USING THIS BOOK

Scientific Name & Common Name: A **species** is the most important unit in plant selection. A species is written as two words, the genus as in *Acer* (the genus for maple) and *saccharum* (the specific epithet). The genus and species (**spp.** for plural abbreviation and **sp.** for singular abbreviation) names are either underlined or italicized in print. Together, *Acer saccharum* describes the species name for the commonly named Sugar Maple.

A species is a group of plants that share many of the same characteristics that are passed along from generation to generation. However, each member of the species is genetically distinct. In some species there may be considerable variation between individuals in terms of leaf shape and color, flower color, fruit size, growth habit, performance and vigor, while in others there may be little variation.

When a distinct variation within a species can be in inherited from generation to generation by seed it is said to be a **variety (var.) or subspecies (ssp)**. *Acer saccharum* ssp. *nigrum* describes a subspecies of Sugar Maple, Black Maple, from the western part of the Sugar Maple's range in the United States. It can be written *Acer saccharum nigum*. However, it is worth noting that some people feel that *A. nigrum* is a separate species unto itself. There may still be considerable variation within a variety or subspecies.

A **cultivar** (for cultivated variety) is a tremendously important designation in horticulture. A cultivar is chosen because of distinctly superior notable traits such as form, autumn leaf coloration, flower color or size, vigor, cold hardiness or disease resistance to name a few. Most of the time, cultivars are genetically identical or clonal. It is possible to have a cultivar of a variety or of a species. They are propagated asexually in order to maintain the genetic character of a specific plant. *Acer saccharum* 'Bonfire' is an example of a cultivar of the species, *Acer saccharum*. *Acer saccharum nigrum* 'Green Column' is an example of a particularly drought tolerant selection of *Acer saccharum nigrum*. The cultivar is always capitalized and put in single quotes. When the species derivation is complex, cultivar names can be added to the genus name directly as in *Malus* 'Adirondack' (Adirondack Crabapple) or *Crataegus* 'Vaughn' (Vaughn Hawthorn).

Trademarked™ or **Registered Trademark®** names are also noted where they apply. These are names given to cultivars to aid in marketing. For example, the Crabapple (*Malus* sp.) cultivar 'Sutyzam' has the registered trademark name Sugartyme®. The trademarked or registered trademark name is typically (although not correctly) listed in place of the cultivar name by many nursery retailers.

Environmental Conditions: It is important to note that some trees are adaptable to a fairly wide range of environmental conditions while others have a narrow range in which they will grow well. By presenting the following tree list we are providing information about adaptability. All trees will grow well under near optimal conditions with a pH of 6.8 and consistently moist but well drained soil. However, we rarely find these conditions in the urban environment. It is our purpose to highlight those trees that tolerate broader, less ideal conditions while still providing the benefits for which we planted them. These more adaptable plants don't prefer poorer conditions, but can still grow adequately in them. This specific information is key to making informed plant selections.

> **Hardiness Zone:** All trees listed here are hardy to Zone 6 (minimum winter temperature of -5° to -10° F) or colder based on the USDA Plant Hardiness Zone Map (see on page 12). A hardiness zone listed in parenthesis for a tree or cultivar indicates that there is some speculation or literature supporting the tree's hardiness extending into that noted colder zone.

Soil Moisture: The following graph lists soil moisture with a 1-12 numerical range: 1-3 represent occasionally saturated or very wet soil conditions; 4-6 represent consistently moist, well drained soil conditions; 7-9 represent occasional periods of dry soil; and 10-12 represent prolonged periods of dry soil conditions. The shaded portions on the chart represent the conditions under which each tree can survive reasonably well. We felt this was the most beneficial and accurate way to convey soil moisture tolerance, as it is extremely difficult to make absolutes in this area.

occasionally saturated or very wet soil			consistently moist, well drained soil			occasional periods of dry soil			prolonged periods of dry soil		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**

*A note of caution: Trees become acclimated to these less than ideal soil-moisture conditions after they have become established in the landscape. Newly transplanted trees are not as acclimated as their established counterparts. It is critical to give newly transplanted trees several years of supplemental watering to hasten their establishment before expecting them to possess wider soil moisture level tolerance.

