Recommended Urban Trees: *A Cornell Campus Walk*

Cornell University
Ithaca, New York

Tree Walk Map on Inside Back Cover

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Acknowledgments

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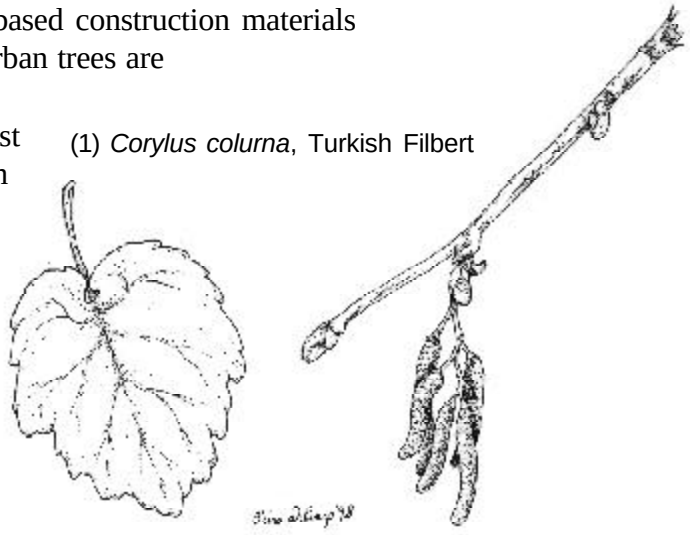
This all-season campus tree walk highlights trees that can withstand tough urban situations. Please note that some trees in this walk will inevitably disappear as a result of winter storm damage, construction, and other circumstances. Most of the walk is wheelchair accessible, with short detours sometimes necessary.

This tree walk and other publications related to recommended urban trees are available on-line at the Cornell University Urban Horticulture Institute web site:

http://www.hort.cornell.edu/department/faculty/bassuk/uhi/

The reputation for natural beauty of the Cornell campus is rightly celebrated. Campus trees strategically planted in the quads and around buildings contribute to that reputation. But although campus trees appear to be in an idyllic setting, many of them are under as much stress as trees in downtown Ithaca. For trees, the "urban environment" is not just "downtown." It includes residential streets, parking lot islands, entrances to shopping malls — anywhere trees face a host of stresses brought on by people and their activities.

Trees in urban settings like the Cornell campus endure drought, poor drainage, heat, vehicle exhaust, foot and vehicular traffic over their roots, limited rooting space and the spray of deicing salts. As a medium for growing healthy plants, urban soils range from barely adequate to totally unacceptable. They may contain construction debris or be contaminated by chemical leaching. The pH of urban soils is almost always above the desirable range due to leaching from limestone-based construction materials such as concrete. Often urban trees are planted in windy, unprotected spots and must absorb heat radiating from buildings. It's no wonder urban trees don't get as big as their wild relatives... life in the city is not easy!



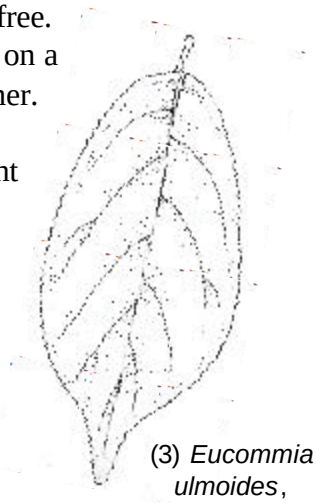
(1) *Corylus colurna*, Turkish Filbert

Your journey begins at the Turkish filbert (*Corylus colurna,* 1) tree in the Minns Garden on Tower Road. Look for the symmetrical, pyramid-shaped tree in the northwest corner of the garden. Notice the attractive scaly bark and the wide branch angles. Branches with wider angles are less likely to have *included bark*, which weakens branch attachment, so they are better able to withstand snow loads without breaking.

Turkish filbert has great potential as a street tree and has been planted on Ithaca streets in recent years. It is slow growing but once established, it tolerates drought, heat, and a wide range of soil pH. With the exception of fungal blight, which can be serious, it has few insect and disease problems. When other, less drought-resistant trees show leaf scorch, Turkish filbert foliage stays a deep, attractive green. The tiny nuts are edible, if you can wrestle them away from the squirrels and bluejays.

Leave the Minns Garden through the nearby exit and head north on the sidewalk that runs along the west side of the Plant Science building. Four cornelian cherry dogwoods (*Cornus mas,* 2) line the building. This species is adaptable to a variety of soil types and pH, and is pest-free. It flowers in very early spring when few other trees put on a show and it has gorgeous, edible red fruits in late summer.

Climb the stairs, pass a purple-leaved tree, and turn right on the asphalt sidewalk. The leggy young tree on the right is hardy rubber tree (*Eucommia ulmoides*, 3). Although it is not used commercially for rubber, latex exudes from its torn leaves. Hardy rubber tree can withstand drought and high soil pH, has few pest problems, and its dark green leaves stay attractive all summer. Close to the ground level, notice the mechanical damage to the trunk. Such injuries often reduce a tree's vigor.



(3) *Eucommia ulmoides*, Hardy Rubber Tree

Why care about urban trees?

Urban green space quite simply makes our cities livable. City trees:

- contribute to air purification and oxygen regeneration
- provide cooling in summer and wind abatement in winter
- reduce storm water runoff and allow groundwater to recharge
- reduce noise, buffer against unsightly views, and slow traffic
- increase property values, urban beauty, and neighborhood pride
- provide habitat for wildlife

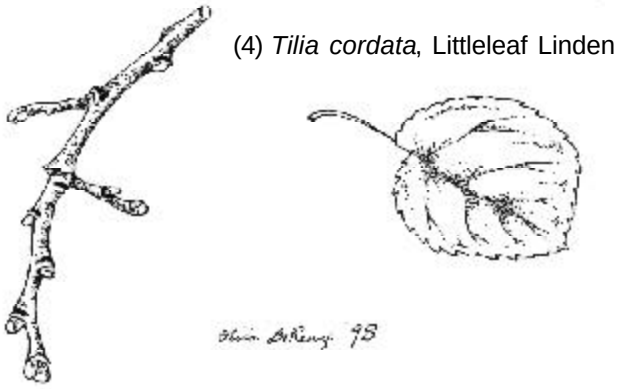
About UHI

The Urban Horticulture Institute (UHI) at Cornell, founded in 1980 by Dr. Nina Bassuk, focuses on research related to street trees. The goals of UHI research are:

- to select, evaluate, and propagate superior trees that withstand such urban stresses as soil compaction, periodic flooding, drought, and salinity;
- to develop improved technologies for assessing and ameliorating site limitations to improve plant growth and development; and
- to develop improved transplanting technologies to ensure successful establishment of trees in the urban environment.

UHI works closely with the city of Ithaca and the Cornell Plantations Arboretum to conduct experiments and to apply research findings to real-life situations. For more information, see the UHI web site:

<http://www.hort.cornell.edu/department/faculty/bassuk/uhi>

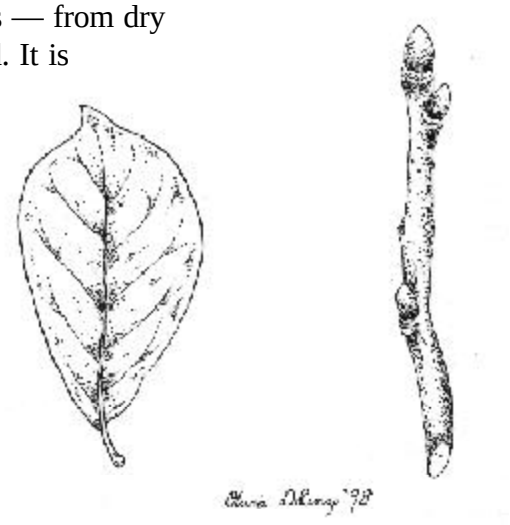


(4) *Tilia cordata*, Littleleaf Linden

Continue past some yew shrubs and benches to the front entrance to Plant Science. The large trees that flank the entrance are littleleaf lindens (*Tilia cordata*, 4). Given its distribution in the wild on limestone soils, it's not surprising that this European native tolerates high soil pH. A shade tree since ancient times, littleleaf linden is fast growing and easy to transplant. Although it can tolerate intermittent drought, prolonged drought may lead to leaf scorch. Also, littleleaf linden is sensitive to salt.

