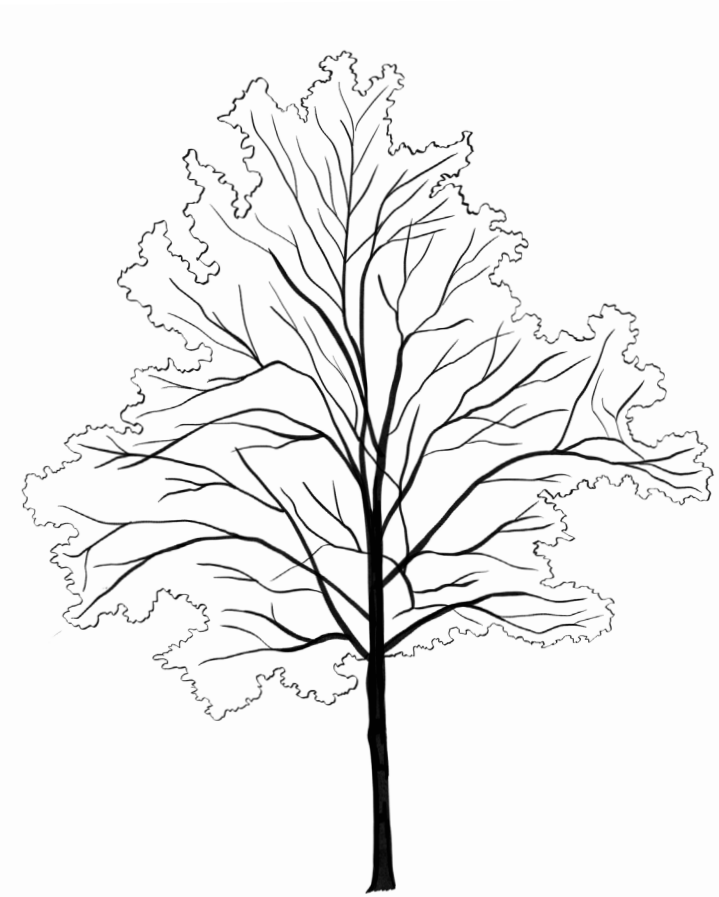
FORM Oval to pyramidal in youth, oval to rounded with upright, spreading branches at maturity

FLOWER Female is inconspicuous but visible in spring, male has worm-like, yellow-brown catkins visible in winter

FRUIT Small, green turning to tan, hop-like pods in hanging clusters

FOLIAGE Dark green turns to yellow-brown to red in fall, drop early

BARK Ornamental grayish-brown, exfoliating



PLANTING CONSIDERATIONS

PESTS Two-lined chestnut borer can be serious for stressed trees

TOLERATES Pollution

TRANSPLANT Difficult B&B or BR, slow to establish

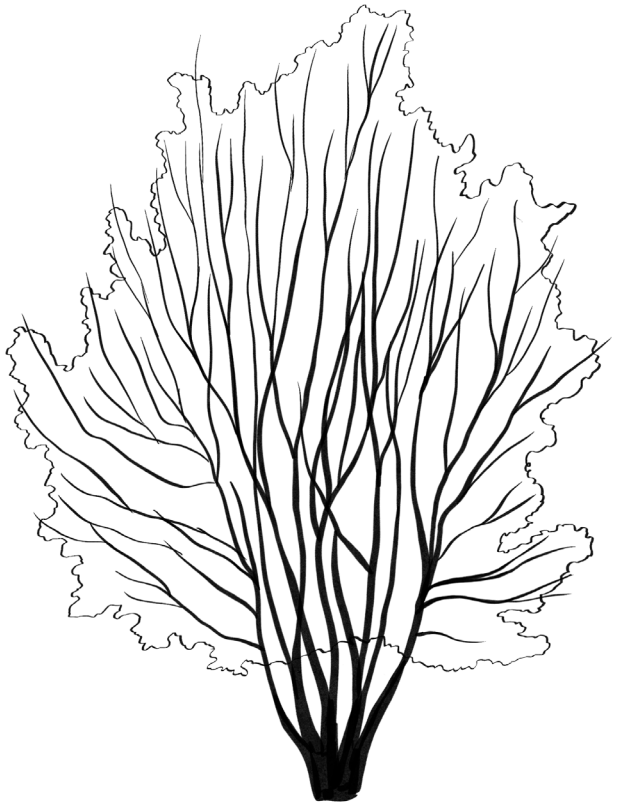
CULTIVARS Autumn Treasure® 'JFS-KW5' has more predictable upright narrow form, making it more suited for street-use

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2019 Urban Tree of the Year, this adaptable species may have limited availability.

PERSIAN PARROTIA

Parrotia persica



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade (fall color best in full sun)

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-30'

GROWTH Slow - medium

FORM Broadly pyramidal to rounded with low branches, varying from horizontal to upright-ascending

FLOWER Showy maroon stamens bloom early

FRUIT Dry brown capsules

FOLIAGE Emerging reddish-purple, green turns to excellent yellow-orange-red mix

BARK Ornamental, exfoliates to expose gray-green-white-brown pattern

PLANTING CONSIDERATIONS

PESTS Japanese beetle

TOLERATES Drought, heat

TRANSPLANT Easy B&B, BR, or CG

CULTIVARS 'Ruby Red' has narrow, upright form and red foliage spring through fall; Persian Spire™ 'JLColumnar' is strongly upright and narrow, good for street-use; 'Vanessa' is tighter, denser, more upright, Society of Municipal Arborists' 2014 Urban Tree of the Year

NOTES & LIMITATIONS

Also known as Persian Ironwood, this species boasts both ornamental value and adaptability to adverse conditions. May be vulnerable to mechanical damage.

SERBIAN SPRUCE

Picea omorika

ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 50-60'

WIDTH 20-25'

GROWTH Slow - medium

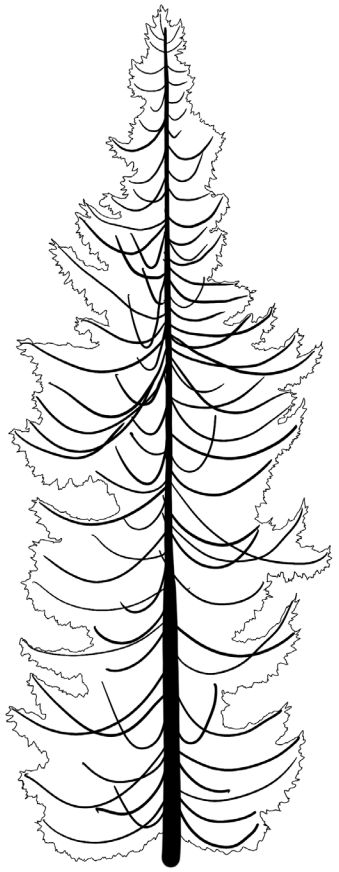
FORM Narrowly pyramidal, gracefully arching branching

FLOWER Inconspicuous

FRUIT Pendulous cones, purple turn to cinnamon-brown at maturity

FOLIAGE Glossy, dark green needles year round

BARK Dark black-brown with thin, peeling scales



PLANTING CONSIDERATIONS

PESTS Borers and aphids are occasionally an issue

TOLERATES Pollution

TRANSPLANT B&B recommended

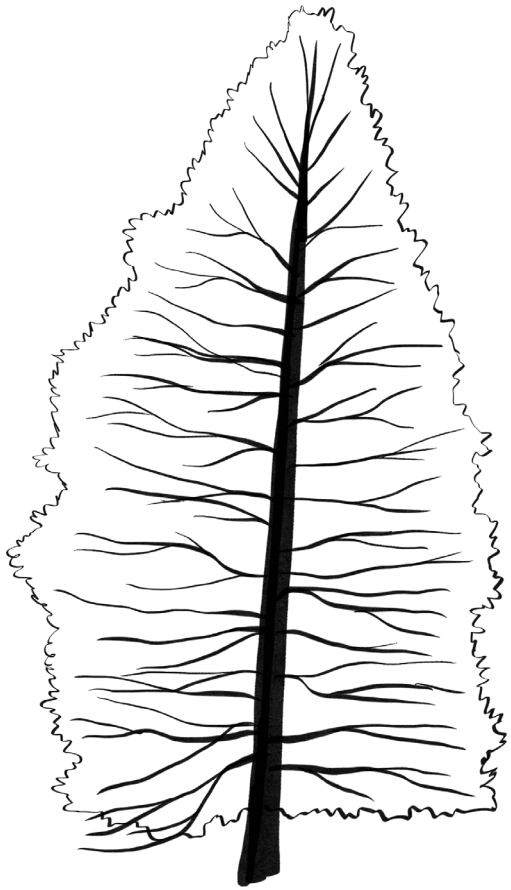
CULTIVARS 'Nana' has a broad pyramid form; 'Pendula' has dramatic, drooping branches with an open form; 'Pendula Bruns' has a narrow, strongly weeping form and blueish-green needles

NOTES & LIMITATIONS

One of the most adaptable spruce trees, this evergreen is noted for its excellent foliage. Does best when protected from strong winter winds.

SWISS STONE PINE

Pinus cembra



ENVIRONMENTAL CONDITIONS

ZONE	4A	**SOIL PH**	≤7.5
LIGHT	Full sun	**MOISTURE**	Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT	30-40'	**FLOWER**	Not ornamentally important
WIDTH	15-25'	**FRUIT**	Purplish-brown cones
GROWTH	Slow	**FOLIAGE**	Blue-green to light green needles
FORM	Narrowly columnar, dense, uniform	**BARK**	New stems covered with orange-brown hairs

PLANTING CONSIDERATIONS

PESTS	Generally pest-free	**CULTIVARS**	'Nana' has a pyramidal habitat, grows to be 20' tall; 'Columnaris' has a dense, narrow fastigiate form
TOLERATES	-		
TRANSPLANT	Easy B&B		

NOTES & LIMITATIONS

This evergreen, although it may have limited availability, transplants easily and makes a good accent tree in the landscape. Its extremely slow-growing tendency may make it a suitable choice for planting sites in the vicinity of utility lines.

LONDON PLANETREE

Platanus x acerifolia

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 70-100'

WIDTH 65-80'

GROWTH Medium

FORM Pyramidal in youth, open, spreading, and rounded at maturity

FLOWER Not ornamentally important

FRUIT Pairs hang on long stalks, turns from green to brown, persists through winter

FOLIAGE Medium to dark green turns to yellow-brown in fall

BARK Ornamental, exfoliates in plates to reveal attractive mix of tan & olive

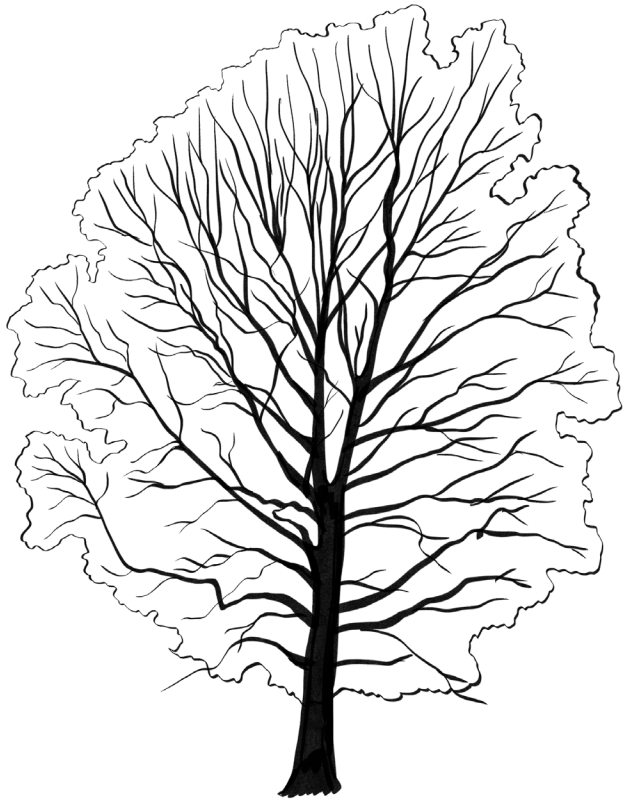
PLANTING CONSIDERATIONS

PESTS A tough tree, but overuse has encouraged issues: plum borer, sycamore lacebug, canker stain, anthracnose, powdery mildew, ALB

TOLERATES Drought, flooding, pollution, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS 'Columbia' and 'Liberty' resistant to anthracnose and powdery mildew; 'Bloodgood' resistant to anthracnose; Exclamation™ 'Morton Circle' resistant to anthracnose, powdery mildew, and frost cracking

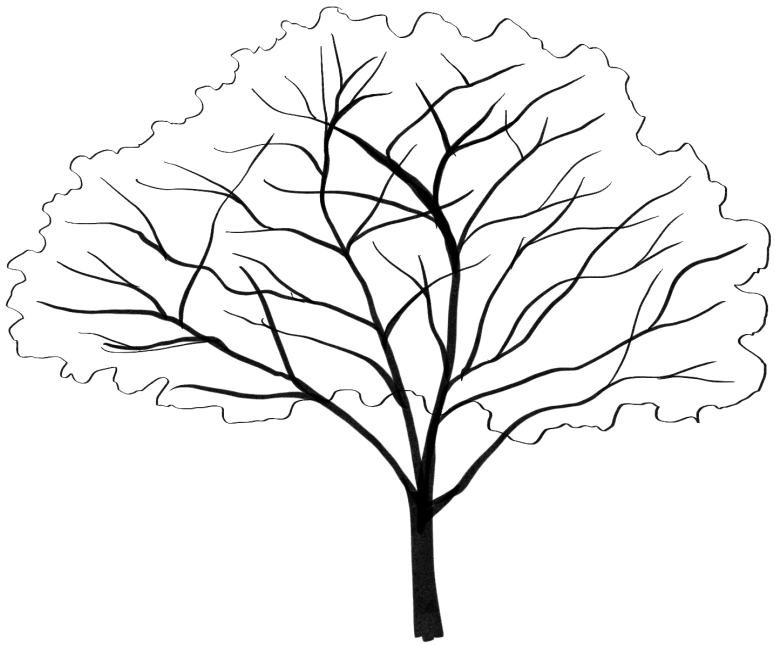


NOTES & LIMITATIONS

Result of a cross between *P. orientalis* and *P. occidentalis,* this large, adaptable species may be over-planted. Can tolerate tough sites, but fruit can be a litter issue, and its roots may heave sidewalks.

