



# Right Tree: Right Place

## Flooding and poor drainage

By Dr. Bert Cregg, Michigan State University, Departments of Horticulture and Forestry

Photos by Bert Cregg, except as noted

Tree selection is one of the most critical elements in the landscape design/installation process. Even if every step in the installation process is conducted flawlessly, tree survival may be poor if trees are selected that don't match the characteristics of the site. In Michigan and the Midwest, poor drainage, alkaline soil, shade, drought, and salt exposure are the main site factors that most often limit plant growth and development. One common thread among all of these site limitations is they are often difficult to remedy on a long-term basis. Therefore, careful site assessment and tree selection — heeding the old adage of “Right tree – right place” — is often the best course of action. In this series of articles we will consider how these factors impact tree physiology and growth and identify trees that are adapted to these environmental limitations and which ones to avoid.

It is difficult to say which single environmental factor is the most limiting for tree growth and development, but flooding is certainly a leading candidate. Poor soil drainage and flooding are particularly problematic for a couple of reasons. First, some trees are so sensitive to flooding they may die after only a few days, or even hours, of inundation. We can contrast this with factors like alkaline soils,

which may lead to severe leaf chlorosis (yellowing) and cause trees to go into a prolonged decline, but may not kill them outright. Secondly, inadequate drainage and flooding are especially difficult to remedy. There's a reason for the old expression, “Like trying to push water uphill.” Water will always settle to the lowest point in a landscape. To keep it from doing so will usually require some

significant engineering efforts; installing drain tile, re-routing downspouts, building berms, and so on. Depending on the scale of the operation and client's budget, these may not be feasible.

If eliminating the underlying flooding or drainage issue is not possible, then selecting trees that can withstand flooding is the most appropriate course of action. Perhaps more than any other stress tolerance trait,

### Trees that are tolerant or intolerant of Wet soils/flooding

#### Wet/flood Tolerant

Red maple  
River birch  
Hackberry  
Honeylocust  
Sweetgum  
Dawn redwood  
London planetree  
Swamp white oak  
Bald cypress  
Arborvitae

#### Wet/flood Intolerant

Hickory  
Sassafras  
Dogwood  
Red oak  
American basswood  
Eastern redbud  
Black walnut  
Beech  
Yellow buckeye  
Sugar maple

NOTE: List is not all-inclusive, but is intended to provide examples of common trees in each category.



flood tolerance in trees is often an either/or situation; some tree species, such as cottonwood, can withstand weeks or even months of inundation while other trees such as pines may be killed after a few days of flooding. It is also interesting to note that several bottomland species that are tolerant of flooding can also

withstand some dry conditions and drought. However, the opposite doesn't always hold; upland species can withstand drought but are often highly intolerant of flooding.

### Why do trees vary in flooding tolerance?

Continuous and even periodic flooding can cause a number of problems for trees. When roots are completely or partially submerged, roots that are underwater experience low oxygen (hypoxia) or no oxygen (anoxia) conditions. This reduces cellular respiration needed to produce energy for root growth and maintenance. It can also lead to the build up of toxic compounds within the

root. Trees that are tolerant of flooding have various adaptations to cope with these conditions including specialized tissues that allow transfer of oxygen within the plant or metabolic adaptations that enable them to reduce or tolerate some of the toxins produced during hypoxia or anoxia.

As one would expect, trees that naturally occur along bottomlands and floodplains are among those that are most tolerant of flooding. Moreover, Dr. George Ware, former Research Director at the Morton Arboretum, among others, often suggested that bottomland trees are good choices for urban sites since they also can tolerate poor aeration associated with clay soils and soil compaction. While ecological habitat can provide a starting point for identifying trees that are tolerant of poor drainage, various references often provide conflicting information and a species may be listed as flood tolerant in one source, but flood intolerant in another. There are several reasons for these inconsistencies. Much of our information on flood tolerance is based on observations during flood events. The relative ranking of a given set of trees may vary by length of flooding, timing, and condition of the trees prior to flood. In

addition, comparisons of flood tolerance conducted in greenhouses or other controlled conditions may not yield the same relative rankings as field studies.

Two of the most useful and comprehensive resources on flood tolerance in trees are Flooding and Its Effect on Trees, developed by the USDA Forest Service Northeast Area State and Private Forestry office in St. Paul, MN and Recommended Urban Trees: Site Assessment and Tree Selection for Stress Tolerance, developed by Dr. Nina Bassuk and her colleagues at the Cornell University Urban Horticulture Institute. Based on these and other sources, here is a 'Top ten' list of trees for Michigan landscapes that are tolerant of poor drainage or flooding.

**Red maple (*Acer rubrum*)** Numerous cultivars of red maple are available in the nursery trade, many of which have been selected for outstanding fall color, such as 'October Glory' and 'Red Sunset'. Two principle limitations of red maple are overplanting of maples in many urban and community landscapes and chlorosis due to manganese deficiency on alkaline soil. Native to the eastern U.S. USDA Hardiness Zone 3-5 depending on cultivar.



Red maple is an old standby for fall color. Photo courtesy: Indiana University-Purdue University - Fort Wayne (IPFW) Grounds Dept.

Landscape Management





River birch trees are often weighted down by ice or snow, but usually recover after the thaw.



**River birch (*Betula nigra*)** is a medium to large tree, often with multiple stems. Among *Betula* species, river birch is the most resistant to bronze birch borer. Like red maple, river birch can tolerate a range of sites from wet to dry, but prefers acidic soils. Native to eastern U.S. USDA zone 4-6 depending on cultivar.