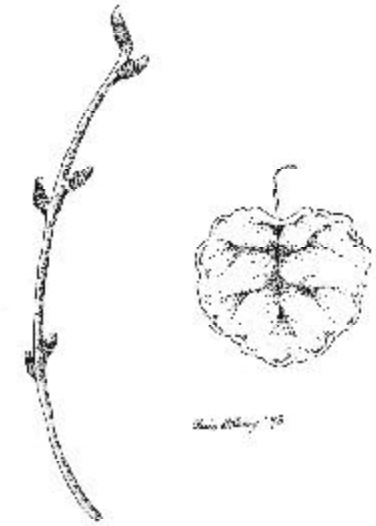
Just beyond the second linden is a single black gum, or tupelo (*Nyssa sylvatica*, 5) planted in the early 1970s. Tupelo's versatility as an urban tree

comes from its diverse native origins — from dry mountainous sites to wet swampland. It is relatively pest free and often has spectacular fall color. Much ado has been made about the difficulty of transplanting tupelo. If transplanted young and watered regularly the first year, it should be fine. One thing to note is that soil pH above 6.0 may depress tupelo's growth. The tree you see here is small for its 30-plus years. Perhaps leaching from the building and sidewalk and resultant high soil pH has stunted the tree's growth.



(5) *Nyssa sylvatica*, Tupelo

Follow the sidewalk around to the left. With your back to Mann Library, look out over the length of the Ag Quad; it looks quite different than it did in the not-so-distant past. Until the early 1970s, a double row of American elms towered over the quad, running east to west. They formed a canopy that gave the quad — and many other parts of campus — a decidedly formal character. Students today have difficulty visualizing the stunning visual impact and sense of sanctuary that these grand trees provided. The scourge that took the elms was Dutch elm disease. American elms were so widely planted as street trees that when the disease pathogen was introduced, it found many hosts on which to multiply. **Monoculture**, the planting of so many of one species, was the culprit.



(6) *Cercidiphyllum japonicum*, Katsura Tree

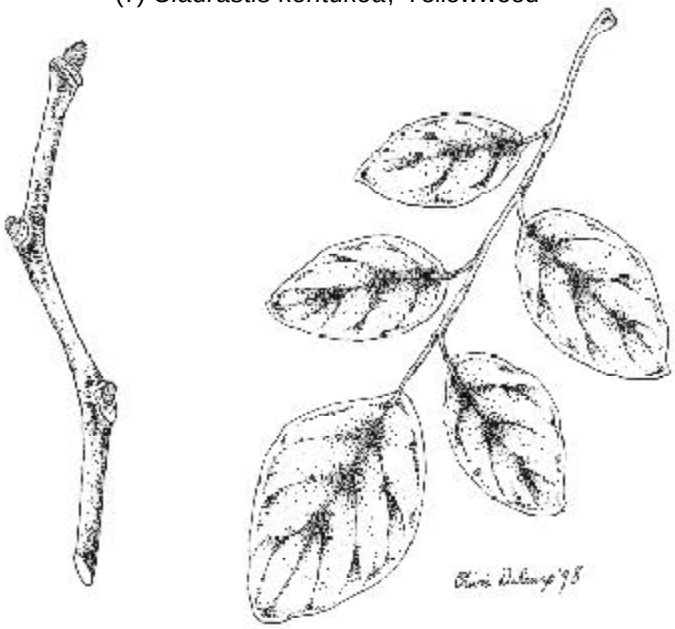
Moving past the silver "Mann Library" lettering, you'll come to a multistem katsura tree (*Cercidiphyllum japonicum*, 6). Hailing

from China and Japan, katsura makes a good street tree due to its lack of major pest problems and its ability to tolerate a range of pH levels. Its only limitation: it does not tolerate drought. In the fall when the leaves turn color and start to drop, you may notice a sugary smell. It's caused by maltose volatizing from the leaves as they die.

Continue left on the sidewalk. To one side of the Warren Hall entrance is a smooth-barked multistem yellowwood *(Cladrastis kentukea,* 7). Called yellowwood because of the color of the heartwood, this medium-sized tree is native to sites underlain by limestone and thus is adapted to a high soil pH. Yellowwood is fast growing, and it has attractive white flowers in spring and noteworthy yellow fall color. It has few insect or disease problems. Notice, however, evidence of one of the failings of yellowwood: branch splitting due to narrow crotch angles and weak wood (*Cladrastis* means "brittle branch"). You can see where a fairly large branch split off and left a wound.

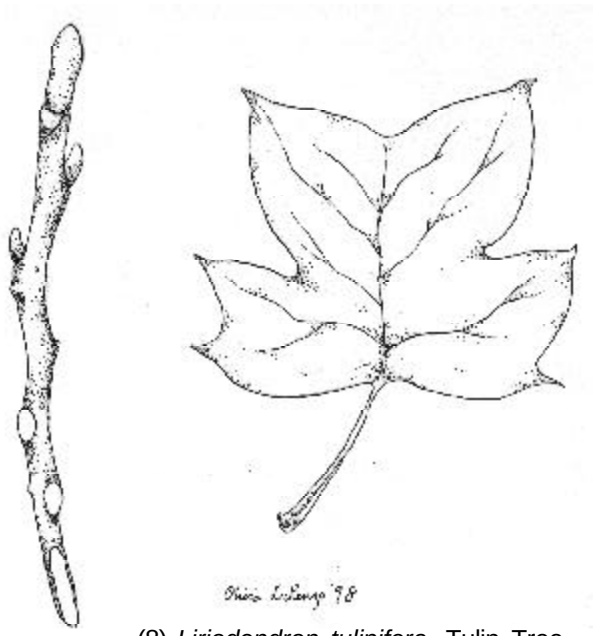
From the yellowwood, head in a diagonal direction away from Warren Hall and towards the evergreens in the distance. On your right are two large tulip trees (*Liriodendron tulipifera,* 8). Tulip tree is a fast growing, relatively pest-free, pH-tolerant choice for urban use. However, because of its massive size (to 70 to 90 feet in height), it needs ample room both above and below ground.

(7) *Cladrastis kentukea*, Yellowwood



Start with the Roots

To understand the best planting and management practices for urban trees, know where and how roots grow. Most of us grew up with the idea that roots mirror the crown of the tree, penetrating as far down as the tree grows tall. Now we know that this is emphatically not the case. Shade tree roots are found primarily in the top 12 inches of soil, and the tiny absorbing roots responsible for most of the tree's intake of water and nutrients are in the top several inches. In terms of horizontal root spread, roots not only grow beyond the dripline, there may be a higher percentage of them beyond the dripline than within it. This is why four square feet of tree protection zone around a trunk during construction is often woefully inadequate. Finally, know that 90–95% of tree roots are routinely removed in the nursery at the time of harvest. What results when trees are then planted in new environments, with only about 5% of their former root mass, is *transplant shock*.