ACCOLADE FLOWERING CHERRY

Prunus 'Accolade'



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-25'

GROWTH Medium

FORM Open, rounded to vase-shaped, spreading

FLOWER Showy, pink

FRUIT Red drupe

FOLIAGE Medium green turns to good yellow, orange, or red in early fall

BARK Ornamental, smooth and striated light gray

PLANTING CONSIDERATIONS

PESTS Reportedly more resistant to the many pests that species is susceptible to

CULTIVARS Information is cultivar-specific

TOLERATES Salt

TRANSPLANT Easy BR

NOTES & LIMITATIONS

A hybrid between *P. sargentii* and *P. subhirtella*, 'Accolade' is valued for its pest resistance and showy flowers.

HOPTREE

Ptelea trifoliata

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun, partial shade, shade

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 15-20'

WIDTH 15-20'

GROWTH Slow - medium

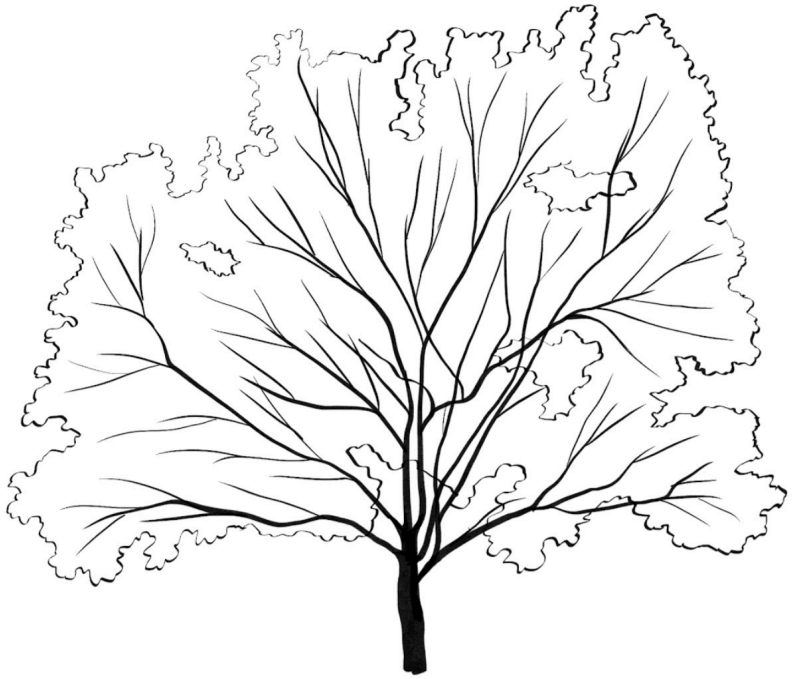
FORM Dense, rounded, and irregular, often multi-stemmed

FLOWER Small, fragrant, greenish-white flowers in terminal clusters

FRUIT Wafer-like samara, green turns to brown, persists through winter

FOLIAGE Glossy, dark green turns to yellow-green in fall; fragrant when crushed

BARK Dark gray-brown with raised lenticels



PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to rust, tree-hoppers, and leaf spot

CULTIVARS 'Aurea' has soft yellow leaves that mature to green; 'Glauca' has blue-green foliage

TOLERATES Drought

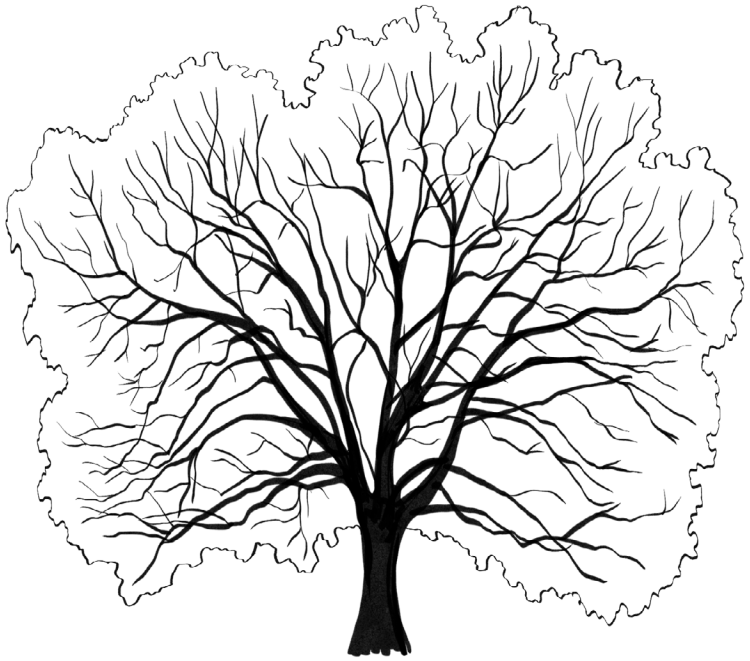
TRANSPLANT Easy B&B

NOTES & LIMITATIONS

Also known as Wafer-Ash, the Hoptree received its common name from the use of its bitter fruit as a substitute for hops in brewing beer in the past. This native species, grown either as a shrub or small tree, has a wide geographic range; although it may have limited availability, it is a great selection for naturalized sites.

WHITE OAK

Quercus alba



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 45-80'

WIDTH 45-80'

GROWTH Slow

FORM Pyramidal in youth, oval-rounded to rounded at maturity with wide-spreading branches

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Dark blue-green to green turn to red or purple-red in late fall

BARK Ornamental, light ashy-brown, develops small scaly plates with age

PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, two-lined chestnut borer, scale, galls, cankers; shows oak wilt resistance

TOLERATES Salt, poor drainage

TRANSPLANT Difficult

CULTIVARS *Q. alba x Q. robur*: CrimsonSpire™ 'Crimschmidt' has a narrow form, tolerates a wide range of conditions, has good red fall color; Streetspire® 'JFS-KW1QX' has a narrow, columnar form, is powdery mildew resistant, has good red fall color

NOTES & LIMITATIONS

This large native species is highly valued in the landscape for its majestic appearance and adaptability. However, it is notably difficult to transplant, and it is recommended to do so when the tree is young,

SWAMP WHITE OAK

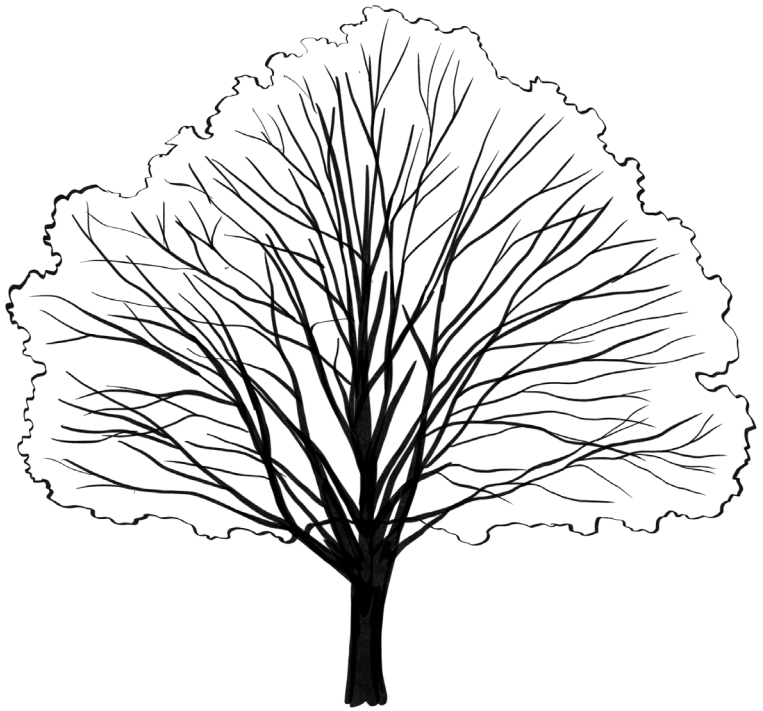
Quercus bicolor

ENVIRONMENTAL CONDITIONS

ZONE	4A	**SOIL PH**	≤7.0
LIGHT	Full sun	**MOISTURE**	Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT	45-70'	**FLOWER**	Not ornamentally important
WIDTH	45-60'	**FRUIT**	Acorns
GROWTH	Slow	**FOLIAGE**	Lustrous dark green turns to yellow or red-purple in fall
FORM	Pyramidal in youth, broad, rounded, open at maturity	**BARK**	Ornamental dark gray-brown, flaky, deeply furrowed and ridged



PLANTING CONSIDERATIONS

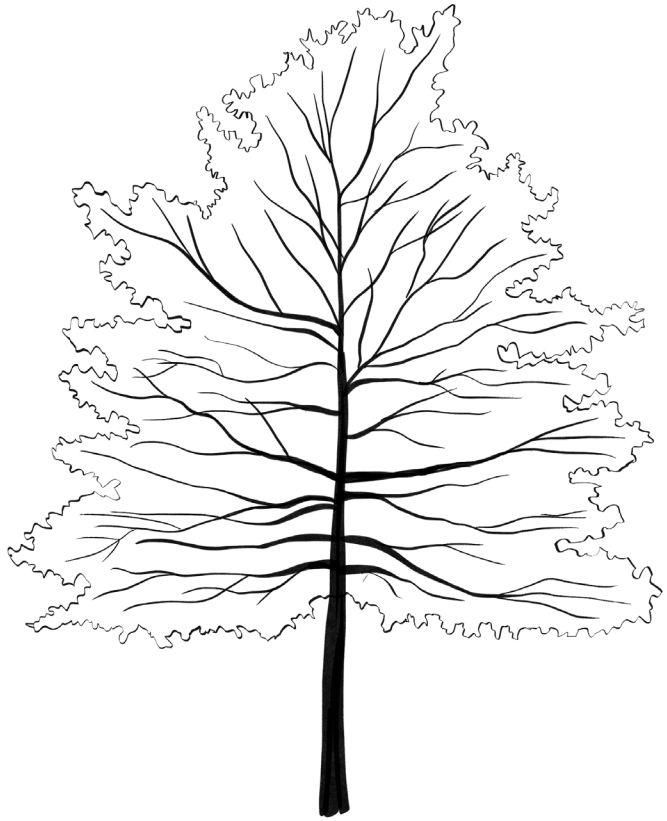
PESTS	Susceptible to gypsy moth, powdery mildew, orange-striped oakworm, anthracnose, canker	**CULTIVARS**	Regal Prince® 'Long' and Rosehill® 'Asjes' have narrow oval habit, grow to be 20' wide, and are highly mildew resistant
TOLERATES	Drought, flooding, salt, pollution, poor drainage		
TRANSPLANT	Moderately easy B&B or ≤2" caliper BR		

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 1998 Urban Tree of the Year, this species is more adaptable and easier to transplant than *Q. alba*. Its lower branches may require pruning for street use, acorns can be a litter issue, and it may exhibit chlorosis when growing in alkaline soil, therefore is typically recommended for large, naturalized areas.

SCARLET OAK

Quercus coccinea



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 60-75'

WIDTH 40-50'

GROWTH Slow

FORM Rounded and open, upright spreading branches

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Glossy dark green turns to excellent russet to scarlet in fall, persist through winter, especially on young trees

BARK Grayish brown with furrows and ridges

PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, two-lined chestnut borer

TOLERATES Drought

TRANSPLANT Difficult, B&B or CG recommended

CULTIVARS -

NOTES & LIMITATIONS

An attractive, adaptable oak, this species may have limited availability due to its difficulty to transplant. Acorns may be a litter issue.