**Hackberry (*Celtis occidentalis*)** can tolerate wet and dry conditions. In addition, it can also tolerate alkaline soils, making it a mainstay on various “Tough trees for tough places” lists. In terms of ornamental characteristics, hackberry is somewhat nondescript; no showy flowers, unimpressive fall color. However, like a reliable utility infielder, its overall adaptability will earn hackberry increased playing time as homeowners and landscapers seek to replace ash trees. Native to eastern U.S. USDA Zone 3.



Hackberry frequently appears on “Tough trees” lists. Photo courtesy: Jesse Saylor, MSU. Inset: Hackberry leaf close up. IPFW Grounds Dept.



Honeylocust is a classic example of a bottomland species that can also grow well on upland sites.

Sweetgum can offer varied fall color from orange-red to purple.







Dawn redwood is a fast growing deciduous conifer that tolerates wet soil. Inset: Metasequoia 'Gold Rush' provides a bright splash of yellow.

**Dawn redwood (*Metasequoia glyptostroboides*)** is a deciduous conifer that adds a unique appeal to the landscape. This is a fast growing tree (1'-2' or more per year) with a tightly pyramidal growth form. Dawn redwood is native to China and was thought to be extinct until its discovery by scientists in the 1940s. The needles are soft-green and shed in the fall to reveal interesting bark patterns. A few cultivars are available; one of the most noteworthy is 'Gold Rush', which has bright yellow foliage. Native to China. USDA Zone 4.

**London plane tree (*Platanus × acerifolia*)** has long been a popular shade tree in Europe, where it is often pollarded. London plane tree is considered a hybrid between Oriental plane (*P. orientalis*) and American sycamore (*P. occidentalis*). London plane trees have many characteristics in common with sycamore, including large palmately lobed leaves and thin papery bark. Plane trees are more resistant to sycamore anthracnose than American sycamores, however, and therefore often preferred for landscape planting. USDA Zone 5.



London plane tree is the quintessential shade tree. Photo courtesy: Tom DeGomez, bugwood.org

### Swamp white oak (*Quercus bicolor*)

While most oaks prefer drier upland sites, swamp white oak often occurs on poorly drained soil with high water tables. Like hackberry, swamp white oak is somewhat nondescript in terms of ornamental characteristics, but is adapted to tough sites and is commonly mentioned on lists of ash replacements. In native habitats, swamp white oak is a long-lived tree (300-350 years). Native to northeast U.S. USDA Zone 4.



Swamp white oak makes a sturdy specimen tree. Photo courtesy: IPFW Grounds Dept. Inset: Finely lobed leaves of swamp white oak. Photo courtesy: IPFW Grounds Dept.





Although its native range extends only to southern Indiana, baldcypress grows well in the Southern half of the Lower Peninsula.



Dr. Bert Cregg, Associate Professor, MSU Dept. of Horticulture and Dept. of Forestry, conducts research and extension programs on tree physiology and management of nursery, landscape, and Christmas tree systems.

All photos used in this article are used by permission of Bert Cregg and may not be reused in any way without express written permission.

**Baldcypress (*Taxodium distichum*)** Like dawn redwood, baldcypress is a fast growing deciduous conifer that grows well even in wet sites. The two species are sometimes confused, but baldcypress tends to have a coarser branch structure and a more irregular crown than dawn redwood. Also, baldcypress foliage has an alternative arrangement, whereas dawn redwood is opposite. Although it is native to bottomlands in the southern U.S., baldcypress grows well in Lower Michigan and can also tolerate relatively dry conditions. USDA Zone 4.

**Arborvitae (*Thuja occidentalis*)** As a general rule, most evergreen conifers are

poorly tolerant or intolerant of wet soils. Arborvitae is one of the notable exceptions. Since arborvitae can withstand heavy soils and provide a year-round screen it is a regular in the Midwest landscape. The name arbo vitae (tree of life) dates to the 16th century when French explorers learned from Native Americans to use the tree's foliage to treat scurvy. *Thuja occidentalis* is among the most diverse species in the nursery trade and the American Conifer Society recognizes nearly 200 cultivars. Native to eastern Canada and northeastern U.S. USDA Zone 4.

#### REFERENCES

- American Conifer Society Conifer database [www.conifersociety.org](http://www.conifersociety.org)
- Bassuk, N., D.F. Curtis, B.Z. Marranca, and B. Neal. 2009. Recommended Urban Trees: Site Assessment and Tree Selection for Stress Tolerance. Urban Horticulture Institute, Cornell University, Ithaca, NY.
- Bratkovich, S., L. Burban, S. Katovich, C. Locey, J. Pokorny, and R. Wiest. 1993. Flooding and its effects on trees. USDA Forest Service, Northeastern Area State and Private Forestry, St. Paul, MN.
- Silvics of North America, USDA Forest Service Agriculture Handbook 654
- Ware, G. 1994. Ecological bases for selecting urban trees. *J. of Arboriculture* 20:98-103.

★ 1864 *150 Years* 2014 ★

## Quality Liners

**Bareroot Liners**



**BAREROOT LINERS**

- Premium grade bedrun
- Fully branched
- Heavy rooted, northern grown

**QUART LINERS**

- Extends your planting season
- Virtually no transplant shock
- Deeper container for better roots
- Great Value!

**Containerized Quart Liners**





**EVERGREEN**  
NURSERY COMPANY INC.  
STURGEON BAY, WISCONSIN  
[www.EvergreenNurseryCo.com](http://www.EvergreenNurseryCo.com) 1 800.448.5691