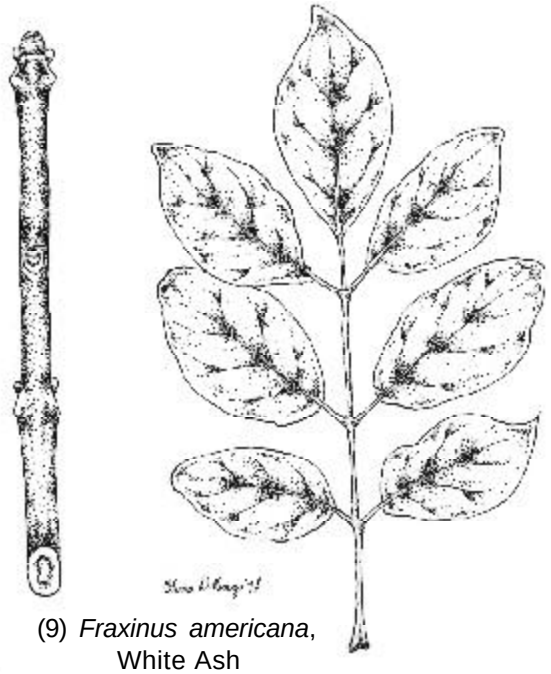


(8) *Liriodendron tulipifera*, Tulip Tree

On the other side of the path from the tulip trees is a single white ash, (*Fraxinus americana* 'Autumn Purple,' 9). Generally, white ash aren't as tough as green ash (*Fraxinus pennsylvanica*), but they have more ornamental value. White ash can tolerate intermittent flooding and high soil pH. The cultivar 'Autumn Purple' is known for its good form and attractive reddish-purple fall color.

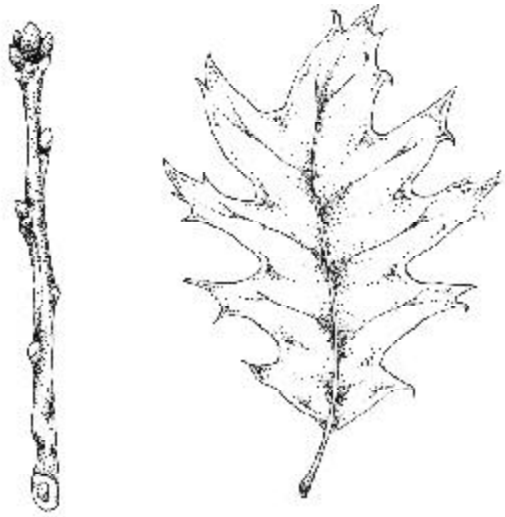
Past the tulip trees you will come into a grove of oaks: three red and three black. You can tell red and black oak apart by looking at their buds — red oak buds tend to appear rounded when viewed head on,

while black oak buds have a more angular appearance. Also, black oak leaves generally are glossier than red oak leaves.



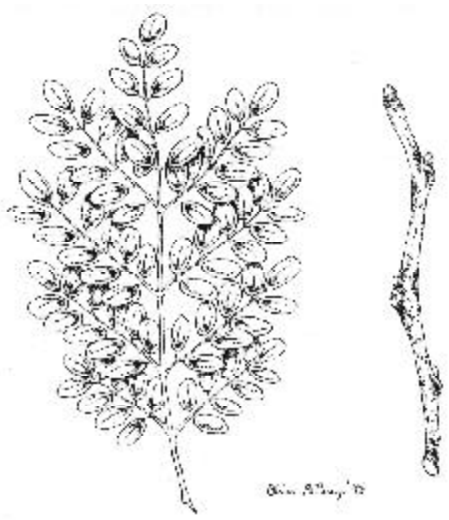
(9) *Fraxinus americana*, White Ash

Northern red oaks (*Quercus rubra*, 10) are workhorses among street trees. You will see many of them on the Cornell campus because red oaks are fairly easy to transplant, are fast growers among the oaks, and can tolerate salt and pollution along city streets. They can withstand moderately alkaline soil pH, and they cope well with dry sites once they are established. If red oaks decline, they do so slowly and gracefully, giving tree care experts plenty of time to figure out what to do.



(10) *Quercus rubra*, Northern Red Oak

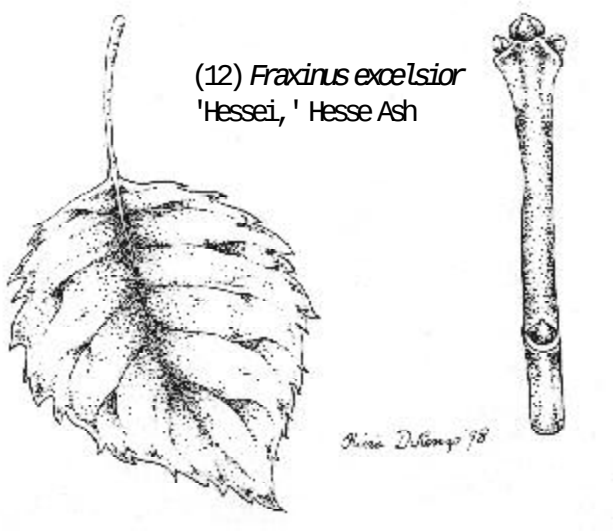
Next on the right are thornless honeylocusts, *Gleditsia triacanthos* var. *inermis* (11). The first is the cultivar ‘Majestic’; the second is 'Skyline.’ Cultivars of honeylocust are chosen for such qualities as insect resistance, compact form, attractive fall color, and reduced fruiting. Honeylocusts are members of the pea family and bear leathery, seven- to eight-inch pods that do not decompose readily.



(11) *Gleditsia triacanthos* var. *inermis*, Thornless Honeylocust

Honeylocust is a tough tree. Because of its versatility and ability to withstand urban conditions, the honeylocust has been widely planted, frequently in spots that American elms had occupied. Because of the overplanting of honeylocust, we are now seeing a variety of serious pests on it: honeylocust plant bug, spider mites, borers, webworms . . . history repeats itself. Honeylocust may be tough, but no tree species can tolerate monoculture. The lesson here is DIVERSITY!

Head toward the hemlock. You'll see two trees on the right, near a fire hydrant. The first tree on your right is Hesse European ash (*Fraxinus excelsior* 'Hessei,' 12), a cultivar that has simple leaves. In its native Europe, it thrives on limestone soils; this makes it a good choice for high pH soils. Hesse ash also tolerates intermittent flooding. This large-maturing tree is valued for its dark green, lustrous leaves. For reasons unknown, this particular specimen has not performed well.



(12) *Fraxinus excelsior* 'Hessei,' Hesse Ash

Just on the other side of the fire hydrant is a tree with some interesting folklore behind it. The seeds of Kentucky coffee tree (*Gymnocladus dioicus*, 13) were roasted and ground up by early settlers as a coffee substitute (the roasting was critical — raw seeds are poisonous!). Female trees

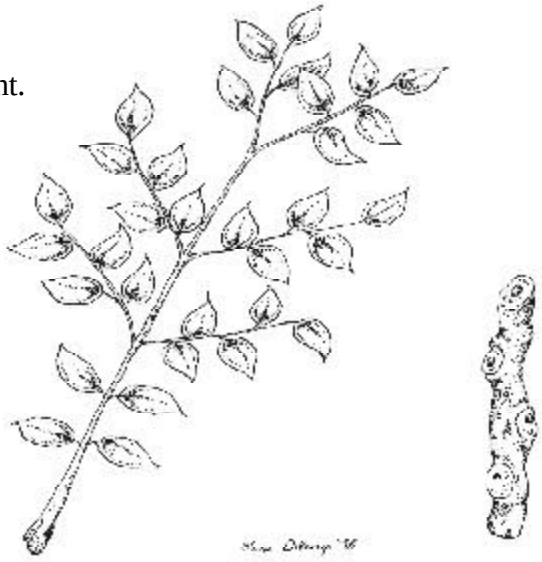
have large, attractive fruit pods that persist into winter. Coffee tree lends itself to urban use due to its tolerance of soil alkalinity, salt, and drought. It has notably few pest problems. A fruitless male cultivar of coffee tree called 'Espresso' is available in the trade, for those who find the pods a nuisance.

Assess the Situation

Site assessment is the critical step-by-step site evaluation process that leads to appropriate tree selection. Site assessment guidelines and checklist in the publication *Urban Trees: Site Assessment, Selection for Stress Tolerance, Planting* are available on the UHI web site: **<http://www.hort.cornell.edu/department/faculty/bassuk/uhi/pubs.html**>. Site assessment includes determining cold hardiness zone, soil pH, degree of soil compaction, available below- and above-ground space, and drainage patterns.