SHINGLE OAK

Quercus imbricaria

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 40-65'

GROWTH Slow

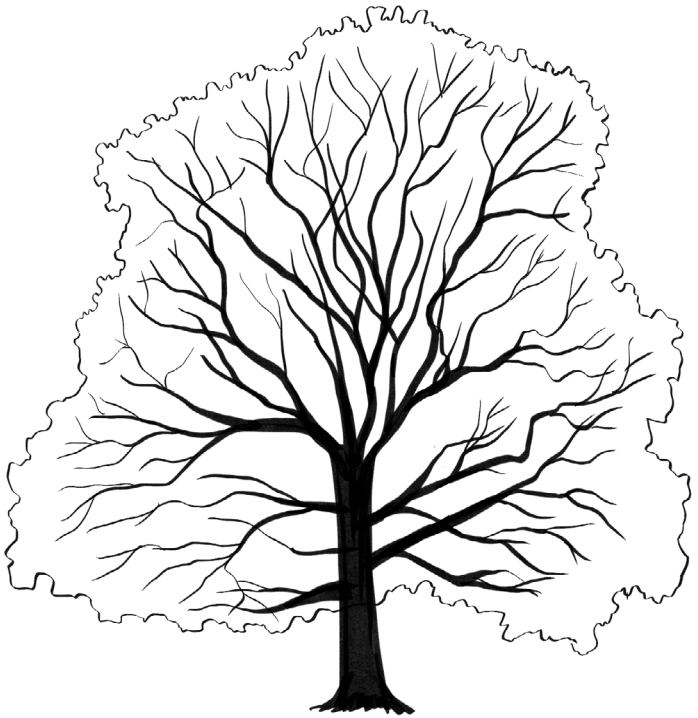
FORM Pyramidal in youth, oval-rounded at maturity with upright, spreading branches, lower branches descending

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Emerging reddish, glossy dark green turns to yellow-brown or russet-red in fall, persists through winter

BARK Gray-brown, shallow furrows and ridges



PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, anthracnose, canker, rust, powdery mildew, wilt, galls

CULTIVARS -

TOLERATES Flooding, salt, shearing

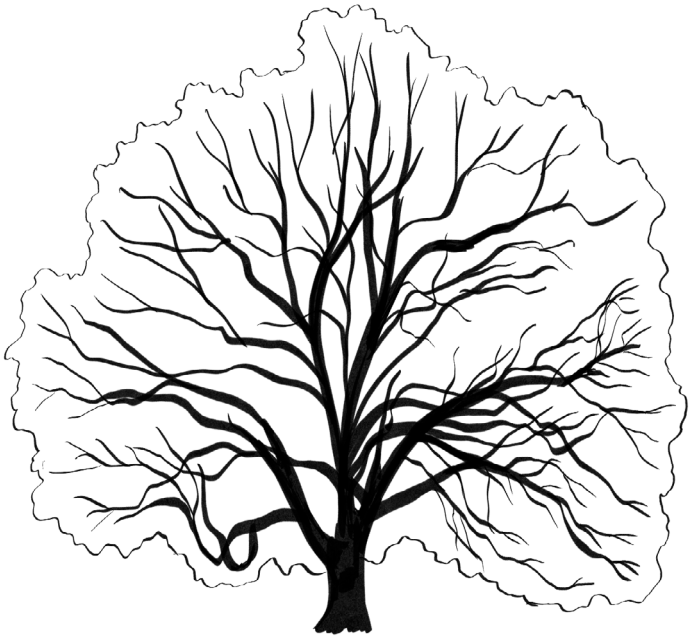
TRANSPLANT Moderately easy B&B or BR, slow to establish

NOTES & LIMITATIONS

This adaptable species is reportedly easier to transplant than other oaks, and its acorns pose less risk of becoming a litter issue.

BUR OAK

Quercus macrocarpa



ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 60-80'

WIDTH 60-90'

GROWTH Slow

FORM Pyramidal to oval in youth, rounded and open with age

FLOWER Not ornamentally important

FRUIT Acorns, heavy crop every 3-5 years

FOLIAGE Dark green turns to yellow-green or yellow-brown in fall

BARK Gray-brown, develops deep ridges and furrows

PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, two-lined chestnut borer, anthracnose, webworm, leaf miner

TOLERATES Drought, flooding, poor drainage

TRANSPLANT Difficult, young trees B&B or CG recommended

CULTIVARS Urban Pinnacle™ 'JFS-KW3' has a narrow-pyramidal habit, resistant to anthracnose and mildew, smaller acorns create less of a litter issue; Jordan Street® 'Atwood' is upright and spreading with a rounded crown and mildew-resistant leaves

NOTES & LIMITATIONS

More adaptable to adverse conditions than most other oaks, this species was named the Society of Municipal Arborists' 2001 Urban Tree of the Year. Acorns can be a litter issue.

CHESTNUT OAK

Quercus montana

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 60-70'

WIDTH 60-70'

GROWTH Medium - fast

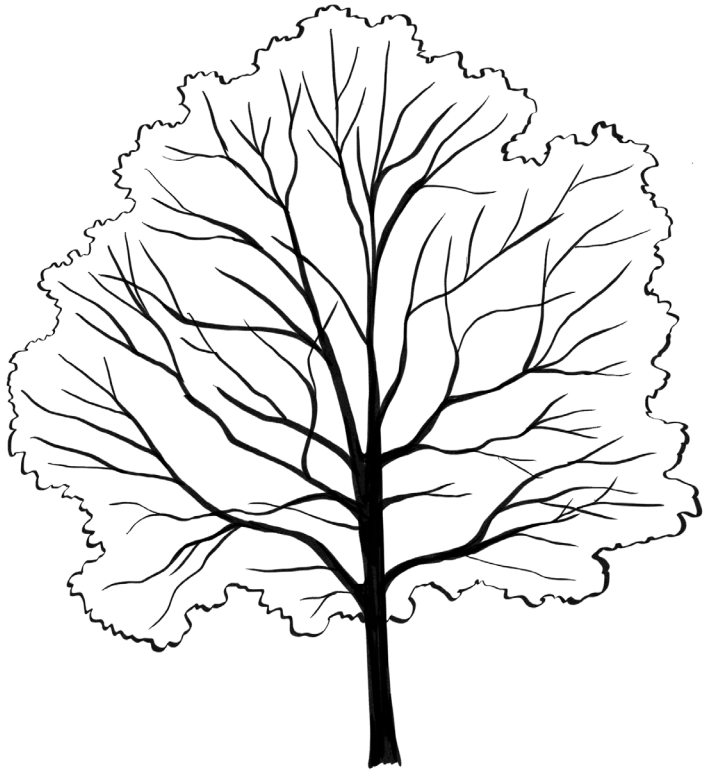
FORM Pyramidal in youth, rounded to vase-shaped at maturity with large spreading branches

FLOWER Not ornamentally important

FRUIT Dark brown acorns, in pairs

FOLIAGE Dark green turns to orange-yellow to reddish or yellowish brown in fall

BARK Ornamental, blackish brown, deeply furrowed at maturity, corky appearance



PLANTING CONSIDERATIONS

PESTS Susceptible to scale, two-lined chestnut borer, mites

CULTIVARS -

TOLERATES Drought

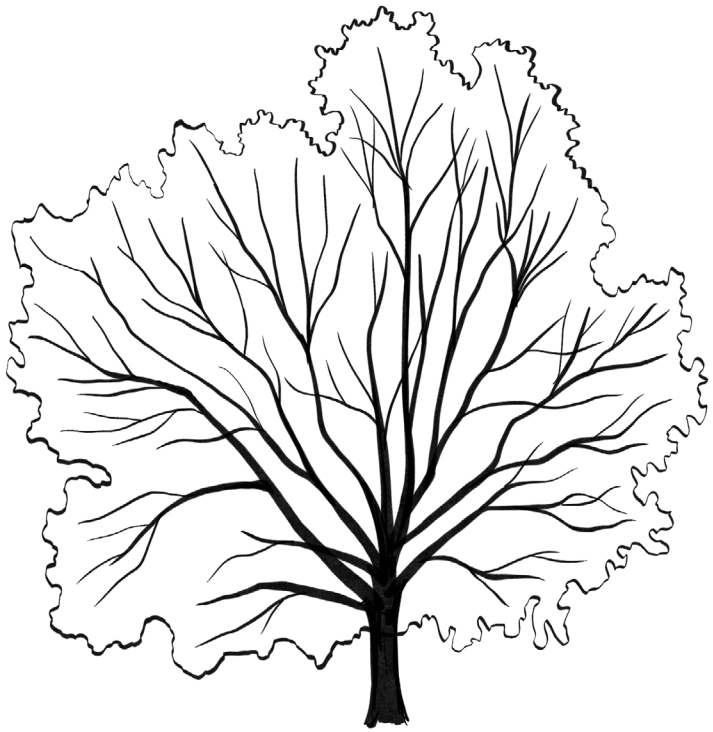
TRANSPLANT Moderately difficult

NOTES & LIMITATIONS

More adaptable to adverse conditions than most other oaks, this species was named the Society of Municipal Arborists' 2017 Urban Tree of the Year. Flowers can be a litter issue.

CHINKAPIN OAK

Quercus muehlenbergii



ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 35-50'

WIDTH 35-60'

GROWTH Slow - medium

FORM Open, rounded

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Glossy dark yellow-green turns to yellow or orange-brown in fall

BARK Light gray, flaky

PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, leaf miners, orange-striped oak worm, acorn weevils

CULTIVARS -

TOLERATES Drought, salt

TRANSPLANT Difficult, B&B recommended

NOTES & LIMITATIONS

More adaptable to adverse conditions than most other oaks, this species was named the Society of Municipal Arborists' 2009 Urban Tree of the Year. Acorns can be a litter issue.

PIN OAK

Quercus palustris

ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤6.5

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 60-70'

WIDTH 60-70'

GROWTH Medium - fast

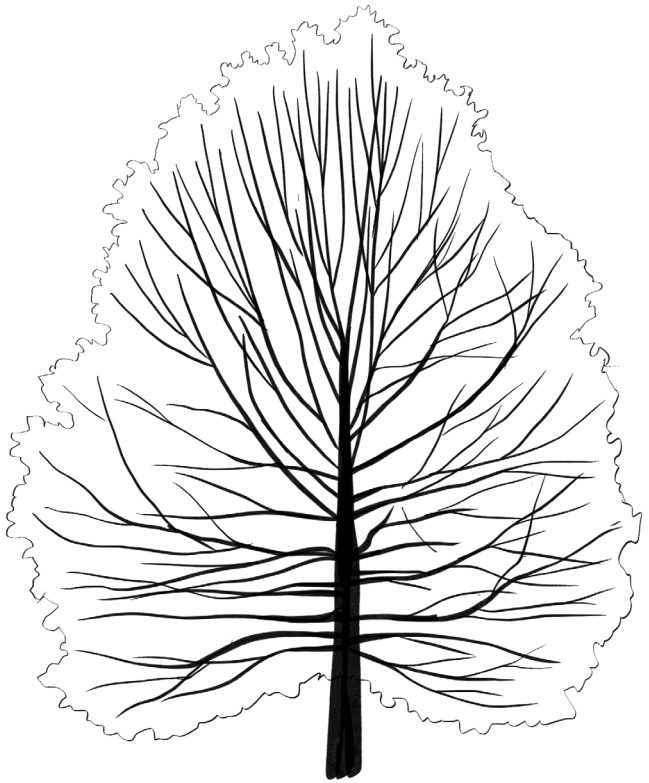
FORM Pyramidal in youth, oval at maturity with upright upper branches, horizontal middle branches, and descending lower branches

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Glossy dark green turns to russet-red in fall, young trees hold leaves through winter

BARK Smooth gray-brown, shallow ridges and furrows at maturity



PLANTING CONSIDERATIONS

PESTS Overuse has encouraged issues: gypsy moth, wilt, galls, cankers; resistant to anthracnose

TOLERATES Drought, flooding, poor drainage

TRANSPLANT Easy B&B, moderately difficult BR

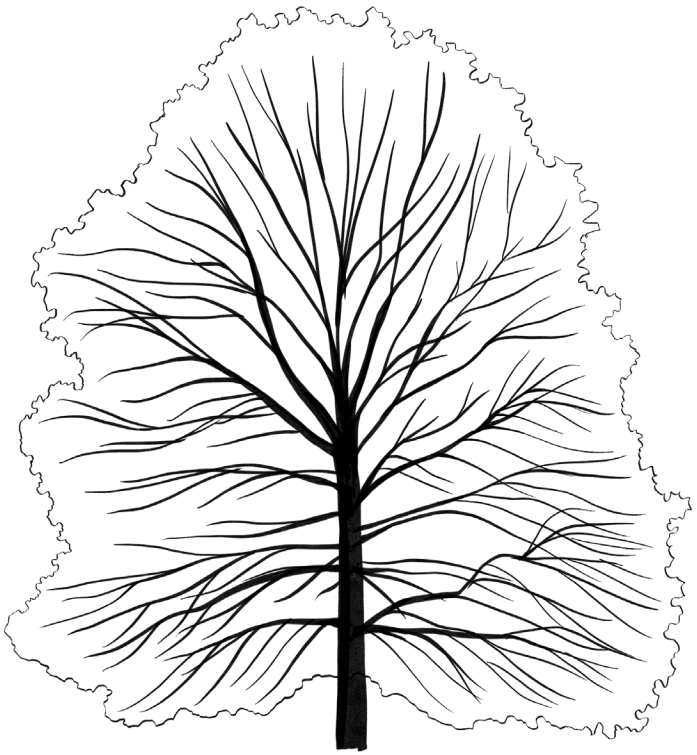
CULTIVARS Green Pillar® 'Pringreen' has a columnar form, grows to be 50' x 15'

NOTES & LIMITATIONS

Possibly already over-planted, due to its ease of growing and transplanting compared to other oaks, this species requires a bit of maintenance for street use: pruning of lower branches may be required, acorns can be a litter issue, it is reportedly sensitive to salt, and it may exhibit chlorosis when growing in alkaline soil.

WILLOW OAK

Quercus phellos



ENVIRONMENTAL CONDITIONS

ZONE 6A

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 30-60'

GROWTH Medium - fast

FORM Pyramidal in youth, rounded at maturity with a dense crown

FLOWER Not ornamentally important

FRUIT Acorns

FOLIAGE Dark green turns to variable brown-yellow, or orange-yellow in fall, persists through winter

BARK Gray-brown, shallow ridges and furrows

PLANTING CONSIDERATIONS

PESTS Susceptible to gypsy moth, borers, scale, orange-striped oakworm; resistant to anthracnose

TOLERATES Drought, flooding, heat, salt, poor drainage

TRANSPLANT B&B or BR recommended

CULTIVARS 'Hightower' has a uniform, dense form, 55' x 30', mite resistant; 'Upperton' grows to be 60' x 30'

NOTES & LIMITATIONS

A popular street tree in the Southern US, this adaptable oak's lower branches may need pruning for street use, acorns may be a litter issue certain years, and it may exhibit chlorosis when growing in alkaline soil.

