by Dr. Bert Cregg

TOP CHOICES FOR TOUGH PLACES

(Photos courtesy of Sarah Tien, City Forester, Park Ridge, IL)

Salt of the earth: baldcypress thrive on this heavily salted parkway on the outskirts of Chicago.

Some of the most common questions I get when discussing conifers at various meetings or programs concern choosing conifers for difficult sites. Frequent questions include: *What conifer can I grow under shade? Is there a conifer that can tolerate flooding? Can conifers grow in alkaline soils?*

Conifers represent a large group of plants, but as a rule do best with good moisture, good drainage, slightly acidic soil pH, and part- to full-sun. As Susan Gruber, former coordinator of the MSU Nursery and Landscape Ag Tech Program, used to note in her conifer program, "Conifers do best on sites that are moist, yet well-drained. But then, who doesn't?" In Michigan and much of the Midwest, the search for the perfect conifer site in the landscape is like the search for the Holy Grail. Virtually every site in this part of the world has at least one environmental factor that is suboptimal for tree growth. So what's a nursery manager or landscaper to do? Fortunately there are conifers that break the mold and can tolerate adverse sites, including drought, poor drainage, alkaline soils, extreme shade, and exposure to road salt.

Conifers have evolved in almost every habitat on earth in which plants can grow. Noted conifer expert Chub Harper points out, "When you're looking for a conifer for a difficult spot, think about which trees naturally occur in those habitats. There's almost always one species, and often more, that are adapted to the situation you're dealing with." With that thought in mind, here are some tough tree selections for tough places.

Dry sites

Handling sites with excess drainage or low soil moisture-holding capacity is a specialty of many conifer species. Many pines, spruces, and junipers have evolved in parts of the world that are



Shady characters. Hemlocks add elegance to shady landscapes.
Hard pines (needles in fascicles of 2's or 3's) are often tough trees with good drought and salt tolerance.

extremely arid. Generally speaking, species in the hard pine group (pines with needles in fascicles of twos or threes) are very drought hardy. Among pines that are native to Michigan, this group includes jack pine (*Pinus banksiana*) and red pine (*P. resinosa*). Other examples include mugo pine (*P. mugo*), ponderosa pine (*P. ponderosa*), Austrian pine (*P. nigra*), and Scots pine (*P. sylvestris*). Although trees in the latter group have some pest issues in Michigan, their drought tolerance is truly remarkable.

As a Research Plant Physiologist with the USDA Forest Service, I conducted drought-tolerance research on ponderosa pine and Scots pine. In greenhouse dry-down trials, seedlings of both species were able to survive over two months without water. Based on pressure chamber measurements, seedlings of these species were able to withstand over 70 bars of plant moisture stress, which is double the amount of stress that most tree seedlings can tolerate. As previously noted, spruces and junipers are also very drought hardy. Colorado blue spruce (*Picea pungens*), for example, is blue because of the glaucous waxy coating on its needles. This coating acts to reduce needle moisture loss as well as protecting the needle's photosynthetic apparatus from excessive UV radiation at high elevation. Junipers, including native *Juniperus virginiana* and exotics such as *Juniperus communis*, are extremely water-use efficient plants because of their scale-like needles. Junipers can be useful on dry sites as trees and also as evergreen shrubs and groundcovers. Another drought-hardy groundcover is Russian cypress (*Microbiota decussata*). Conifer expert, Chub Harper notes, "One of the unique attributes of *Microbiota* is that it is one of the few plants that grows well under shade *and* drought."

Wet sites

Although no one keeps statistics on such things, it's probably safe to say that poor drainage and wet site conditions limit the use of conifers in Michigan landscapes more than any other environmental condition. One usually doesn't have to look very far in mid-Michigan to find conifers — typically pines or firs — that someone has planted in locations that are too wet. These trees will struggle along for a few years with their crowns getting thinner and thinner until they finally succumb. This pattern is especially obvious in nurseries or Christmas tree plantations. The majority of the plantation is hale and hardy until you run across a depression or low spot where the trees are declining.

Among landscape conifers, one of the best choices for exceedingly wet sites is baldcypress (*Taxodium distichum*). Following Chub Harper's "look at where they occur naturally" rule, this is an obvious choice. Baldcypress grow in swamps and along rivers throughout the southeastern United States, northward into southern Illinois. This tree can withstand prolonged flooding and even saltwater intrusions. Other deciduous conifers such as dawn redwood and larch are also extremely flood tolerant.

In contrast to selecting a deciduous conifer for wet sites, identifying a flood-tolerant evergreen conifer is more challenging. Arborvitae come the closest to fitting this bill. White spruce (*Picea glauca*) can also withstand wet feet better than most other conifers. In both cases, however, these trees are best described as tolerating intermittent flooding rather than weeks of inundation.