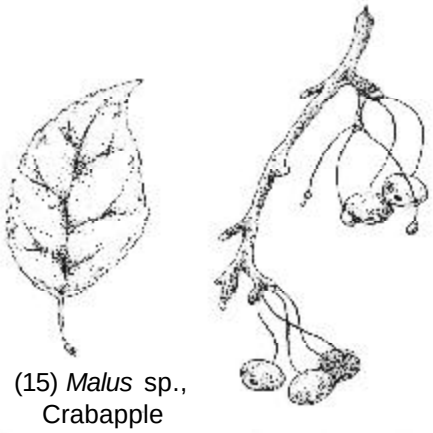
Backtrack a little now, just far enough to head down the straight path to Caldwell Hall. You'll pass a honeylocust on your left; the tree farther down on the right is basswood or American linden *(Tilia americana*, 14). The leaves of basswood are noticeably larger than those of the littleleaf lindens on the quad. Basswood lends itself to urban use because it tolerates high soil pH and it is easy to transplant.

One of the most gorgeous crabapple trees on campus is straight ahead, by the entrance to Caldwell Hall. It is *Malus* 'Snowdrift' (15), named for its attractive blanket of white flowers in spring. Crabapples are small-stature trees that are ideal for the urban landscape because they can tolerate drought, high pH, and salt, and they are easy to transplant. Hundreds of crabapple cultivars are available in the trade, and several dozen are

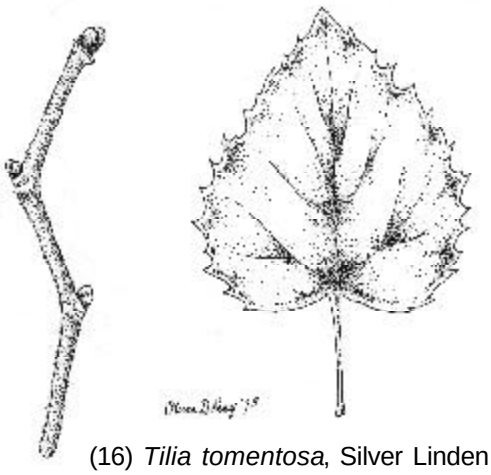


(13) *Gymnocladus dioicus*, Kentucky Coffee Tree

(14) *Tilia americana*, Basswood



(15) *Malus* sp., Crabapple



(16) *Tilia tomentosa*, Silver Linden

recommended for urban use (see **<http://www.hort.cornell.edu/department/faculty/bassuk/uhi/chart1.html>** for a list).

Not far from the crabapple, across the sidewalk, is a trio of trees whose leaves have silvery undersides. These are silver lindens (*Tilia tomentosa*, 16). Silver linden tolerates heat and drought better than littleleaf linden and is resistant to Japanese beetle feeding. A helpful ID feature is that stems of silver linden tend to be more pubescent or "fuzzier" than those of other lindens.

Continue on the sidewalk heading west. At the corners of the Computing and Communications Center (CCC) are small trees with attractive bark, Japanese tree lilac (*Syringa reticulata,* 17). Japanese tree lilac is a desirable tree for urban sites because, unlike its shrubby common-lilac counterpart, it resists powdery mildew and borers. It doesn't mind alkaline soil or drought, it transplants readily, and it matures at under 30 feet.

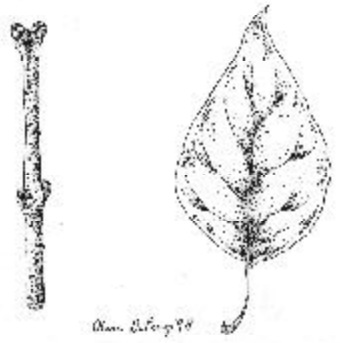
Head south, away from the CCC. Six scholar trees (*Styphnolobium japonicum,* 18) are scattered near

The Trouble with Salt

Most successful urban trees tolerate *deicing salts*, rock salts frequently comprised of sodium and chloride ions (NaCl). As snow is moved off streets and sidewalks and onto the tree lawn, deicing salts accumulate in the soil. Damage occurs in a number of ways: salt competes with tree roots to soak up available water in the soil, it damages soil structure by preventing the formation of aggregates, and it interferes with the absorption of other nutrients. The marginal or tip leaf scorch that you see on some trees is caused by the uptake of chloride ions into the plant's vascular system. Chloride ions accumulate in toxic levels in the newest plant growth, killing leaf tissue at the tips and along margins.

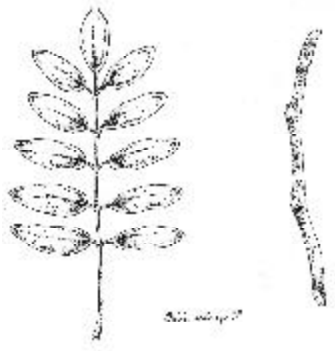
What to do about salt? Tolerant species experience less damage from these effects; they include white ash, honeylocust, and white, bur and red oak. However, they too can be damaged with heavy salt concentrations. Other deicing agents such as sand, light gravel, or cinders can be used in place of NaCl.

the main walkway that leads into the Kennedy-Roberts arch. Scholar tree is the last of the large ornamental trees in this region to flower. Trees bear creamy white flower spikes in late summer followed by intriguing seedpods that look like beans, but with a twist. Scholar tree is performing extremely well on the Cornell campus and in Ithaca. It is tolerant of drought, salt, and high soil pH.



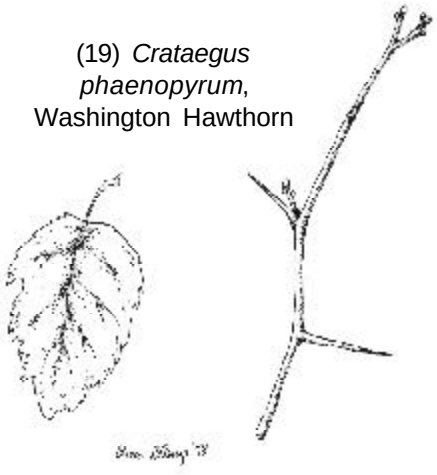
(17) *Syringa reticulata*, Japanese Tree Lilac

(18) *Styphnolobium japonicum*, Scholar Tree



This is a good place to scan the quad one last time. Do you notice what's missing? Besides the two clumps of hemlocks, there are no conifers on the quad. Pines, spruces, and other conifers generally do not tolerate urban conditions. They require moist soils and cannot tolerate salt. Because their leaves remain through winter, evergreen conifers lose some water to

transpiration at a time when roots cannot draw water out of the soil. This makes evergreens especially susceptible to desiccation. Deicing salts in the soil only compound the problem.



(19) *Crataegus phaenopyrum*, Washington Hawthorn

Walk through the arch between Kennedy and Roberts Hall. Cross the road to see a row of four small trees alongside Malott Hall. They are Washington hawthorns (*Crataegus phaenopyrum*, 19). This planting is a great example of "right tree, right place." A simple site assessment reveals that there is only 15 feet of space between the building and the sidewalk. Overhead eaves cast a partial rain shadow over the site, and the slope tends to be dry. Given the surrounding lime-based building materials and concrete, the soil pH is likely to be high. Clearly, the site calls for a drought-tolerant, pH-adaptable small tree. Washington hawthorn fits the bill. Aside from being suited to this site, it has attractive white flowers in spring and red fruits in fall that persist into winter. One warning, though — this is not a tree for playgrounds: it has one- to three-inch thorns.