ENGLISH OAK

Quercus robur

ENVIRONMENTAL CONDITIONS

ZONE	5A	**SOIL PH**	≤8.2
LIGHT	Full sun	**MOISTURE**	Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT	40-60'	**FLOWER**	Not ornamentally important
WIDTH	40-60'	**FRUIT**	Acorns
GROWTH	Slow - medium	**FOLIAGE**	Dark green to blue-green, either drop green or turn to brown in fall
FORM	Pyramidal or oval in youth, broadly open and rounded at maturity	**BARK**	Grayish-black, deep furrows and ridges

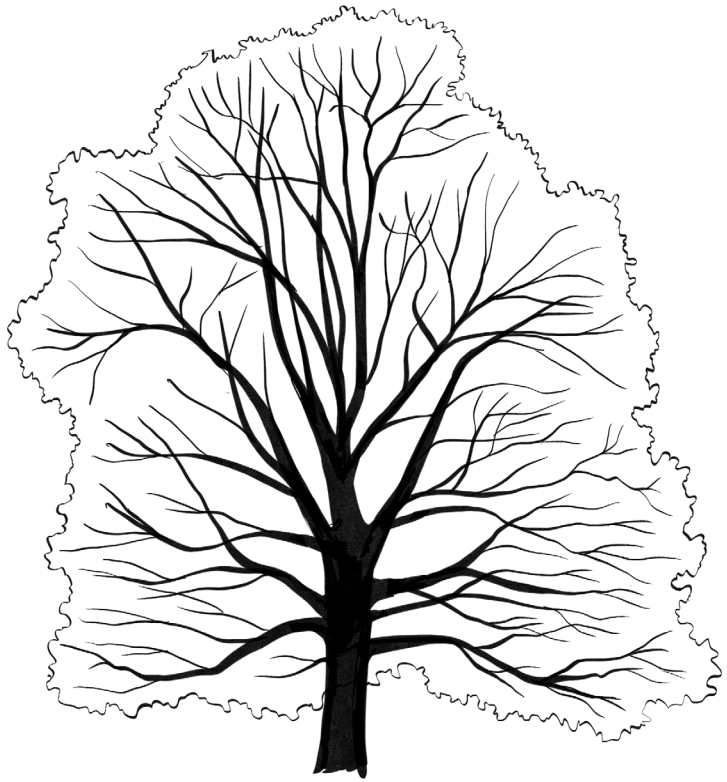
PLANTING CONSIDERATIONS

PESTS Powdery mildew may pose serious threat, anthracnose, gypsy moth

TOLERATES Drought, salt, pollution

TRANSPLANT B&B recommended

CULTIVARS CrimsonSpire™ 'Crimschmidt', Attention! 'DTR 105', Streetspire® 'JFS-KW1QX', and Skymaster® 'Pyramich' are all reportedly resistant to powdery mildew

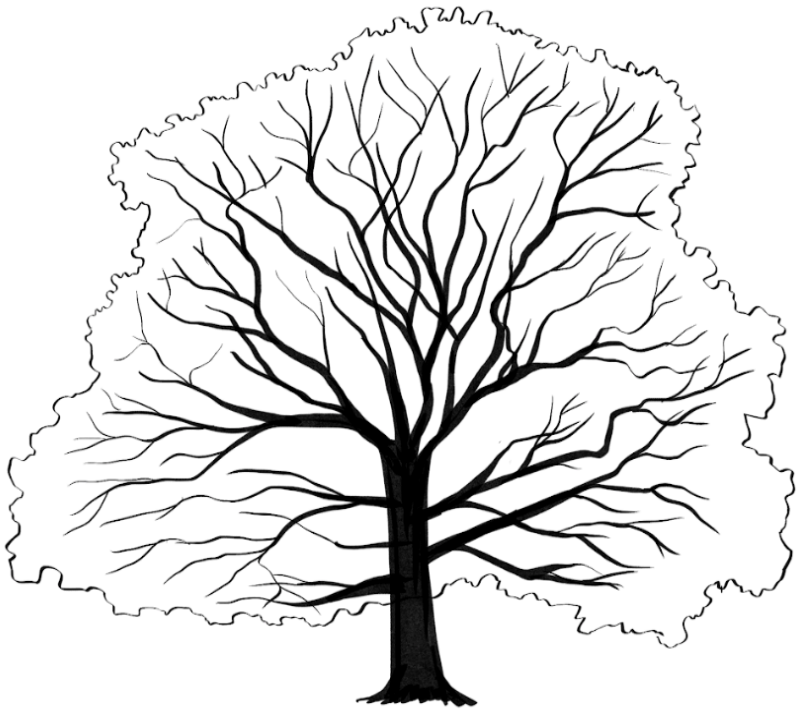


NOTES & LIMITATIONS

This adaptable, non-native oak is easier to transplant than *Q. macrocarpa* or *Q. alba*. Acorns can be a litter issue, and twig dieback may occur during harsh winters.

NORTHERN RED OAK

Quercus rubra



ENVIRONMENTAL CONDITIONS

ZONE 4A

LIGHT Full sun

SOIL PH ≤7.5

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 60-75'

WIDTH 60-75'

GROWTH Fast

FORM Rounded with upright spreading branches

FLOWER Pale yellow-green catkins

FRUIT Acorns

FOLIAGE Dark green turns to variable red in late fall

BARK Brown to black with fissures and ridges

PLANTING CONSIDERATIONS

PESTS Susceptible to various caterpillars; resistant to anthracnose

TOLERATES Drought, salt, pollution

TRANSPLANT Difficult BR, B&B recommended

CULTIVARS 'Aurea' has golden yellow fall foliage; 'Boltes Gold' has golden leaves in spring, turning from lime green in summer to red and orange in fall, grows 50' x 30'; 'Magic Fire' has yellow fall foliage, grows 30' x 25'

NOTES & LIMITATIONS

Northern Red Oaks perform well in the urban environment, provide abundant shade from their dense canopy, and are valuable to wildlife. However, it is worth considering that they require large planting sites, their acorns can be a litter issue, and they may exhibit chlorosis when growing in alkaline soil.

SHUMARD OAK

Quercus shumardii

ENVIRONMENTAL CONDITIONS

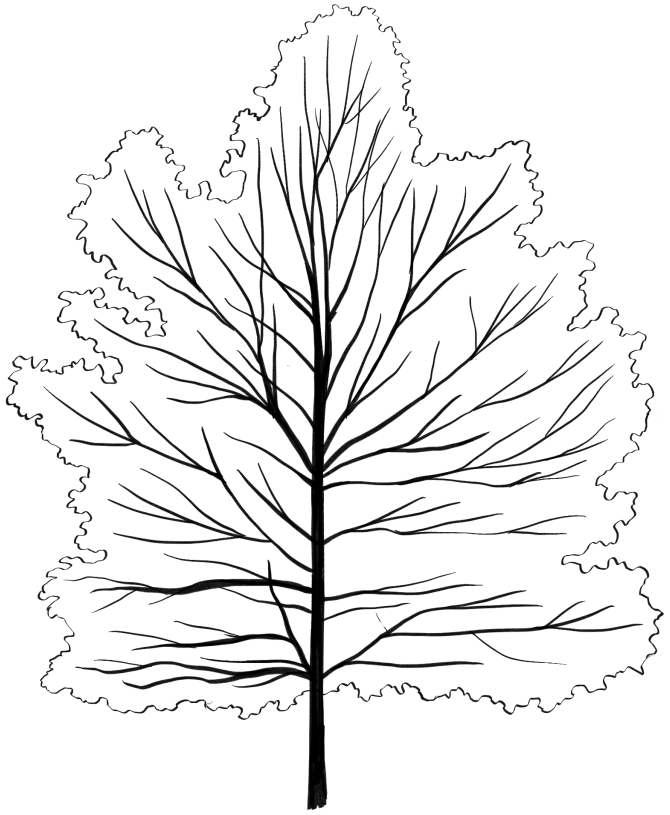
ZONE	5B	**SOIL PH**	≤8.2
LIGHT	Full sun	**MOISTURE**	Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT	40-60'	**FLOWER**	Not ornamentally important
WIDTH	40-65'	**FRUIT**	Acorns
GROWTH	Slow - medium	**FOLIAGE**	Dark green turns to yellow-bronze or red in fall
FORM	Pyramidal in youth, broadly oval to rounded at maturity	**BARK**	Gray-brown, developing somewhat platy ridges and furrows with age

PLANTING CONSIDERATIONS

PESTS	Generally pest-free, but susceptible to gypsy moth	**CULTIVARS**	-
TOLERATES	Drought, flooding, poor drainage		
TRANSPLANT	Easier than most oaks		

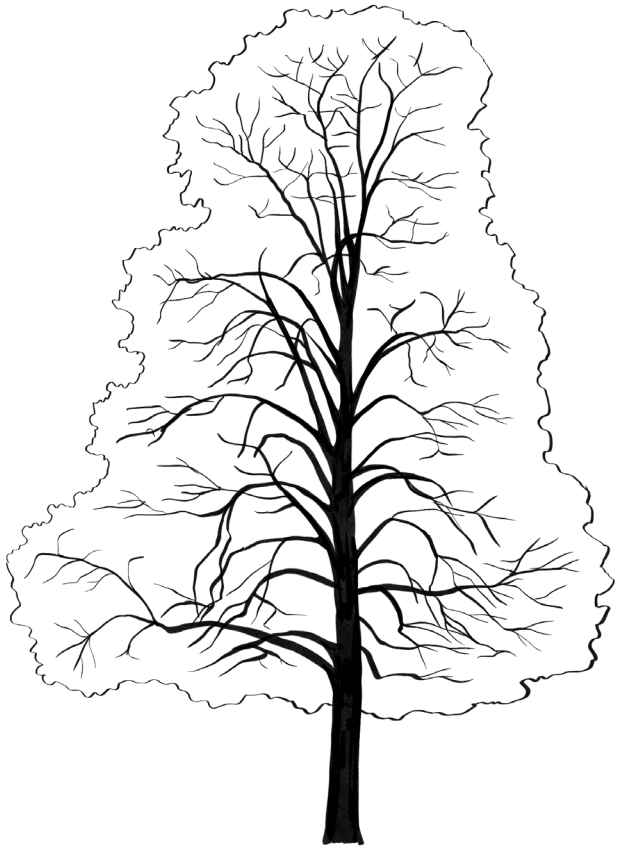


NOTES & LIMITATIONS

This species' extreme adaptability to adverse conditions and ease of transplanting make it a popular tree in the urban environment. Acorns can be a litter issue.

COMMON SASSAFRAS

Sassafras albidum



ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Prefers partial or full shade, tolerates full sun

SOIL PH ≤7.5

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 30-60'

WIDTH 25-40'

GROWTH Medium - fast

FORM Pyramidal to irregular

FLOWER Female trees have small, fragrant yellow flowers in clusters, males have inconspicuous flowers

FRUIT Blue-black, oval

FOLIAGE Bright green turns to brilliant yellow, orange, and red in fall

BARK Ornamental, dark cinnamon-brown, deeply ridged and furrowed

PLANTING CONSIDERATIONS

PESTS Susceptible to borers and bagworms

TOLERATES Flooding, poor drainage

TRANSPLANT Difficult, young trees CG recommended

CULTIVARS 'Birch Mountain' has irregularly variegated leaves

NOTES & LIMITATIONS

One of the best species for fall foliage, this species is best suited for naturalized areas. It is notably difficult to transplant, and it may have limited availability.

JAPANESE UMBRELLA PINE

Sciadopitys verticillata

ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Prefers moist soil, avoid dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-20'

GROWTH Very slow

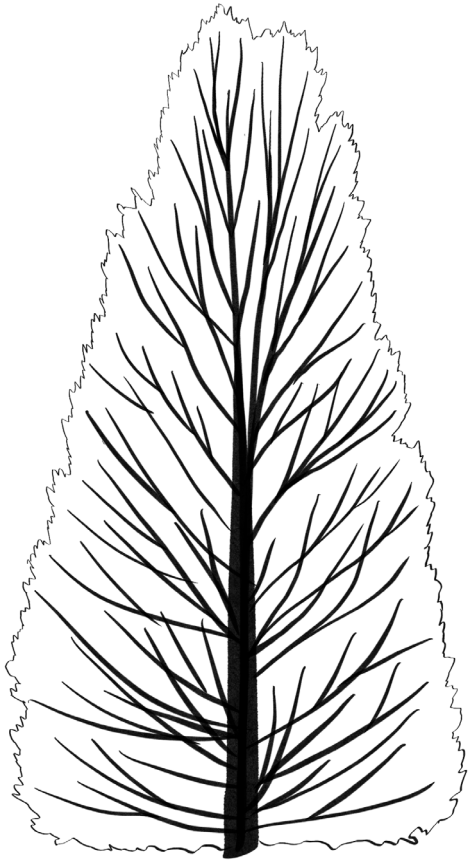
FORM Compact in youth, typically opens up with age, varying from broadly pyramidal to spire-like

FLOWER Not ornamentally important

FRUIT Upright, oval cones turn from green

FOLIAGE Large, glossy dary green needles are not true leaves; true leaves hug

BARK Reddish- brown, exfoliates in plates and strips with age; ornamental but often not visible under dense foliage