Sun/Shade: Most trees require full sun, although some will tolerate the lower light levels of partial shade and a small few will tolerate full shade. Full sun plants require more than 6 hours of direct sunlight a day. Partial shade plants tolerate direct sun for less than 6 hours a day, or filtered light for most of the day. Full shade plants tolerate little or no direct sunlight, or less than 6 hours of filtered sunlight a day.

Salt: Salt can impact trees in two ways: as salt spray and as salt in the soil. There is only anecdotal information about salt tolerance in trees, much of which doesn't differentiate between spray and soil. *This section is referencing only the plant's observed tolerance or sensitivity to salt in the soil.* Salt spray can be more obviously damaging to plant stems and buds. Soil salt may be leached away before active growth begins in spring. However, salt applied during an early snowfall (late October or early November) may also damage trees, as will a late salt application (April) because soil temperatures are warmer and roots are more active. Heavy salt applications are always damaging regardless of reported tolerance. In areas where high levels of road salt or sidewalk salts are used, trying to choose species that have some observed tolerance and avoiding the sensitive ones may minimize damage later.

pH: Most urban soils have a higher pH (from near neutral to alkaline) than surrounding rural areas due to limestone-containing materials in the street environment. A simple pH test can determine your site's characteristics. Trees that require acid soil with a pH of 5.0-7.0 are listed as ≤ **7.0**. Trees that can tolerate acid to neutral soil with a pH of 5.0-7.5 are listed as ≤ **7.5**. Trees that can tolerate acid to alkaline soil with a pH of 5.0-8.2 are listed as ≤ **8.2**.

Other: This section addresses additional environmental sensitivities and tolerances to consider for certain trees, such as wind exposure or heat.

Insect/Disease Factors:
This section does not attempt to list all potential pests related to each of these trees. Rather, it attempts to note specific pests that may pose a serious threat to these trees, limiting their usefulness in certain situations. This section also makes note of pest-resistant or pest-tolerant species and cultivars. Trees may be more susceptible to insects and disease problems, such as borers, when they are under stress. Reducing the potential risk of pests attacking a tree is another reason for proper site assessment and plant selection. However, some pests indiscriminately attack trees, healthy or stressed. We recommend consulting your local County Cooperative Extension Office or local nursery growers to find out specific insect and disease problems in your area.

Growth Characteristics: The following trees are broken down into two categories: small trees only reaching 30 feet or under in height and large trees reaching over 30 feet in height. This division is due to the 30 foot average height of overhead utility wires, the most common above-ground limiting factor for urban tree selection. After this initial division, specific tree growth information is listed in this category under **Height**, **Width**, **Form/Habit** and **Rate**. There is often, but not always, a direct relationship between growth rate and wood strength. Slow growing trees typically have stronger wood, just as faster growing trees typically have weaker wood. Stronger wooded trees generally hold up well to storm (snow/ice/wind) damage, while weaker wooded trees are more susceptible. Branch angle attachment is also often a contributing factor to storm damage susceptibility. Typically the 90 degree angle (to the trunk) is considered the strongest branch attachment.

Ornamental Characteristics: **Flower**, **Fruit**, **Seasonal Foliage Color**, and **Bark** categories address these aesthetic attributes. The **Other** category is included when needed to address additional noteworthy aesthetic attributes.

Transplant Issues: In general, whether transplanted balled and burlaped (B&B) or bare root, the larger the caliper tree, the longer it will take to become established after transplanting. As a 'rule of thumb', allow 1 year for every inch caliper before the tree is growing normally in its new site. Easy to transplant trees may take a shorter time to establish successfully while more difficult to transplant trees take longer. ***Choose the smallest caliper tree appropriate for the job, taking into consideration the site complexities and design intents***. ***There are very few compelling reasons that justify planting a tree larger than 3" caliper at most sites***. Bare root planting potential (if currently known) is listed in this section for each tree. Bare root transplanting has time constraints with a smaller window for planting but poses a less expensive option for some communities and the trees weigh less so they may be planted without machinery.
***For more information on Bare Root transplanting contact the Urban Horticulture Institute to receive the *Creating the Urban Forest: The Bare Root Method* booklet and/or video. The booklet is available on line at the UHI website: <http://www.hort.cornell.edu/uhi>**

Management Issues: This section includes warnings regarding potential management concerns to consider when planting these trees: such as fruit litter, pruning concerns, susceptibility to storm damage, and graft incompatibility problems.