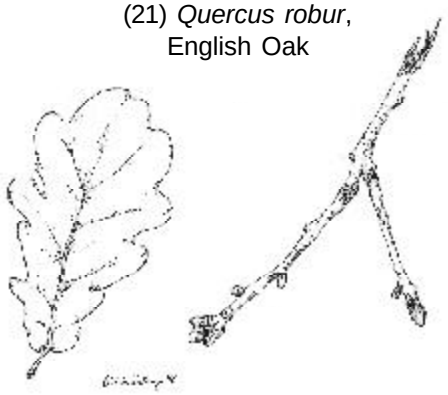
Backtrack a bit and follow the sidewalk around the

B&B vs. Bare Root

Balled and burlapped (B&B) transplanting is frequently regarded as essential for trees. However, bare root trees have many advantages over B&B: they are lighter, cheaper, less expensive to ship, and they require no special equipment to move or plant, allowing more community involvement. Furthermore, UHI found that bare root trees have 200% more root mass than B&B trees. For these reasons, the city of Ithaca plants virtually all of its trees bare root. A hydrogel root dip at the nursery helps prevent desiccation of the bare roots between harvest and planting. For more information about bare root planting, see ***Creating the Urban Forest*** **at <http://www.hort.cornell.edu/department/faculty/bassuk/uhi/pubs.html>.**

north side of Malott Hall. Head for the brick-pillared entrance to the Big Red Barn. Pass the Barn on your right and follow the gravel path as it veers left. The first tree on the left is Crimean linden (*Tilia euchlora*, 20). It resembles littleleaf linden, but the leaves are a bit larger and the new stems are yellow-green. Crimean linden is more drought- and aphid-resistant than littleleaf linden and tolerates high soil pH.

(21) *Quercus robur*, English Oak

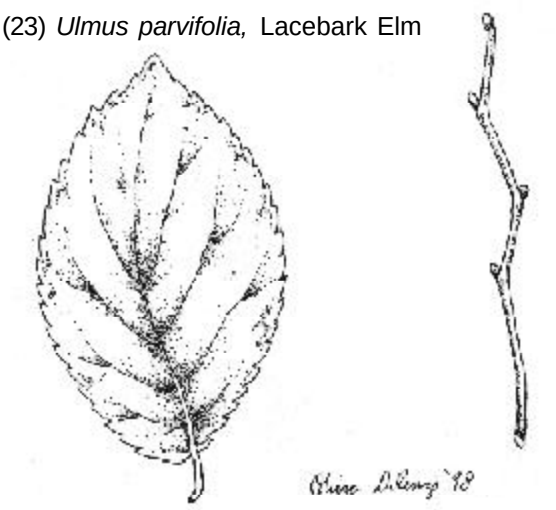


Head back toward the Big Red Barn and veer to the left on the gravel path, which changes to parking lot, then to an asphalt sidewalk. Just past the Barn on the right, beside the asphalt sidewalk, you'll see a large English oak (*Quercus robur*, 21) with bluish-green leaves. English oak is one of the few oaks that can tolerate alkaline soils without showing leaf chlorosis, or yellowing. Although it should be given plenty of space to look its best, English oak can cope with a somewhat more restricted rooting volume and is drought tolerant. Near the end of the growing season you can expect the leaves to become gray with powdery mildew, but that is the only noteworthy pest of English oak.

(22) *Phellodendron amurense*, Amur Corktree

Continue past the fence and turn left. Walk down to East Avenue, cross it, and take a right. Head north along East Avenue past red-brick Lincoln Hall until you come to a path between Lincoln and Rand halls that curves off to the left. Along this short section of path is a European beech on the left with its characteristic smooth elephantine bark. Behind it is Amur cork tree (*Phellodendron amurense*, 22). If you press your fingers into the bark, you'll

(23) *Ulmus parvifolia,* Lacebark Elm



The Tree-Turf Conflict

Trees and turf don't get along. When young trees are planted in grass, turf can outcompete fine tree roots for water and nutrients. Some turf grasses actually exude chemicals that inhibit tree root growth. Conversely, when turf is planted under mature trees, shade and root competition make it harder to establish grass. To avoid this basic incompatibility, trees should always be provided a generous expanse of mulched, grass-free area. This area should extend at least as far as the dripline of the tree. The mulch should be two to four inches deep (not more than four inches, as oxygen deprivation to the roots results), and should be pulled back from around the trunk. Besides holding down weeds and conserving moisture, mulch keeps the lawn mowers and string trimmers away from the trunk, where one accidental wound can do serious damage.

see how cork tree got its common name. Cork tree is relatively pest-free and tolerates alkaline soil and intermittent drought. Note the desirable wide crotch angles. This tree does less well in restricted root areas than some other tree species in this walk; thus, it is best used in urban parks where it has plenty of rooting volume.

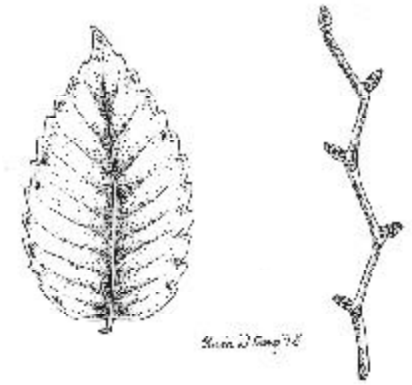
The curving path leads down steps, across a service road, and into the Arts Quad. If you look up, you'll see the white dome of Sibley Hall; follow the sidewalk that hugs Sibley and take a right at the end of the building. These six young lacebark elms (*Ulmus parvifolia*, 23) could someday be among the most dramatic trees on campus. The mottled gray, green, orange, and brown bark gives the tree its common name. Lacebark elm tolerates the gamut of urban conditions. It is a large tree, maturing at 50 to 70 feet.

Get back on the sidewalk heading west, then veer off to the left where the sidewalk

descends. At White Hall, take the diagonal path that crosses the quad. Just after the fire hydrant on your left, look on your right for shingle oak (*Quercus imbricaria*, 24), a pyramid-shaped, wide-spreading tree with long, unlobed, strap-shaped leaves. Both the common name and the specific epithet *imbricaria* ("overlapping") refer to the use of the wood for shingles, a practice begun by pioneers. Shingle oak is a medium to large tree that does well on sites where it has ample room for its wide-spreading lower branches. It can tolerate drought, and pH up to 7.5. Its leaves persist through winter, functioning as a windbreak.

(24) *Quercus imbricaria*, Shingle Oak

Continue along the diagonal path into the oak grove, one of the most beautiful spots on campus and a great place to pause and take a rest. The grove includes a mixture of mature black, white, and red oaks, with a few hickories sprinkled in. Leaving the oak grove, take a right onto the zelkova-lined sidewalk (*Zelkova serrata*, 25) running north-south. Zelkova is drought, salt, and pH tolerant, and has a beautiful vase shape reminiscient of the American elms. However, it has one major flaw. Notice how narrow the branch angles are; splitting and crotch cankers result. If you look into the trees, you will see cables running from trunk to trunk to prevent further splitting.



(25) *Zelkova serrata*, Japanese Zelkova

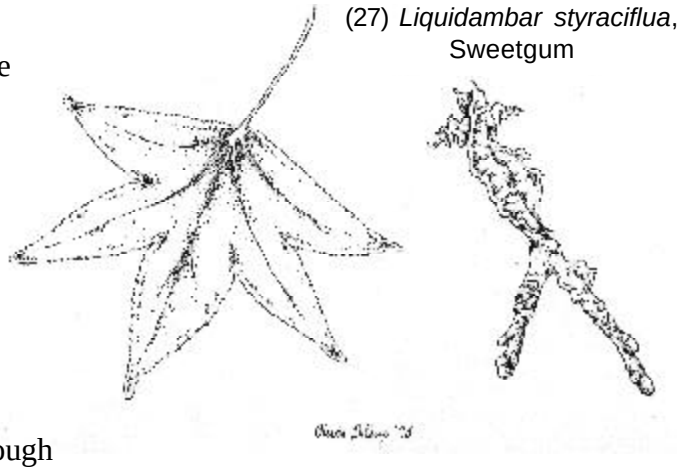
At the "Goldwin Smith Hall" lettering, turn right and head down the diagonal sidewalk toward the clock tower. A few paces past the clock tower, turn left. Lining the left side of the sidewalk are flowering cherry (*Prunus* 'Accolade,' 26) interplanted with elms. Members of the problematic Rose family, many flowering cherries tend to be riddled with insect and disease problems, and they are often

short-lived. ‘Accolade’ is more vigorous and has better resistance to pests than other flowering cherries. It’s also a rapid grower and sports attractive bark and very early semidouble pink flowers.