PLANTING CONSIDERATIONS

PESTS Generally pest-free

TOLERATES -

TRANSPLANT Difficult; B&B or CG recommended

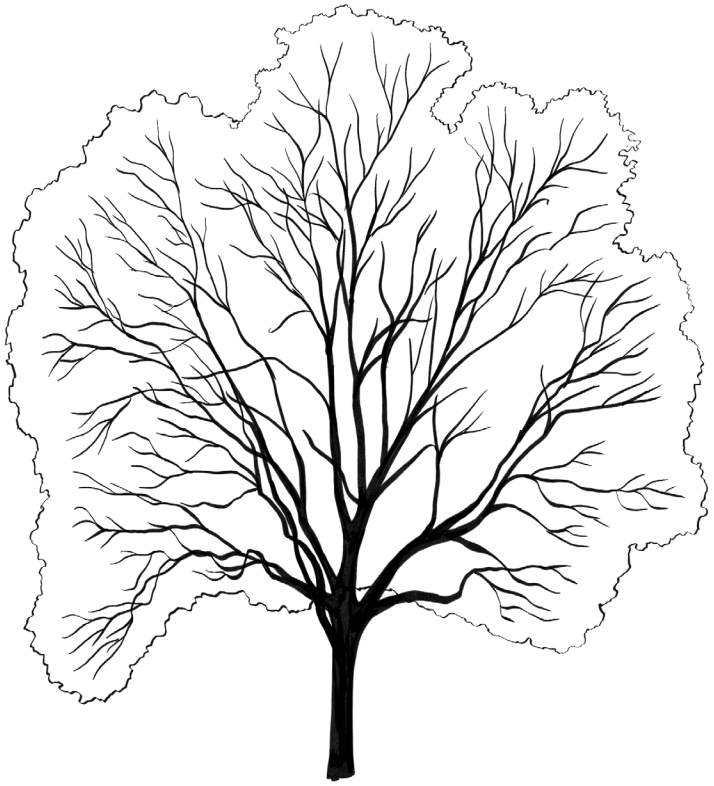
CULTIVARS May be hard to find: 'Wintergreen' has very glossy, bright green needles, has a narrow conical habit; 'Pendula' has weeping branches; 'Aurea', 'Ossorio Gold', and 'Ann Haddow' have golden yellow needles

NOTES & LIMITATIONS

Not a true pine, this evergreen species was named for its umbrella-like whorls of needles that provide a unique, ornamental addition to the landscape. It does best when protected from windy sites and late afternoon sun, and it may have limited availability.

JAPANESE PAGODATREE

Styphnolobium japonicum



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 50-70'

WIDTH 35-55'

GROWTH Medium - fast

FORM Oval to rounded with upright spreading branches, dense

FLOWER Showy, slightly fragrant, creamy white pea-like flowers in clusters appear mid-summer

FRUIT Bright green pods turn to yellow-brown

FOLIAGE Lustrous, bright green in summer turns yellowish in late fall

BARK Light grayish-brown, becomes furrowed with age

PLANTING CONSIDERATIONS

PESTS Stem canker possible in harsh winters

TOLERATES Drought, salt, pollution

TRANSPLANT Easy B&B

CULTIVARS Regent® is fast growing, flowers at younger age, resistant to leaf-chewing insects; 'Columnaris' and 'Princeton Upright' have upright branching habits that are more tall than wide

NOTES & LIMITATIONS

Also know as the Scholartree, this species is well suited to urban environments despite its fruit possibly being a litter issue and its susceptibility to branch breakage.

JAPANESE TREE LILAC

Syringa reticulata

ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Full sun, partial shade; flowers best in full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 20-30'

WIDTH 15-25'

GROWTH Slow

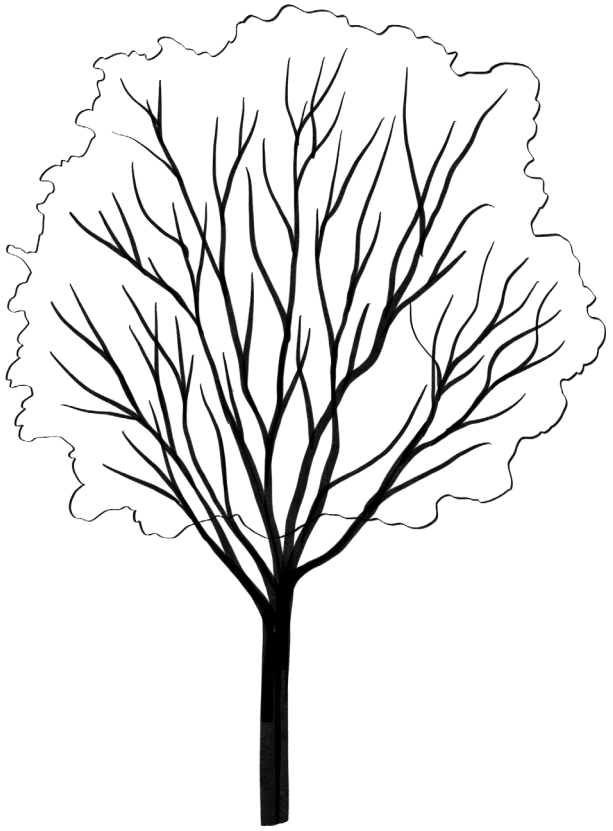
FORM Oval

FLOWER Showy, fragrant, cream colored pyramidal clusters

FRUIT Tan capsules

FOLIAGE Dark green, often nonexistent fall color, occasionally dull yellow

BARK Ornamental, smooth reddish-brown, with horizontal lenticels



PLANTING CONSIDERATIONS

PESTS None serious; resistant to powdery mildew and scale

TOLERATES Drought, salt, pollution

TRANSPLANT Easy B&B or ≤2" caliper BR

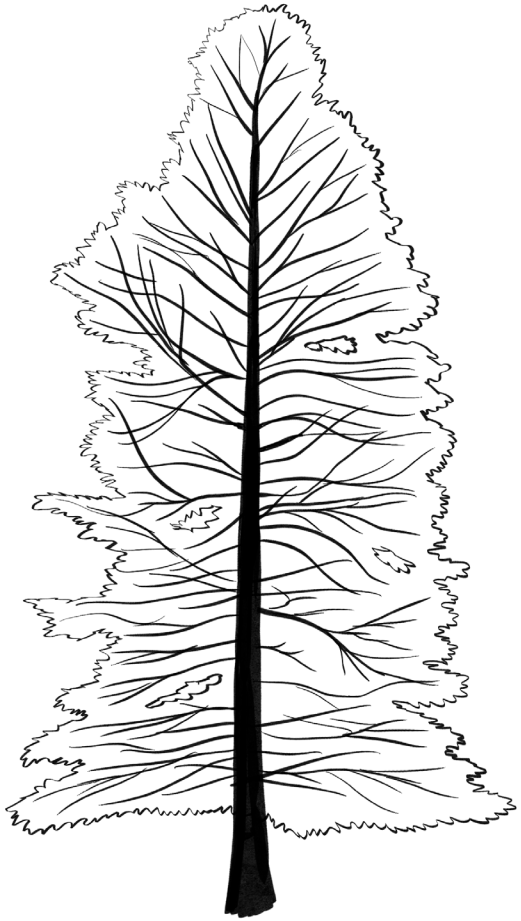
CULTIVARS Regent™ 'PNI 5723', 'Summer Snow', and 'Ivory Silk' reportedly all have superior flower production and foliage, as well as a uniform form; 'Ivory Silk' named Society of Municipal Arborists' 1997 Urban Tree of the Year

NOTES & LIMITATIONS

Reportedly the most adaptable lilac, this species makes a beautiful street tree. However, it has begun to cause concern related to invasive potential - recommended to not plant near natural settings where they could invade, and to monitor.

BALD CYPRESS

Taxodium distichum



ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun, partial shade

SOIL PH ≤7.0

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 50-70'

WIDTH 20-40'

GROWTH Slow - medium

FORM Columnar in youth, slender pyramidal at maturity with horizontal branches and a buttressed trunk

FLOWER Not ornamentally important

FRUIT Small globe-shaped cones, green to purple turns to brown

FOLIAGE Emerging late in spring, soft green turns to brilliant orange-brown in fall

BARK Attractive reddish-brown with narrow ridges

PLANTING CONSIDERATIONS

PESTS Susceptible to spider mites, forest tent caterpillar moth

TOLERATES Drought, flooding, salt, pollution, poor drainage, wind

TRANSPLANT Difficult, B&B or CG recommended, slow to establish

CULTIVARS Shawnee Brave® 'Michelson' is narrow, shows mite resistance, and tolerates higher pH soils; 'Monarch of Illinois' is wide-spreading, and may be the most resistant to mites

NOTES & LIMITATIONS

Named the Society of Municipal Arborists' 2007 Urban Tree of the Year, this long-lived deciduous conifer is often found in swamps or wet areas in its native range. Although it may exhibit chlorosis when growing in alkaline soil, it also makes a good street tree.

ARBORVITAE

Thuja occidentalis

ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 40-60'

WIDTH 10-15'

GROWTH Slow

FORM Narrow- to broadly-pyramidal

FLOWER Not ornamentally important

FRUIT Small, brown to tan cones

FOLIAGE Dense, rich green needles may turn to yellowish-green in winter

BARK Gray to reddish-brown furrows

PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to bagworm, heart rot, spider mites, & leaf miner

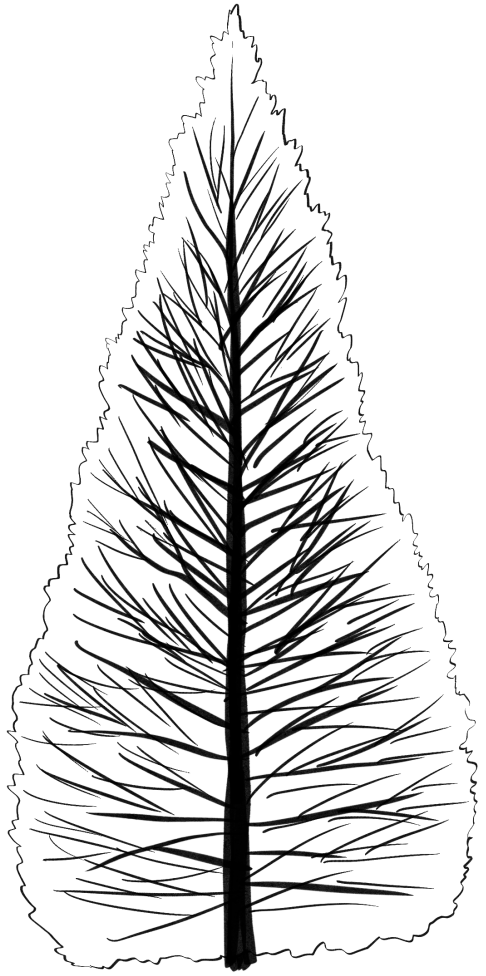
TOLERATES Salt, pollution, poor drainage, shearing

TRANSPLANT B&B or CG recommended

CULTIVARS 'Degroot's Spire', 'Nigra', 'Pendula', 'Hetz Midget', 'Pumila Sudworth' are all utility line compatible

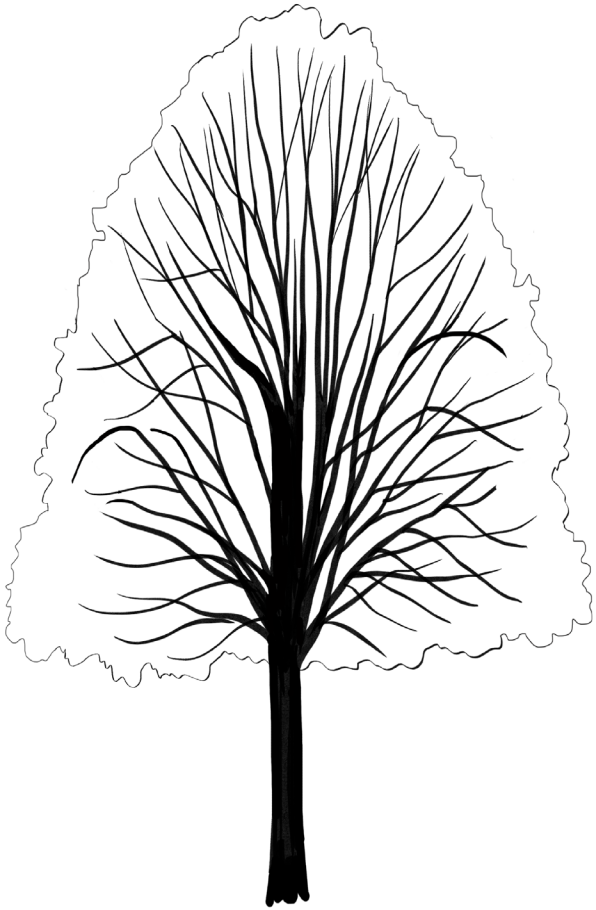
NOTES & LIMITATIONS

Also known as White Cedar, this popular evergreen is attractive and adaptable, and commonly used in the landscape as an effective screen, although it may be susceptible to deer browse and branch breakage.



AMERICAN LINDEN

Tilia americana



ENVIRONMENTAL CONDITIONS

ZONE 3A

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry and saturated soil

CHARACTERISTICS

HEIGHT 60-80'

WIDTH 20-40'

GROWTH Medium - fast

FORM Pyramidal in youth, oval- rounded with arched, spreading branches at maturity

FLOWER Small, fragrant creamy-yellow blooms held in drooping clusters

FRUIT Whitish-yellow, fuzzy, hard-shelled nutlets

FOLIAGE Dark green turns to yellow-green in fall at best

BARK Gray to brown, smooth in youth, furrowed with flat ridges at maturity

PLANTING CONSIDERATIONS

PESTS None serious, but susceptible to linden mites, Japanese beetles, aphids

TOLERATES Flooding, poor drainage

TRANSPLANT Easy B&B

CULTIVARS 'Lincoln' has an, upright, compact form with good yellow fall color; American Sentry® 'McKSentry' has a pyramidal, symmetrical form; 'Redmond' is common, densely branched, named Society of Municipal Arborists' 2000 Urban Tree of the Year

NOTES & LIMITATIONS

Also known as Basswood, this reportedly underutilized, beautiful native species may not be well suited to tough urban sites, as it is sensitive to salt and pollution and may be susceptible to branch breakage, but makes a great addition to large sites in the landscape.