High-pH soils

Soil pH is probably next to poor drainage as a limiting soil factor for conifers in Michigan. As a rule of thumb, conifers grow best in soils between pH 5.5 and 6.5. The optimum range for individual species, however, can vary widely. Fraser fir (*Abies fraseri*), for example, grows in soils as low as pH 3.5 in its native North Carolina. As soil pH increases, several mineral elements — notably manganese and iron — become limiting and trees may become chlorotic. For the most part, firs are among the most sensitive conifers to increased pH. In our exotic fir research, however, corkbark fir and sub-alpine firs have shown to be more tolerant of higher pH than other firs. Spruces, particularly white spruce and Serbian spruce (*Picea omorika*), usually make the list of alkaline-tolerant trees. Several members of the Cupressaceae, including *Thuja* and *Juniperus*, can also tolerate alkaline soils.

Shade

Dealing with shade brings up the important issue of *acclimation*

Arizona corkbark fir is able to withstand high soil pH better than most true firs.

Deciduous conifers such as dawn redwood, baldcypress and larches are great choices for sites with poor drainage.

versus *adaptation*. We often use these terms interchangeably, but there is an important distinction. *Adaptation* refers to traits that a species evolves over time, whereas *acclimation* refers to the response of an individual tree based on the environment in which it is growing. An illustration here may be helpful. The hemlock genus (*Tsuga*) has evolved adaptive traits for low-light conditions (high photosynthetic efficiency, low-light compensation point for photosynthesis), and yet individual hemlock trees planted in partial or even full sun can acclimate and grow well. Likewise, some trees that we regard as needing a lot of light, such as the Norway spruce (*Picea abies*) or Eastern white pine (*Pinus strobes*), can acclimate and grow well in shade. Where we often encounter problems is when a tree is acclimated to one set of conditions (say, full sun in a nursery) and then transplanted to different conditions (a shady landscape). If the shift is too dramatic or rapid, the tree may fail before having a chance to acclimate to its new environment.

So, given all that, who are the shady characters among conifers? Hemlocks, of course, usually start and end the conversation on shade-tolerant conifers. Their elegant form and texture adds an element of class to virtually any landscape. Yews (*Taxus spp.*), although much disparaged due to indiscriminant pruning, are a great choice for shady spots. In fact, shady areas are good places to plant yews and allow them to develop their natural character without turning them into hockey pucks or meatballs. Members of the *Cupressaceae* are adapted to a variety of light conditions. *Thuja* and *Chamaecyparis* can withstand shade, though their growth is slower and their form is more open in shade than in sun. As mentioned earlier, Norway spruce and Eastern white pine can acclimate to shady conditions. For example, at Lake Lansing Park near East Lansing, Norway spruce has naturalized and seedlings and saplings are coming in under a dense overstory of mature spruces.

Salt exposure

Road salt presents a challenge for selecting trees for sites near roadways throughout Michigan and the upper Midwest. Road salt can damage trees directly due to toxic aerial deposits of excess sodium and chloride. Accumulations of road salt in soils can cause osmotic stress similar to "fertilizer burn," and high levels of soil sodium can reduce the uptake of essential elements such as potassium and magnesium. As with many tough site issues, deciduous conifers, particularly larches and baldcypress, are frequently the trees of choice. Baldcypress consistently ranks as one of the most salt-tolerant trees available in the landscape. In the Chicago suburb of Park Ridge, Illinois, City Forester Sarah Tein reports that baldcypress trees planted in a narrow parkway along heavily salted roads are thriving. Exposure to road salt presents an even greater challenge for evergreen conifers since, unlike deciduous trees, their foliage is exposed to aerial salt drift and salt splash throughout the winter. As a group, pines vary widely in their tolerance to road salt and include some of the most salt-tolerant conifers (e.g., Austrian pine) and some of the most sensitive (e.g., Eastern white pine). In general, hard pines are more salt tolerant than soft, although Japanese white pine (*Pinus parviflora*) appears on several lists of salt-tolerant trees.

Summary

To successfully establish trees on difficult sites, nursery managers, landscapers, and homeowners have two basic options. One is to modify the environment to reduce plant stress. This option works best when the issue is drought or excess drainage, which can be addressed directly by irrigation. Other site problems, however, such as alkaline soils or poor drainage, are difficult to remedy on a long-term basis. For example, adding elemental sulfur or using ammonium-based fertilizer can lower soil pH, but the shift in pH is transient. Rather than struggling to make the site right for the tree, a better and more sustainable option is to select trees that are adapted to the site.