(26) *Prunus* 'Accolade,' Flowering Cherry

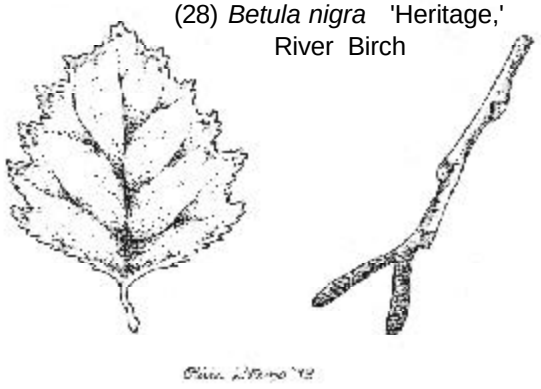
Wind your way behind Sage Chapel, where, in the triangle of lawn behind Day Hall, there are three trees with star-shaped leaves, sweet gum (*Liquidambar styraciflua*, 27). Hardy to zone 5b, they are at the edge of their cold hardiness on the Cornell campus. Not for use under utility wires, *Liquidambar* can grow to be very large, 70 to 100 feet, and its roots need ample space. Apart from beautiful foliage that turns a variety of striking colors in fall, it is valued for its tolerance of intermittent flooding, moderate drought and for the absence of major pest problems. One warning, though — don’t walk barefoot anywhere near it in the fall. The seeds are borne in round, woody fruits that are painfully sharp.

(27) *Liquidambar styraciflua*, Sweetgum



Moving around to the other side of Sage Chapel, you’ll find a series of four multistem river birches *(Betula nigra* ‘Heritage,’ 28). This cultivar is the nursery

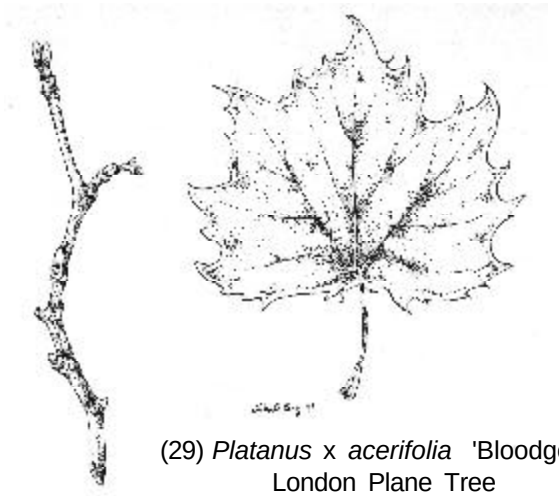
(28) *Betula nigra* 'Heritage,' River Birch



industry's answer to white bark birches that inevitably succumb to bronze birch borer. Although not a long-lived street tree (in part because it suffers from iron deficiency at high pH), it is often worth using for the beauty and year-round interest it imparts. The exfoliating, salmon-pink bark is noteworthy.

Go down the steps to your left and head downhill on Ho Plaza. The double row of trees in the plaza are London plane trees, *Platanus* x *acerifolia* 'Bloodgood,' 29). London plane is often selected for city use because it is very fast-growing and durable. It is a cross between Oriental plane tree and American sycamore; its common name comes from its extensive use in London as a dependable urban tree. 'Bloodgood' is resistant to the fungal disease anthracnose, but overplanting has made it vulnerable to other pests. Leaf, bark, and fruit litter can also be an annoyance.

The trees *outside* the stone plaza wall have a much more favorable soil environment. Growing in lawn instead of concrete are two



(29) *Platanus* x *acerifolia* 'Bloodgood,' London Plane Tree

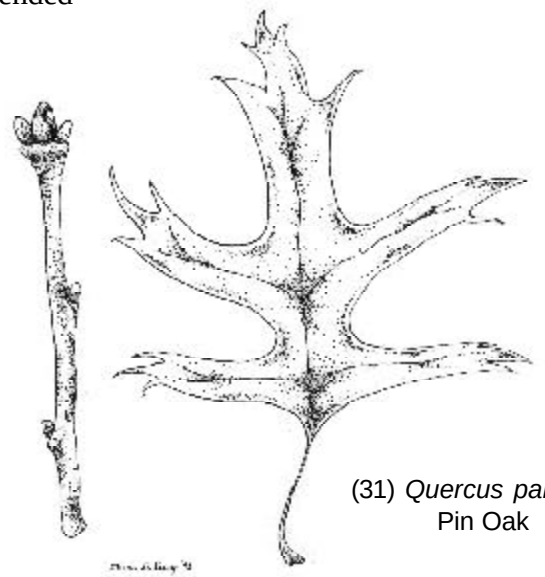
The pH Factor

Urban trees are selected partly on the basis of their tolerance of high soil pH. Soil pH is a measure of how acidic or alkaline (sour or sweet) the soil is. Acid soil has a higher concentration of hydrogen ions (H^+), whereas alkaline soil has more hydroxide ions (OH^-). Their relative concentration determines the nature of chemical reactions in the soil, especially whether nutrients can be made available to the roots. For that reason, when soil pH is out of the desirable range for a particular plant, nutrient uptake is limited and the plant exhibits symptoms of deficiency. Most plants prefer a soil pH of 6.0-7.5. To identify potential street trees that can handle the high pH of the concrete-laden environment, the UHI looks for trees that grow in limestone-based soils in their native habitat.

rows of callery pears (*Pyrus calleryana* ‘Aristocrat,’ 30). The ‘Bradford’ callery pear is notorious for its narrow branch angles, which make it vulnerable to splitting under snow and ice, but ‘Aristocrat’ pear has a more open branch structure and is less prone to splitting. It tolerates drought, alkaline soils, and salt. ‘Aristocrat’ is also favored for profuse flowers early in spring and for leaves that persist into the fall and early winter.

(30) *Pyrus calleryana* 'Aristocrat,' Callery Pear

Just past the Gannett center on the right are three pin oaks (*Quercus palustris,* 31). If you get close enough you’ll see that “pin” refers to the short, pinlike side twigs or spurs. The specific epithet *palustris* means “swampy” since native pin oak is found primarily on wet sites. Despite many good attributes, pin oak is not recommended for urban use unless the soils are naturally acidic. On alkaline soil it develops unsightly iron chlorosis, or leaf yellowing.



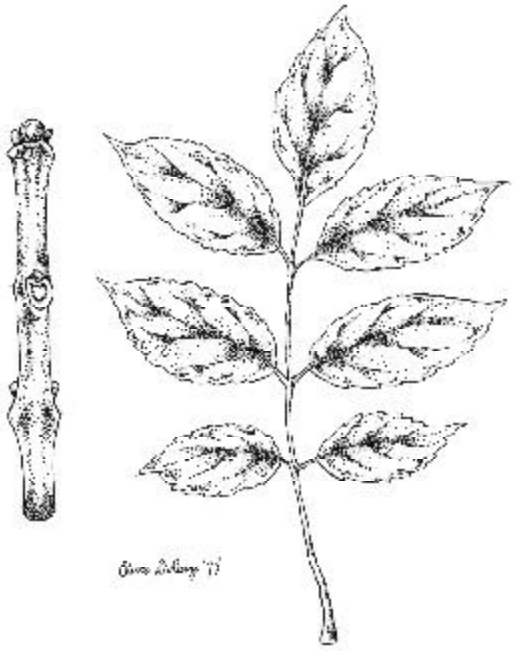
(31) *Quercus palustris*, Pin Oak

Continue straight ahead across Campus Road and head down Central Avenue past Anabel Taylor and Myron Taylor halls. Continue across the Central Avenue bridge to the Performing Arts Center. Situated where three roads meet is an island planted with five multistem green ash (*Fraxinus pennsylvanica,* 32); cross over to the green ash island.

Car exhaust, heat, pedestrian traffic, and limited soil volume conspire to make this an incredibly inhospitable place for trees.