LITTLELEAF LINDEN

Tilia cordata

ENVIRONMENTAL CONDITIONS

ZONE 3B

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 50-70'

WIDTH 30-50'

GROWTH Medium - fast

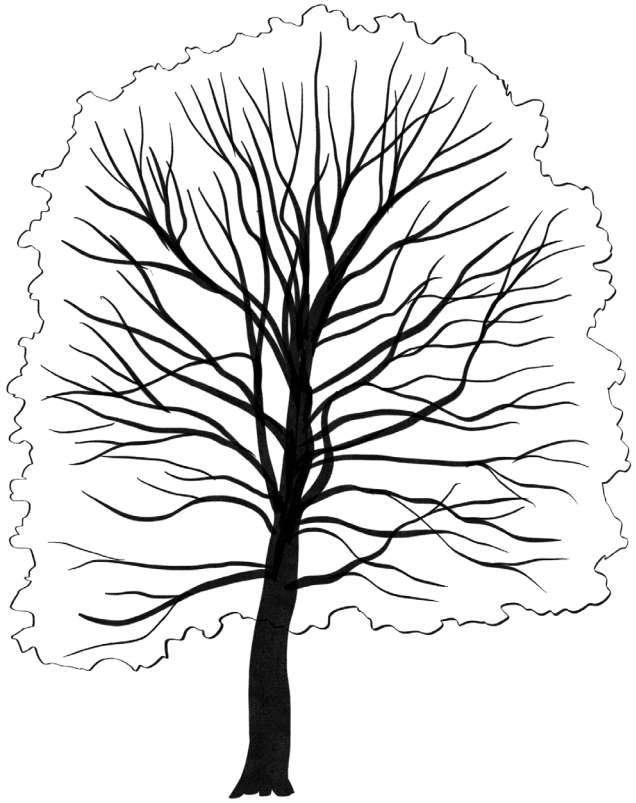
FORM Pyramidal in youth, upright-oval to pyramidal-rounded at maturity, dense

FLOWER Small, fragrant yellowish flowers in loose drooping clusters attached to leaf-like bracts

FRUIT Small, globose nutlets

FOLIAGE Dark green turns to yellow-green to yellow in fall

BARK Gray-brown, ridged and furrowed with age



PLANTING CONSIDERATIONS

PESTS Aphids, Japanese beetles, and sooty mold can be a serious issues

TOLERATES Pollution, shearing

TRANSPLANT Easy B&B or ≤2" caliper BR

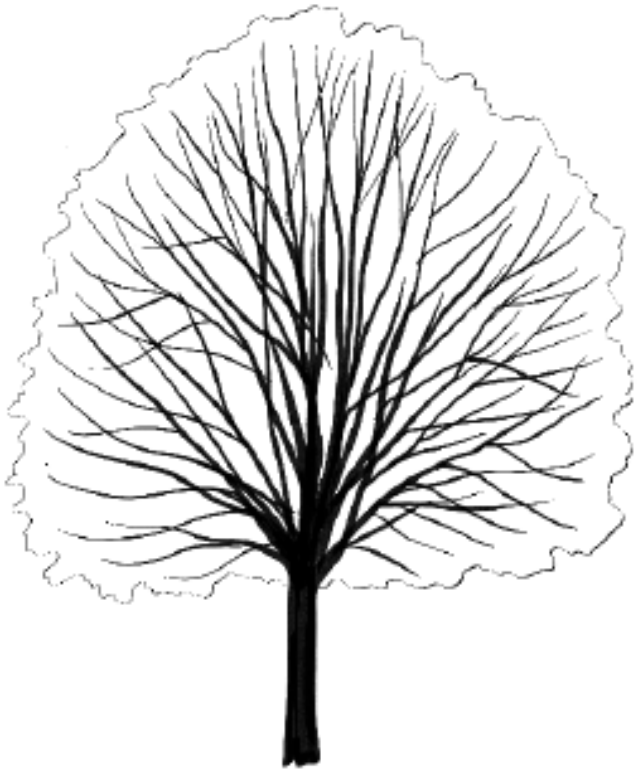
CULTIVARS Greenspire® is popular due to its central leader and uniform branching; Corinthian® 'Corzam' has compact habit, with thicker, glossier foliage; Summer Sprite® 'Halka' grows to be 20' x 18', good heat tolerance; 'Glenleven' is reportedly very cold hardy, but less dense

NOTES & LIMITATIONS

This species is much more commonly planted than *T. americana*, due to its adaptability to adverse conditions, although it may be susceptible to branch breakage.

SILVER LINDEN

Tilia tomentosa



ENVIRONMENTAL CONDITIONS

ZONE	5A	**SOIL PH**	≤8.2
LIGHT	Full sun, partial shade	**MOISTURE**	Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT	50-70'	**FLOWER**	Small, fragrant yellowish-white drooping clusters attached to pale greenish- yellow bracts
WIDTH	25-55'		
GROWTH	Medium	**FRUIT**	Small nutlets
FORM	Pyramidal in youth, pyramidal to upright-oval, dense and symmetrical at maturity	**FOLIAGE**	Glossy dark green with a silver underside turns to green-yellow or yellow in fall
		BARK	Smooth light gray in youth, gray-brown and furrowed with age

PLANTING CONSIDERATIONS

PESTS	Susceptible to various pests, aphids can be serious; less susceptible to Japanese beetles than other *Tilia*	**CULTIVARS**	'Sterling' is reportedly resistant to Japanese beetle and Gypsy Moth; Green Mountain® 'PNI 6051' is faster growing; Satin Shadow™ 'Sashazam' may be more cold hardy, reportedly resistant to Japanese beetle, uniform symmetrical growth make it better suited for street use
TOLERATES	Drought, heat, pollution, shearing		
TRANSPLANT	Moderately difficult B&B or BR, slow to establish		

NOTES & LIMITATIONS

Noted as the most beautiful linden, this species is quite adaptable to adverse conditions, although it may have limited availability.

AMERICAN ELM CULTIVARS

Ulmus americana

ENVIRONMENTAL CONDITIONS

ZONE Varies, 3B-5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 60-80'

WIDTH 30-60'

GROWTH Medium - fast

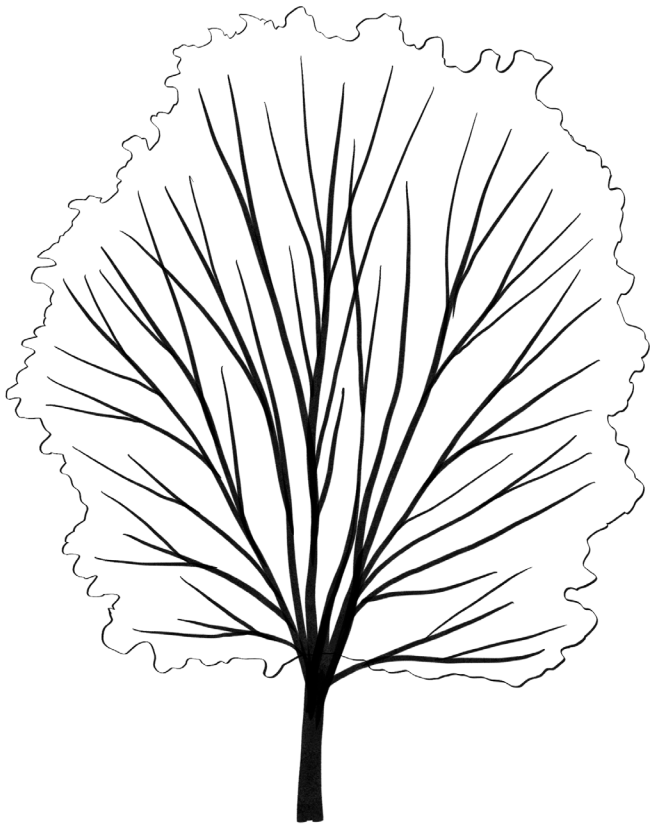
FORM Varies, often majestic and vase-shaped

FLOWER Not ornamentally important

FRUIT Small, greenish-yellow samaras

FOLIAGE Green to dark green turns to yellow in fall

BARK Dark gray with broad, deep ridges



PLANTING CONSIDERATIONS

PESTS Cultivars resistant to DED; elm yellows and elm leaf beetle resistance varies; susceptible to ALB, cankers, aphids, powdery mildew

TOLERATES Drought, flooding, salt, pollution, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

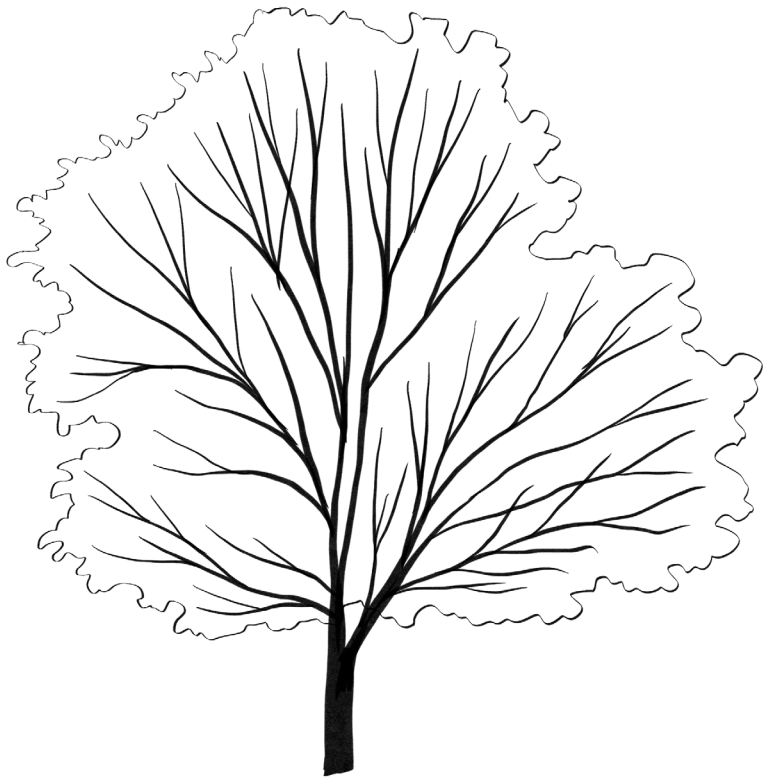
CULTIVARS 'New Harmony', 'Jefferson', 'Delaware #2', 'Princeton', and 'Valley Forge' reportedly have the most promising resistance, with the latter two cultivars being the most available in commerce

NOTES & LIMITATIONS

The beauty and adaptability of this native species is perhaps unmatched, however, extreme caution should be used when selecting due to the severity of pest issues and susceptibility to branch breakage caused by poor structure. New cultivars show promising pest resistance, and are strongly recommended to select over the species.

LACEBARK ELM

Ulmus parvifolia



ENVIRONMENTAL CONDITIONS

ZONE 5B

LIGHT Full sun, partial shade, shade

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 40-75'

WIDTH 30-75'

GROWTH Medium - fast

FORM Rounded to vase-shaped, branching varies; upright-spreading, horizontally-spreading, or pendulous

FLOWER Not ornamentally important

FRUIT Small, greenish-red disc-shaped samara

FOLIAGE Leathery dark green turns to variable yellow-brown or burgundy in fall

BARK Ornamental, exfoliating to reveal gray, green, orange, and brown colors

PLANTING CONSIDERATIONS

PESTS Susceptible to ALB; shows resistance to elm leaf beetle, Japanese beetle, DED, and elm yellows

TOLERATES Drought, flooding, salt, poor drainage

TRANSPLANT Easy B&B

CULTIVARS 'Small Frye' is a smaller form, 18' x 25'; Everclear® 'BSNUPF' has upright, columnar form, 40' x 15'; Allee® 'Emer II' resembles the American elm, 70' x 60', named Society of Municipal Arborists' 2003 Urban Tree of the Year

NOTES & LIMITATIONS

Extreme adaptability, ornamental beauty, and resistance to pests make this species a great addition to a wide variety of sites.

ELM HYBRIDS

Ulmus x spp.