Suggested Uses: This section includes: narrow street tree lawns/pits, wide street tree lawns/pits, parks, and suitable for CU-Structural Soil™. Street tree lawns or pits (without structural soil) 4-6'wide are considered narrow, while those greater than 6' wide are considered wide. This narrow or wide designation assumes that these lawns or pits are continuous (soil extending length wise, most often under grass) and have a 3' soil depth. When possible, trees should not be planted in tree pits smaller than 4' by 4' without CU-Structural Soil™.

Trees Suitable for growing in CU- Structural Soil™: The major impediment to establishing trees in paved urban areas is the lack of an adequate volume of soil for tree root growth. Soils under pavements are highly compacted to meet load-bearing requirements and engineering standards. This often stops roots from growing, causing them to be contained within a very small useable volume of soil without adequate water, nutrients or oxygen. Subsequently, urban trees with most of their roots under pavement grow poorly and die prematurely. It is estimated that an urban tree in this type of setting lives for an average of only 7-10 years, where we could expect 50 or more years with better soil conditions. Those trees that do survive within such pavement designs often interfere with pavement integrity. Older established trees might cause pavement failures when roots grow directly below the pavement and expand with age. Displacement of pavement can create a tripping hazard. As a result, the potential for legal liability compounds expenses associated with pavement structural repairs. Moreover, pavement repairs that can significantly damage tree roots often result in tree decline and death.

The problems as outlined above do not necessarily lie with the tree installation but with the material below the pavement in which the tree is expected to grow. New techniques for meeting the often-opposing needs of the tree and engineering standards are needed. One new tool for urban tree establishment is the redesign of the entire pavement profile to meet the load-bearing requirement for structurally sound pavement installation while encouraging deep root growth away from the pavement surface. The new pavement substrate, called 'structural soil', has been developed and tested so that it can be compacted to meet engineering requirements for paved surfaces, yet possess qualities that allow roots to grow freely, under and away from the pavement, thereby reducing sidewalk heaving from tree roots.

Structural soil mixes are two-part systems comprised of a stone lattice for strength and soil for horticultural needs. Structural soils depend on a load-bearing stone lattice to support the pavement. The lattice provides stability through stone-to-stone contacts while providing interconnected voids for root penetration, air, and water movement. The friction between the stones provides the strength. A narrow particle size distribution of the stone is chosen to provide a uniform system of high porosity after compaction. The system assumes full compaction to construction standards. Angular stone is selected to increase the porosity of the compacted stone lattice. As the stone is the load-bearing component of the system, the aggregates should meet regional standards for aggregate soundness and durability requirements for pavement base aggregates.

The structural soil developed at Cornell University has been patented and licensed to insure quality control. Its trademarked name is 'CU-Structural Soil' or 'CU-Soil.' By specifying this material, the designer or contractor is guaranteed to have the material mixed and tested to meet research-based specifications.

Structural soils in the context of this discussion have specific intended uses. The material supports pavement designed to withstand pedestrian and vehicular traffic. The materials can be designed for use under pedestrian malls, sidewalks, parking lots, and possibly some low-use access roads. The material is intended as a tool to be used when there are no other design solutions to provide adequate soil volumes for trees surrounded by pavement.

The basis for plant selection for structural soils should aim toward alkaline-tolerant and drought tolerant plant species. The stone used, whether limestone or granite, or other aggregates, will heavily influence soil pH. Structural soils made with limestone generally end up with a soil pH of about 8.0, regardless of the soil pH when the material was first mixed. For many parts of the country this is not unusually high even in normal soils and especially in urban areas. Using structural soil aggregates that do not influence pH, such as granite may not affect pH as quickly, but the pH will continue to climb as the concrete slowly breaks down. A structural soil system provides an opportunity for choosing alkaline-tolerant species that require good drainage and are drought tolerant.

Cultivars: Not all cultivars are listed for all species. The commercially available and appropriate cultivars are listed, along with some rarer cultivars worth noting. *Any cultivar characteristics that differ from the listed species characteristics are listed after the cultivar in parentheses.*