Look down at the surface — how will water get to the roots of these trees? The hardscape material on this site, although visually nondescript, was actually chosen based on careful research. It's known that any water that infiltrates a site like this does so through the joints between the pavers. When these joints are sealed shut, precious little water reaches the tree roots from rainfall. The key is to provide a jointing material that is permeable to water, yet has the structural strength necessary to keep the pavers level and in place. Here, the material used is asphalt mastic, a coarse sand mixed with bitumins from asphalt. The bitumins coat and bind the other materials, yet include air space for water to infiltrate and percolate down to the roots.

(32) *Fraxinus pennsylvanica*, Green Ash



Green ash is one of the toughest, most adaptable street trees available in the trade. In its native habitat, it is found in both wet and dry environments, so it can tolerate both drought and intermittent flooding. Green ash also tolerates salt and high soil pH, and it is relatively pest-resistant. The drawbacks? It is not the most attractive species, and it is overused.

Head back into campus on the asphalt path that leads into the woods and to a foot bridge. After you cross the bridge, veer left, cross the road, and head for the mixed planting on the east side of Snee Hall (33). This landscape was

Give Me Space

The conventional city tree pit is 4 foot x 4 foot and surrounded by concrete. Ever wonder if that's enough space for tree roots? Inadequate soil volume is one of the main reasons why city trees last, on average, only seven years.

UHI has developed a step-by-step methodology to calculate how much soil is needed for a given-size tree. The following is a shortcut version of that methodology that can be used to approximate adequate soil volume in areas with rainfall levels similar to those of Ithaca.

1. For an existing tree, measure the distance from the tree's main trunk to the dripline (the outermost edge of the canopy). Or, consult a reference book to find the optimum mature spread of the tree you are considering. Estimate that your tree will reach 75% of the optimum, then take half of that number. This is your radius, **r**.

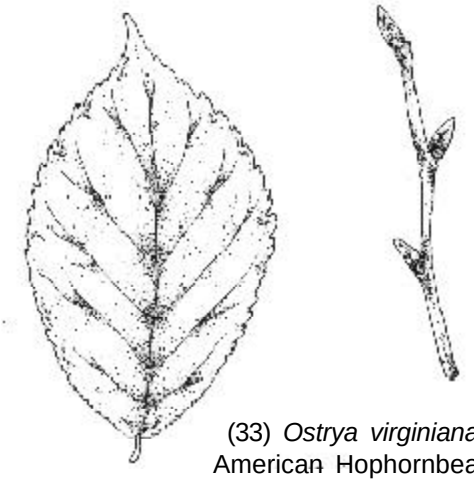
2. Calculate $3.14 \times r^2$ to get the **crown projection**, the area of the circle within the dripline of the tree.

3. **Crown projection is measured in square feet. For every square foot of crown projection, provide 2 *cubic* feet of soil**.

Example: You read that common chokecherry (*Prunus virginiana*) spreads 18 to 25 feet at maturity. You can expect that in most city sites the lower figure, 18 feet, is more realistic. Then:

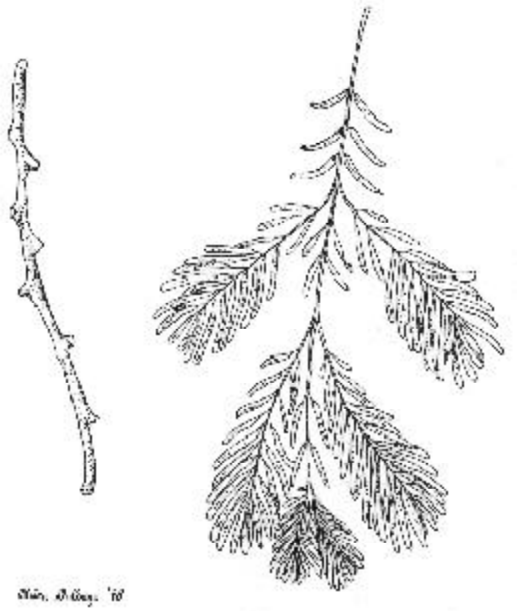
1. The radius would be 9 feet.
2. The crown projection would be $(3.14)(9^2) = 254$ square feet. **For every square foot of crown projection, provide 2 *cubic* feet of soil**. Thus, 254 x 2 = **508 cubic feet** of soil volume is needed.
3. Since roots are rarely deeper than 3 feet, use 3 feet as your depth dimension (unless you know your planting site will be shallower). Thus, 508/3 = 169, and the area of usable soil in your planter or site must be at least 169 square feet (equivalent to a planting site that's 13 feet wide, 13 feet long, and 3 feet deep).

designed to look like an extension of the native vegetation of Cascadilla Gorge. As it turns out, the garden includes many recommended urban trees.



(33) *Ostrya virginiana*, American Hophornbeam

The three small trees near the entrance with shredding bark in long, rectangular strips are American hophornbeam (*Ostrya virginiana*). Native to eastern North America, it often grows in the woodland understory and thus is tolerant of some shade. Hophornbeam tolerates some urban stresses but cannot withstand the most difficult sites; it is especially sensitive to salt. Use hophornbeam in moderately challenging situations such as urban parks and greenways. It will reward you with stress tolerance and interesting bark, leaves, and fruits.



(33) *Metasequoia glyptostroboides*, Dawn Redwood

Young dawn redwoods (*Metasequoia glyptostroboides*) are unmistakably and consistently cone-shaped. Look for one here, intermingled with the shorter hophornbeams — it has feathery, flattened, needlelike leaves. If dawn redwood strikes you as primitive-looking, it should. Dawn redwood has been around for more than 50 million years. It's known as a "living fossil" since fossil evidence of it was discovered *before* the first trees were sighted. Since its discovery in China in the 1940s, it has been widely propagated. Given its longevity as a species it is

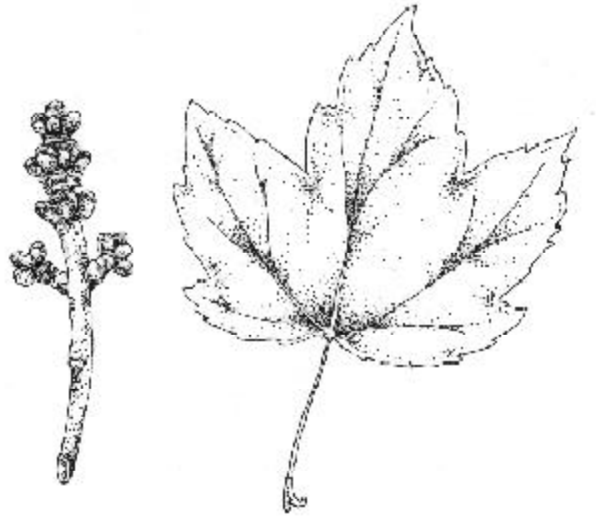
no surprise that it tolerates urban stress. Since it is low branching, it needs to be "limbed up" for street tree use; otherwise, its neat conical habit eliminates the need for pruning. Dawn redwood prefers moist, slightly acid soils.

Just beyond the dawn redwood, on the same side, are two red maples (*Acer rubrum*) with smooth, silvery gray bark, red new growth, and abundant red buds. Like green ash, red maple has evolved in both wet sites and dry sites. Among East Coast trees, red maple has one of the largest north-south ranges. It is a large tree with year-round ornamental interest and is superior to silver maple in its wood strength. Many cultivars have been selected for superior fall color, columnar form, or flood tolerance. Take care, however, to give red maple both ample space and moderate to acidic soils. On alkaline soils, manganese uptake is limited and red maple leaves become chlorotic, or yellowed.

Go Native?

Like the word "organic," the phrase "native plant" does not have a universally accepted definition. How long must a plant have been here to be native — 200 years, since Columbus arrived, since the time of the dinosaurs?

One argument in favor of natives over exotics holds that trees "from" this region are the most suited to grow here. However, since the urban environment has so many features that have been changed by humans, trees native to the surrounding countryside will not necessarily flourish in the city. With any urban tree, the results may be disappointing if the native hasn't been carefully matched to the site.