ENVIRONMENTAL CONDITIONS

ZONE Varies, 3B-5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil and occasional periods of saturated soil

CHARACTERISTICS

HEIGHT 50-70'

WIDTH 40-60'

GROWTH Medium - fast

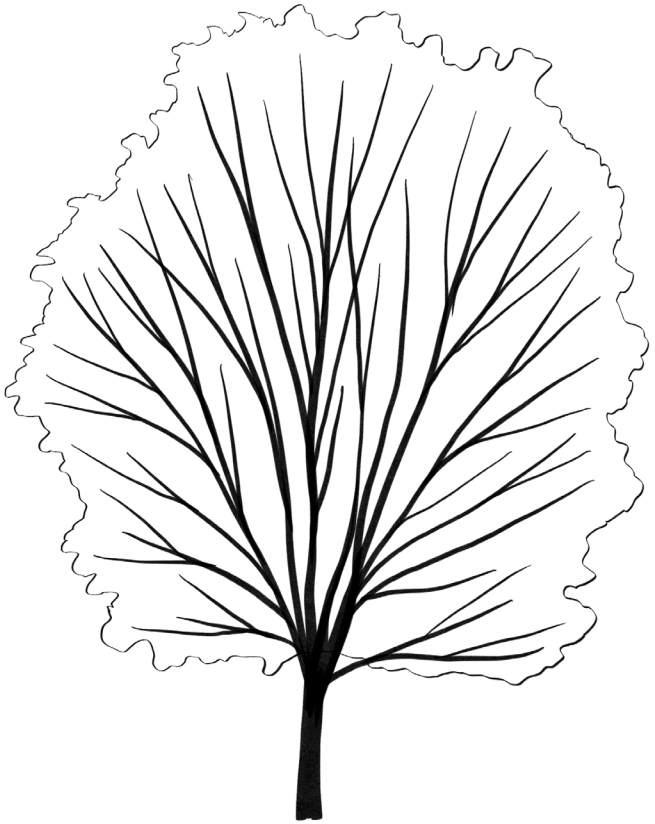
FORM Varies

FLOWER Inconspicuous

FRUIT Small, disc-shaped

FOLIAGE Medium to dark green turn to yellow in fall

BARK Gray to brown, ridged or scaly



PLANTING CONSIDERATIONS

PESTS Listed cultivars are resistant to DED; elm yellows & elm leaf beetle resistance varies; susceptible to ALB

TOLERATES Drought, flooding, salt, pollution, poor drainage

TRANSPLANT Easy B&B or ≤2" caliper BR

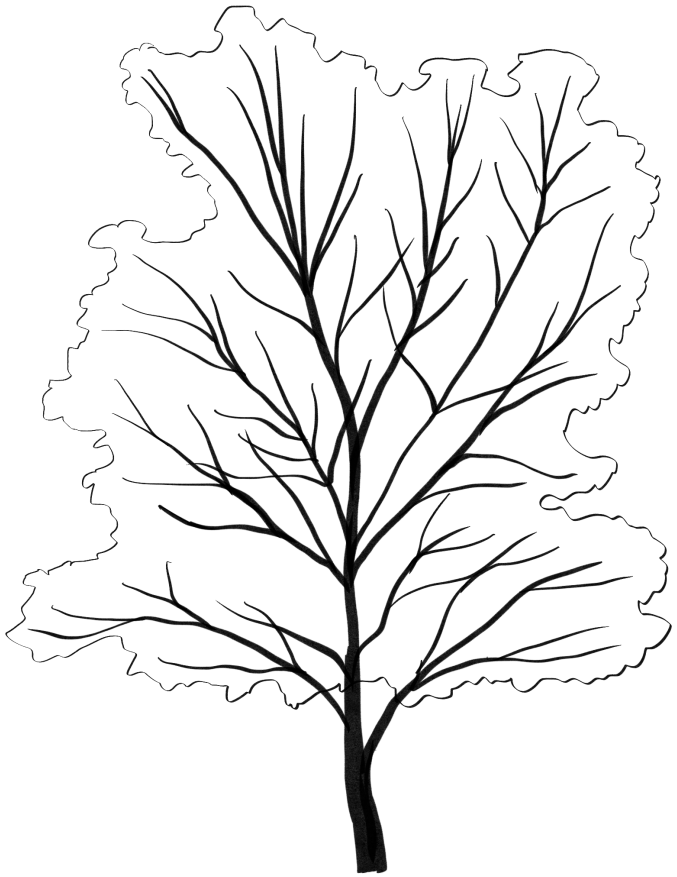
CULTIVARS 'New Horizon' is upright with a full crown; 'Patriot' is narrower than most elms, with an upright, vase- shaped form; Accolade™ 'Morton' has an American elm-like habit, glossy dark green foliage, Society of Municipal Arborists' 2012 Urban Tree of the Year

NOTES & LIMITATIONS

Hybridization between different elm species has yielded pest resistance and adaptability to adverse conditions.

SIEBOLD VIBURNUM

Viburnum sieboldii



ENVIRONMENTAL CONDITIONS

ZONE 4B

LIGHT Full sun, partial shade

SOIL PH ≤8.2

MOISTURE Tolerates occasional periods of dry soil

CHARACTERISTICS

HEIGHT 15-20'

WIDTH 10-15'

GROWTH Medium

FORM Upright, open

FLOWER Showy, fragrant, flat clusters of small cream-colored flowers can cover entire plant

FRUIT Showy oval drupes in clusters, red matures to black

FOLIAGE Dark green, occasionally turns to red or purple in fall, but often no fall color

BARK Gray, alligator-like

PLANTING CONSIDERATIONS

PESTS Not susceptible to Viburnum leaf beetle

TOLERATES Shearing

TRANSPLANT Easy

CULTIVARS 'Seneca' is heavily flowering, fruit remains attractive for longer; 'Wavecrest' grows 10-12' x 6-8', bright red fall foliage; Ironclad™ 'KLMfour' is notably cold hardy, grows 15' x 12', dark burgundy fall foliage

NOTES & LIMITATIONS

Although this species does poorly in heat and drought conditions, it makes a highly ornamental addition to the landscape, sheared as a shrub or kept as a small tree.

JAPANESE ZELKOVA

Zelkova serrata

ENVIRONMENTAL CONDITIONS

ZONE 5A

LIGHT Full sun

SOIL PH ≤8.2

MOISTURE Tolerates prolonged periods of dry soil

CHARACTERISTICS

HEIGHT 50-80'

WIDTH 40-60'

GROWTH Medium

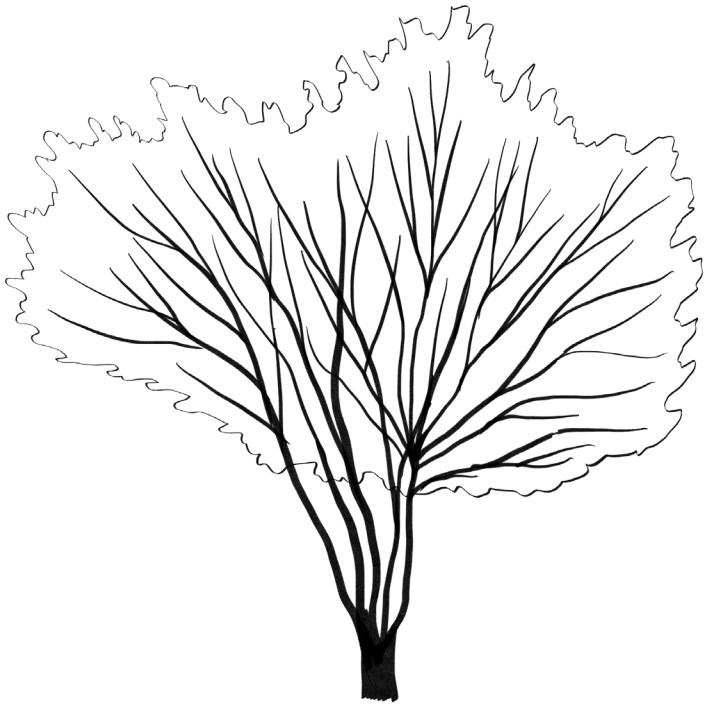
FORM Vase-shaped with upright arching branches and a short trunk

FLOWER Not ornamentally important

FRUIT Not ornamentally important

FOLIAGE Dark green turns to variable yellow, orange, red, bronze, purple mix in fall

BARK Ornamental, brown and smooth in youth, gray and exfoliating with age to expose orange inner bark



PLANTING CONSIDERATIONS

PESTS Japanese beetles feed on foliage, shows resistance to Dutch elm disease and bacterial canker

TOLERATES Drought, heat, salt, pollution

TRANSPLANT Easy B&B or ≤2" caliper BR

CULTIVARS City Sprite™ grows to be 24' x 18'; Green Vase® has a graceful form and grows fast; 'Musashino' has an upright, narrow form that is good for tight planting areas, Society of Municipal Arborists' 2016 Urban Tree of the Year

NOTES & LIMITATIONS

Similar, yet less impressive, in appearance to an elm tree. Boasts adaptability to adverse conditions and pest resistance. Makes a good street tree, although it may be susceptible to branch breakage.

TREE SPECIES - QUICK GUIDE

Common Name	Scientific Name	Zone	Height (Ft)	Width (Ft)	Native	Utility Line Compatible	Notably Urban	Candidate for Assisted Migration	Page #
White Fir	*Abies concolor*	4A	30-50	15-30	✓				17
Trident Maple	*Acer buergerianum*	5B	20-30	15-25		✓	✓		18
Hedge Maple	*Acer campestre*	5A	25-35	25-35			✓		19
Paperbark Maple	*Acer griseum*	5A	20-30	20-30		✓			20
Miyabe Maple	*Acer miyabei*	4B	30-45	30-40					21
Red Maple	*Acer rubrum*	3B	40-60	30-70	✓		✓		22
Sugar Maple	*Acer sacharrum*	3B	60-75	35-50	✓				23
Purpleblow Maple	*Acer truncatum*	4B	25-30	25-30		✓	✓		24
Freeman Maple	*Acer x freemanii*	4A	40-75	Varies	✓				25
Red Horsechestnut	*Aesculus x carnea*	5A	30-50	30					26
Serviceberry	*Amelanchier* spp.	4A	15-25	15-30	✓	✓			27
River Birch	*Betula nigra*	4A	40-70	40-60	✓				28
Common Hornbeam	*Carpinus betulus*	5A	35-60	30-40					29
American Hornbeam	*Carpinus caroliniana*	3A	20-30	20-30	✓	✓			30
Northern Catalpa	*Catalpa speciosa*	4A	40-60	20-40	✓		✓		31
Sugar Hackberry	*Celtis laevigata*	5A	60-80	50	✓		✓	✓	32
Common Hackberry	*Celtis occidentalis*	3A	40-60	40-60	✓		✓	✓	33
Katsura Tree	*Cercidiphyllum japonicum*	4A	40-60	25-60					34
Eastern Redbud	*Cercis canadensis*	4A	20-30	25-35	✓	✓	✓	✓	35
Atlantic White Cedar	*Chamaecyparis thyoides*	4B	40-60	10-20	✓				36
White Fringetree	*Chionanthus virginicus*	5A	15-25	10-25	✓	✓	✓		37
Yellowwood	*Cladrastis kentukea*	4A	30-50	40-55	✓				38
Japanese Clethra	*Clethra barbinervis*	5B	10-20	10-20		✓			39
Kousa Dogwood	*Cornus kousa*	5A	15-30	15-30		✓			40
Corneliancherry Dogwood	*Cornus mas*	5A	15-25	15-20		✓			41
Dogwood Hybrids	*Cornus x rutgersensis*	5A	10-20	10-20		✓		✓	42

TREE SPECIES - QUICK GUIDE

Common Name	Scientific Name	Zone	Height (Ft)	Width (Ft)	Native	Utility Line Compatible	Notably Urban	Candidate for Assisted Migration	Page #
Turkish Filbert	*Corylus colurna*	4A	40-50	15-35			✓		43
American Smoketree	*Cotinus obovatus*	4A	20-30	15-30	✓	✓	✓		44
Thornless Cockspur	*Crataegus crusgalli* var. *inermis*	4A	20-30	20-35	✓	✓	✓		45
'Winter King' Hawthorn	*Crataegus virdis* 'Winter King'	4A	25	25	✓	✓	✓		46
Hardy Rubber Tree	*Eucommia ulmoides*	5A	40-60	40-60			✓		47
Gingko	*Gingko biloba*	4B	50-80	30-40			✓		48
Thornless Honeylocust	*Gleditsia triacanthos* var. *inermis*	4B	40-60	30-70	✓		✓		49
Kentucky Coffeetree	*Gymnocladus dioicus*	3A	50-75	40-50	✓		✓		50
Carolina Silverbell	*Halesia carolina*	5A	20-40	20-35	✓				51
Witchhazel	*Hamamelis virginiana*	4A	10-30	15-20	✓	✓			52
Eastern Red Cedar	*Juniperus virginiana*	3B	40-50	8-20	✓		✓	✓	53
Goldenraintree	*Koelreuteria paniculata*	5A	30-40	30-40			✓		54
American Sweetgum	*Liquidambar styraciflua*	5B	50-75	40-65	✓			✓	55
Tuliptree	*Liriodendron tulipifera*	5A	70-90	35-50	✓			✓	56
Amur Maackia	*Maackia amurensis*	4A	20-30	20-30		✓	✓		57
Thornless Osage Orange	*Maclura pomifera* var. *inermis*	5B	20-50	20-50	✓		✓	✓	58
Flowering Crabapple	*Malus* spp.	4B	10-25	10-25		✓			59
Dawn Redwood	*Metasequoia glyptostroboides*	5A	70-100	25-50					60
Black Gum	*Nyssa sylvatica*	4A	30-60	20-40	✓				61
American Hophornbeam	*Ostrya virginiana*	4A	25-40	20-40	✓				62
Persian Parrotia	*Parrotia persica*	5A	20-30	15-30		✓	✓		63
Serbian Spruce	*Picea omorika*	4B	50-60	20-25					64
Swiss Stone Pine	*Pinus cembra*	4A	30-40	15-25					65
London Planetree	*Platanus* x *acerifolia*	5A	70-100	65-80			✓		66
Accolade Cherry	*Prunus* 'Accolade'	5A	20-30	15-25		✓			67
Common Hoptree	*Ptelea trifoliata*	4A	15-20	15-20	✓	✓			68

TREE SPECIES - QUICK GUIDE

Common Name	Scientific Name	Zone	Height (Ft)	Width (Ft)	Native	Utility Line Compatible	Notably Urban	Candidate for Assisted Migration	Page #
White Oak	*Quercus alba*	4A	45-80	45-80	✓			✓	69
Swamp White Oak	*Quercus bicolor*	4A	45-70	45-60	✓		✓		70
Scarlet Oak	*Quercus coccinea*	5A	60-75	40-50	✓			✓	71
Shingle Oak	*Quercus imbricaria*	4A	40-60	40-65	✓			✓	72
Bur Oak	*Quercus macrocarpa*	3A	60-80	60-90	✓		✓	✓	73
Chestnut Oak	*Quercus montana*	5A	60-70	60-70	✓			✓	74
Chinkapin Oak	*Quercus muehlenbergii*	4B	35-50	35-60	✓			✓	75
Pin Oak	*Quercus palustris*	4A	50-70	25-40	✓				76
Willow Oak	*Quercus phellos*	6A	40-60	40-60	✓		✓	✓	77
English Oak	*Quercus robur*	5A	40-60	40-60			✓		78
Northern Red Oak	*Quercus rubra*	4A	60-75	60-75	✓		✓		79
Shumard Oak	*Quercus shumardii*	5B	40-60	45-65	✓		✓		80
Common Sassafras	*Sassafras albidum*	4B	30-60	25-40	✓				81
Japanese Umbrella Pine	*Sciadopitys verticillata*	5B	20-30	15-20		✓			82
Japanese Pagodatree	*Styphnolobium japonicum*	5A	50-70	35-55			✓		83
Japanese Tree Lilac	*Syringa reticulata*	3A	20-30	15-25		✓	✓		84
Bald cypress	*Taxodium distichum*	5A	50-70	20-40	✓		✓	✓	85
Arborvitae	*Thuja occidentalis*	3A	40-60	10-15	✓		✓		86
American Linden	*Tilia americana*	3A	60-80	20-40	✓				87
Littleleaf Linden	*Tilia cordata*	3B	50-70	30-50					88
Silver Linden	*Tilia tomentosa*	5A	50-70	25-55			✓		89
American Elm Cultivars	*Ulmus americana*	3B-5A	60-80	30-60	✓		✓		90
Lacebark Elm	*Ulmus parvifolia*	5B	40-75	30-75			✓		91
Elms Hybrids	*Ulmus* x spp.	3B-5A	50-70	40-60			✓		92
Siebold Viburnum	*Viburnum sieboldii*	4B	15-20	10-15		✓			93
Japanese Zelkova	*Zelkova serrata*	5A	50-80	40-60			✓		94

TREE SPECIES - TRAITS

Notable ornamental characteristics

Common Name	Scientific Name	Flower	Fruit	Foliage	Bark	Page #
White Fir	*Abies concolor*			✓		17
Trident Maple	*Acer buergerianum*			✓	✓	18
Paperbark Maple	*Acer griseum*			✓	✓	20
Red Maple	*Acer rubrum*	✓		✓	✓	22
Sugar Maple	*Acer saccharum*			✓		23
Purpleblow Maple	*Acer truncatum*			✓		24
Freeman Maple	*Acer* x *freemanii*			✓	✓	25
Red Horsechestnut	*Aesculus* x *carnea*	✓				26
Serviceberry	*Amelanchier* spp.	✓		✓	✓	27
River Birch	*Betula nigra*				✓	28
American Hornbeam	*Carpinus caroliniana*			✓	✓	30
Northern Catalpa	*Catalpa speciosa*	✓				31
Katsuratree	*Cercidiphyllum japonicum*			✓		34
Eastern Redbud	*Cercis canadensis*	✓			✓	35
White Fringetree	*Chionanthus virginicus*	✓		✓		37
Yellowwood	*Cladrastis kentukea*	✓		✓	✓	38
Japanese Clethra	*Clethra barbinervis*	✓			✓	39
Kousa Dogwood	*Cornus kousa*	✓	✓	✓	✓	40
Corneliancherry Dogwood	*Cornus mas*	✓	✓		✓	41
Flowering Dogwood Hybrids	*Cornus* x *rutgersensis*	✓	✓	✓		42
American Smoketree	*Cotinus obovatus*		✓	✓	✓	44
Thornless Cockspur	*Crataegus crusgalli* var. *inermis*	✓	✓	✓		45
'Winter King' Hawthorn	*Crataegus virdis* 'Winter King'	✓	✓	✓	✓	46
Gingko	*Gingko biloba*			✓		48
Thornless Honeylocust	*Gleditsia triacanthos* var. *inermis*			✓	✓	49

TREE SPECIES - TRAITS

Notable ornamental characteristics

Common Name	Scientific Name	Flower	Fruit	Foliage	Bark	Page #
Carolina Silverbell	*Halesia carolina*	✓				51
Witchhazel	*Hamamelis virginiana*			✓		52
Goldenraintree	*Koelreuteria paniculata*	✓		✓		54
American Sweetgum	*Liquidambar styraciflua*			✓		55
Tuliptree	*Liriodendron tulipifera*	✓		✓	✓	56
Amur Maackia	*Maackia amurensis*				✓	57
Thornless Osage Orange	*Maclura pomifera* var. *inermis*				✓	58
Flowering Crabapple	*Malus* spp.	✓	✓	✓		59
Black Gum	*Nyssa sylvatica*			✓		61
American Hophornbeam	*Ostrya virginiana*				✓	62
Persian Parrotia	*Parrotia persica*	✓		✓	✓	63
London Planetree	*Platanus* × *acerifolia*				✓	66
Accolade Cherry	*Prunus* 'Accolade'	✓	✓	✓	✓	67
White Oak	*Quercus alba*			✓	✓	69
Swamp White Oak	*Quercus bicolor*			✓	✓	70
Scarlet Oak	*Quercus coccinea*			✓		71
Chestnut Oak	*Quercus montana*			✓	✓	74
Northern Red Oak	*Quercus rubra*			✓		79
Common Sassafras	*Sassafras albidum*			✓	✓	81
Japanese Pagodatree	*Styphnolobium japonicum*	✓				83
Japanese Tree Lilac	*Syringa reticulata*	✓			✓	84
Bald Cypress	*Taxodium distichum*			✓	✓	85
Lacebark Elm	*Ulmus parvifolia*				✓	91
Sielbold Viburnum	*Viburnum sieboldii*	✓	✓			93
Japanese Zelkova	*Zelkova serrata*			✓	✓	94

APPROACH

1.1 Tree species

A comprehensive, broad-based literature review was undertaken to decide which tree species would be included in Planting for Resilience: Selecting Urban Trees in Massachusetts. This began by determining which trees were recommended in other selection guides produced by university extension programs, state agencies, and the industry (i.e., nurseries). Once an initial list relevant to growing conditions in the Northeast was composed, characteristics and attributes of each tree (i.e., preferred environmental conditions, site adaptability, optimal growing conditions) were assessed. This information was gathered from not only the aforementioned selection guides, but tree identification books, encyclopedias, and online resources generated from various stakeholders (see pages 104-106).

Individual tree species were carefully scrutinized and eliminated based on invasive potential (i.e., *Robinia pseudoacacia*), pest susceptibility (i.e., *Fraxinus* spp., *Sorbus* spp.), management considerations (i.e., *Pyrus calleryana*) and overall compatibility to adverse urban environments (i.e., *Acer saccharinum, Pinus strobus*). Tree species' sensitivity and adaptability to common stress factors found in the urban environment (i.e., alkaline soil, drought, heat, salt, pollution, poorly drained soils, mechanical damage), were specifically considered; from there, current and future habitat suitability was analyzed in an attempt to ensure that remaining tree species would be well-adapted to future climate projections of the Northeast (see Methods 1.5).

1.2 Criteria

Tree species data is often anecdotal, based on observations of industry professionals, agency/university specialists and tree enthusiasts from the general public. Discrepancies concerning tree attributes and characteristics often occurred between reference materials. Thus, consistency and agreement among sources was an important consideration relevant to determining the information that was deemed acceptable to include. Generally, information presented in this guide has been verified by at least two other references. Though no single claim or piece of information was casually dispensed with, a hierarchy of trust was established where isolated claims and observations in sole sources were not included in an attempt to conservatively consider discrepancies. For example, the "highest" or most conservative hardiness zone rating found in the literature for each species was listed on their profile, if it could be verified by two or more sources. This was done so that a tree would not be planted in a zone that would be too cold, beyond what it could tolerate. A range was presented regarding each tree species' height and width, that generally included the smallest and largest values found in the literature.

1.3 Limitations

Urban forestry is a relatively new field of study, and unlike traditional forestry where trees have been studied and observed for many centuries, there is a dearth of data concerning the growth and response of trees in our expanding towns and cities. Climatic projections themselves also vary. Being such long-lived organisms, trees may not perform as predicted relative to their response to shifting habitat suitability, over extended periods of time.

1.4 Urban tree suitability

"Urban" tree species must be able to tolerate a host of difficult conditions including soils that often feature extreme pH, prolonged periods of dryness, salt, pollution, and poor drainage. Although not all species here are well-suited for tough, urban sites, we highlight species (using an icon in the top corner of its profile page) that are notably adaptable to these adverse conditions. Some references (Dirr, University of Connecticut, Cornell University) presented a list of species that were recommended to plant in tough, urban sites, which were taken into account.

1.5 Trees and assisted migration

This table displays our interpretation of data obtained from the US Forest Service[10,20]. This data set was specific to Massachusetts, and was divided into 1° latitude x 1° longitude sectors, which essentially coincide with what is considered western, central, and eastern Massachusetts. Species marked with * were not included in this data set, but were found in the US Forest Service's Climate Change Tree Atlas. Highlighted species are projected to gain habitat suitability, therefore were chosen as 'Candidates for assisted migration'.

Model reliability

1= most reliable, 3= least reliable.

Current abundance

Tree species abundance varies across the state, due to numerous factors. To determine each species' mean state-wide current abundance, we averaged the data from the three sectors of Massachusetts by assigning a value to each abundance class [0: absent; 1: rare; 2: common; 3: abundant].

Changes in habitat suitability

Possible change in habitat suitability by 2100 according to the ratios of future (2070-2099) suitable habitat for an average of 3 climate models to current (1981-2010) modeled habitat at RCP4.5 (low emissions) and RCP8.5 (high emissions) scenarios. This does not necessarily mean the species' *abundance* will change in the area by 2100, only that the habitat is expected to change in suitability for that species over time. Further, it is important to note that this data is not specific to urban environments, meaning these projections may differ in the urban forest. To determine each species' mean state-wide change in habitat suitability, we averaged data from the three sectors of Massachusetts by assigning a value to each change class [-3: extirpated; -2: large decrease; -1: small decrease; 0: no change, unknown; +1: small increase; +2: large increase; +3: new habitat].

Adaptability

This score is based on a literature review of 12 disturbance (i.e., disease, drought, pollution) and 9 biological characteristics (i.e., shade tolerance, seedling establishment, environmental habitat specificity) for each species. It aims to account for factors that may effect how a species will respond to climate change that the models do not take into consideration. Scores have been classified as High (5.2-9.0), Medium (3.4-5.1), and Low (0.1-3.3). However, these scores may differ based on specific location-based factors.

Scientific Name	Model Reliability	Current Abundance	Change in Habitat Suitability (Low)	Change in Habitat Suitability (High)	Adaptability
Acer rubrum	1	Abundant	No change	Small decrease	High
Acer saccharum	1	Common	No change	No change	High
Amelanchier spp.	3	Rare	Decrease	Small decrease	Medium
*Betula nigra**	3	Rare	Unknown	Small increase	Medium
Catalpa speciosa	3	Rare	Unknown	Unknown	Medium
*Carpinus caroliniana**	2	Moderately common	Small decrease	No change	Medium
Celtis laevigata	2	Rare	New habitat	New habitat	Medium
*Celtis occidentalis**	2	Rare	Small increase	Increase	High
Cercis canadensis	3	Rare	New habitat	New habitat	Medium
Chamaecyparis thyoides	3	Rare	No change	No change	Low
Cornus florida	2	Rare	Unknown	Increase	Medium
Gleditsia triancanthos	3	Rare	No change	No change	High
*Gymnocladus dioicus**	3	Rare	Unknown	Unknown	Medium
Halesia spp.	2	Rare	Unknown	Unknown	Low
Juniperus virginiana	2	Common	Small increase	No change	Medium
Liquidambar styraciflua	1	Rare	New habitat	New habitat	Medium
Liriodendron tulipifera	1	Moderately rare	New habitat	New habitat	High
*Maclura pomifera**	2	Rare	Unknown	Small increase	High
Nyssa sylvatica	2	Common	No change	No change	High
Ostrya virginiana	3	Moderately common	Small decrease	No change	High
Quercus alba	2	Abundant	Small increase	Small increase	High
Quercus bicolor	3	Moderately rare	Small decrease	Small decrease	Medium
Quercus coccinea	2	Moderately abundant	Small increase	No change	Medium
*Quercus imbricaria**	2	Rare	Small increase	Small increase	Medium
*Quercus macrocarpa**	2	Rare	Unknown	Small increase	High
Quercus montana	1	Common	Small increase	Small increase	High
Quercus muehlenbergii	2	Rare	Unknown	Small increase	Medium
Quercus palustris	2	Rare	Large decrease	No change	Low
Quercus phellos	2	Rare	New habitat	New habitat	Medium
Quercus rubra	2	Moderately abundant	No change	No change	High
*Quercus shumardii**	3	Rare	Unknown	Small increase	High
Sassafras albidum	3	Rare	No change	No change	Medium
*Taxodium distichum**	2	Rare	Small increase	Small increase	Medium
*Thuja occidentalis**	1	Moderately common	Small decrease	Small decrease	Medium
Tilia americana	2	Common	No change	No change	Medium
Ulmus americana	2	Common	No change	Small decrease	Medium

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