(33) *Acer rubrum*, Red Maple

Leave this unique spot and head back out the main entrance. Cross the road to the corridor that is flanked by pines and has a trio of honeylocust at its entrance. Head north through the corridor, which is planted with a mixture of trees, shrubs, and groundcovers, including a tupelo, basswood, and several serviceberry trees (*Amelanchier* sp., 34). One serviceberry grows close to the stairs on the right. This small tree is often used in multistem form. It is an appealing member of the Rose family that should be used where soils are acidic or only moderately alkaline. Ornamental features include early white flowers and attractive bark, fruit, and fall color.

(34) *Amelanchier* sp., Serviceberry

(35) *Ginkgo biloba*, Ginkgo

Up the stairs and to your right is the Engineering Quad; make your way diagonally across it.

At the intersection of Campus Road and East Avenue are two trees of great interest, a mature ginkgo (*Ginkgo biloba*, 35) at the corner of Phillips Hall, and a mature bald cypress (*Taxodium distichum*, 36) south of historic Sage Hall. Ginkgo, like dawn redwood, has ancient origins, having existed on the planet for more than 150 million years. It is an all-around low-maintenance, tough urban tree. It thrives in some of the tiniest tree lawns in Ithaca. This tough species has one notorious disadvantage, the memorably bad smell of the fleshy seeds (often called "fruits," but botanically, they are seeds) of

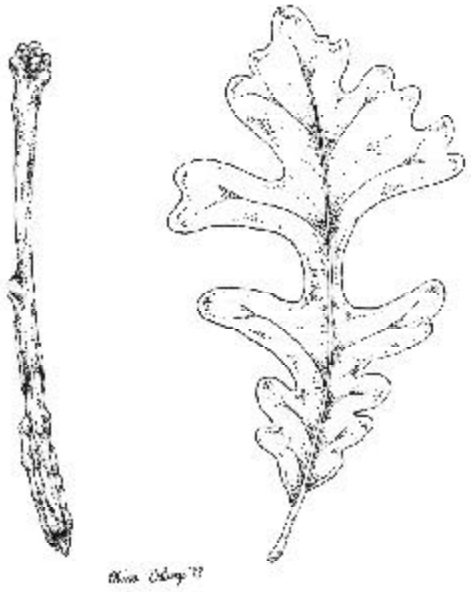
(36) *Taxodium distichum*, Bald Cypress

female trees. For that reason, male cultivars are a must.

(37) *Quercus bicolor,* Swamp White Oak

Bald cypress is so named because it is so late to leaf out — it often remains "bald" until early summer. When you think of bald cypress, swampy sites come to mind. Since it originates from such places, it can manage wet soils and intermittent flooding. However, bald cypress leaves can become chlorotic in soil pH above 7.5. If high pH is not an issue, it is a great choice as a street tree since it is relatively pest and maintenance free (just allow plenty of room — as you can see, it gets big).

(38) *Quercus macrocarpa*, Bur Oak



A third mature tree is found in an alcove of Statler Hall, a spectacular swamp white oak (*Quercus bicolor*, 37) that probably predates the Cornell campus. Swamp white oak was named the "Urban Tree of the Year" in 1998 by the Society of Municipal Arborists. It is a native that can tolerate both dry and poorly drained sites; it is relatively pest-free, but doesn't tolerate soil pH much above the neutral range.

Head further up East Avenue, turn right on Tower Road, and cross over to the north side of Tower. Halfway up the block, look to your left to see a young bur oak (*Quercus macrocarpa*, 38). It is close to the sidewalk, in front of a small stand

of hemlocks and a dedication plaque. Like English oak, bur oak tolerates alkaline soils. It also withstands both drought and intermittent flooding. In winter the ornamental value of its corky bark is especially apparent. Like most oaks, bur oak can become a giant in height and spread. Because the leaves of this specimen are not strictly characteristic of bur oak, it is speculated to be a hybrid between bur oak and white oak.

(39) *Carpinus caroliniana*, Musclewood

Further up Tower Road, flanking the south entrance to Malott Hall, are three multistem musclewood, or ironwood (*Carpinus caroliniana*, 39). Note the fluted wood of the trunk that gives this tree its common name. Musclewood is a small tree that tolerates occasionally wet soils. It can be grown as a single- or multistem tree. You can find this native in the understory of our local woodlands.

Cross over Garden Avenue and head up Tower Road back toward the Minns Garden. The red oak trees lining Tower Road have an interesting history. The oaks on the left and right sides of the road were planted at the same time. Notice how much bigger the trees on the left are — they are grown in generous

All in the Mix

New sidewalks and roads are a thorn in the city forester's side. Meanwhile, trees can upheave sidewalks and aggravate the city engineer. Must it be so? One of UHI's research-based introductions is *structural soil*, a mix of crushed stone, clay loam, and a polymer called hydrogel that keeps the stone and soil evenly mixed. Structural soil allows tree roots to penetrate under sidewalks and roads without heaving pavement. Its uniform stone satisfies load requirements set by municipal engineers. The mix has been used sucessfully on campus, in Ithaca, and in New York City. For more information, see the UHI web site: **<http://www.hort.cornell.edu/department/faculty/bassuk/uhi/ssoils/sld001.htm>.**

swaths of lawn. By contrast, the trees on the right, starting across from the Minns Garden, contend with the indignity of parking lots on both sides of them. Root damage from parking lot construction and soil compaction from cars has stunted these once-vigorous red oaks. The trees on the left are living the good life, but those on the right show what happens when urban stress takes its toll. u

Notes

Tree Key

1. *Corylus colurna*, Turkish Filbert
2. *Cornus mas*, Cornelian Cherry Dogwood
3. *Eucommia ulmoides*, Hardy Rubber Tree
4. *Tilia cordata*, Littleleaf Linden
5. *Nyssa sylvatica*, Tupelo
6. *Cercidiphyllum japonicum*, Katsura Tree
7. *Cladrastis kentukea*, Yellowwood
8. *Liriodendron tulipifera*, Tulip Tree
9. *Fraxinus americana* 'Autumn Purple,' White Ash
10. *Quercus rubra*, Northern Red Oak
11. *Gleditsia triacanthos* var. *inermis*, Thornless Honeylocust
12. *Fraxinus excelsior* 'Hessei,' Hesse European Ash
13. *Gymnocladus dioicus*, Kentucky Coffee Tree
14. *Tilia americana*, Basswood
15. *Malus* sp., Crabapple
16. *Tilia tomentosa*, Silver Linden
17. *Syringa reticulata*, Japanese Tree Lilac
18. *Styphnolobium japonicum* 'Halka,' Scholar Tree
19. *Crataegus phaenopyrum*, Washington Hawthorn
20. *Tilia euchlora*, Crimean Linden
21. *Quercus robur*, English Oak
22. *Phellodendron amurense*, Cork Tree
23. *Ulmus parvifolia*, Lacebark Elm
24. *Quercus imbricaria*, Shingle Oak
25. *Zelkova serrata*, Japanese Zelkova
26. *Prunus* 'Accolade,' Flowering Cherry
27. *Liquidambar styraciflua*, Sweet Gum
28. *Betula nigra* 'Heritage,' River Birch
29. *Platanus* x *acerifolia* 'Bloodgood,' London Plane Tree
30. *Pyrus calleryana* 'Aristocrat,' Callery Pear
31. *Quercus palustris*, Pin Oak
32. *Fraxinus pennsylvanica*, Green Ash
33. *Ostrya virginiana*, American Hophornbeam
Metasequoia glyptostroboides, Dawn Redwood
Acer rubrum, Red Maple
34. *Amelanchier* sp., Serviceberry
35. *Ginkgo biloba*, Ginkgo
36. *Taxodium distichum*, Bald Cypress
37. *Quercus bicolor*, Swamp White Oak
38. *Quercus macrocarpa*, Bur Oak
39. *Carpinus caroliniana*, Musclewood

Cornell Campus Map for Recommended Tree Walk