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Commercial Greenhouse and Nursery Production

Drought-tolerant Plants

Purdue Horticulture and Landscape Architecture
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EXPERT REVIEWED

The eastern half of the United States is generally characterized by frequent summer rains that are sufficient to meet the water requirements of most, if not all, landscape plants. However, late summer water stress is common in the Midwest. The more severe droughts that occur in some years remind us that we cannot take adequate rainfall for granted.

Some locations — whether several square miles or a few square feet — are more prone to drought than others. For such locations, it is important to select plants that can tolerate dry conditions. Since they are such an important part of the landscape, this publication describes characteristics that make trees tolerant to drought, and then lists drought-resistant trees, shrubs, and groundcovers for Midwest landscapes.

Characteristics of Drought-tolerant Trees

Leaves can tell us a lot about whether a particular plant is likely to be more or less drought-tolerant. Understanding some common leaf traits and how they relate to drought tolerance can be useful when selecting trees for a particular landscape.

Plants lose water through a process called transpiration. Stomata (the pores in leaves) are necessary to allow carbon dioxide to enter the leaves for photosynthesis, but in the process, water is lost. Transpiration is important for other processes, including the movement of nutrients throughout the plant. However, water loss can lead to reduced growth or even death if it is not controlled in the plant.

Figure 1. *Drought-tolerant plants often have smaller leaves or shorter needles. They also can accumulate waxes on their leaves or needles (like this blue spruce). Waxes are thought to prevent water loss from these organs.*

Plants have a number of ways to reduce the water loss that occurs through transpiration. One is to simply reduce leaf area. When water stress is an issue, large leaf areas can be detrimental to growth and survival because there is more surface area from which water can be lost. Therefore, drought-tolerant plants will often have small leaves, or in the case of conifers, needles with small surface areas (Figure 1).

Figure 2. *Deep sinuses (the indentations between leaf lobes) reduce leaf area, which can limit water loss.*

While this is generally true, there are many plants that have large leaf areas that are drought-tolerant, such as southern magnolia, hardy rubber trees, and sycamore. Many of the plants on our List of Drought-tolerant Trees, Shrubs, and Groundcovers (below) have very large leave surface areas, so leaf size alone does not always indicate drought tolerance.

Another way plants can reduce leaf area is to have deep sinuses (the indentations between lobes on a leaf). Trees that are more tolerant of dry conditions often have deep sinuses, which decreases their total leaf area (Figure 2).

Another sign of drought-tolerance is leaves that have a heavy accumulation of waxes. The waxes often appear as a whitish-blue coating, such as that seen on blue spruce needles (Figure 1). The waxes that plants produce have many functions, but one of them is to reduce the amount of water that leaves or needles lose during dry conditions. The waxes simply make it more difficult for water to evaporate from inside the leaf to the outside.

While we still don't fully understand how leaf hairs (or trichomes) affect plant water loss, leaves that are covered with these small hairs typically lose less water than those that do not. Therefore, when selecting trees and shrubs for dry areas of the landscape, look for leaves with a thick covering of trichomes (Figure 3).

Native Trees and Drought Tolerance

Does native mean drought tolerant?

Not necessarily. First, it is important to carefully define the term *native*. If two different species grow in natural populations that are, for example, just 10 miles apart (and have been present in those areas for, say, hundreds of years), they might be grouped together with other plants of the greater geographical region as being "native." However, if the different local areas where these plants grow differ drastically in their soil conditions (water and nutrient availability, structure, and so on), exposure, or temperature, you should not assume they will perform similarly when transplanted to a new site in the landscape.

Figure 3. *Trichomes (hairs) may reduce water loss from leaves.*

For example, a perennial plant that is native to the Midwest prairie is a drought-tolerant plant, but a fern that is native to high rainfall mountain ranges is not, even if these two areas are within the same state or local region. Many people assume that all native plants will thrive in a dry area with no additional water. Many native species in the eastern United States, in fact, require large amounts of water because they are either native to high-rainfall areas or stream banks.

Even trees that are native to dry environments can experience drought stress. Severe seasonal droughts with lower than average rainfall can produce water stress even in drought-tolerant plants. In landscape environments, trees compete with turf and other plants for water. Hardscapes such as sidewalks also can limit water entry into soils, as can the soil compaction typical of suburban and urban areas. Furthermore, in natural environments, leaf debris helps maintain soil water. But that debris is usually removed from managed landscapes.

This concept becomes even more applicable when we talk about plants that are native to the United States. If we compare red maple trees from Texas to those from the northeast part of the country, they are very different in their adaptations, even though they are the same species. The trees from Texas will have many of the characteristics of drought-tolerant trees described above: small leaves, thick cuticles, and deeper sinuses. These are all adaptations to low-water environments and, as described above, indicate that these trees will be more tolerant of dry landscape conditions.

List of Drought-tolerant Trees, Shrubs, and Groundcovers

We have compiled a list of trees, shrubs, and groundcovers that are drought-tolerant and suitable for landscapes in the eastern United States. This list is based on the personal experiences of professional horticulturists and scientific research reports in various publications. To “make the cut,” each of these plants had to appear in at least three independent scientific or professional reports of woody plant drought tolerance. Use this list as a guide when selecting plants that need to tolerate dry conditions.

Scientific Name	Common Name
Trees	
Acer buergeranum	trident maple*
Acer campestre	hedge maple*
Acer saccharinum	silver maple
Acer tataricum ssp. *ginnala*	amur maple
Asimina triloba	pawpaw
Carpinus caroliniana	American hornbeam
Carya spp.	pecan
Catalpa speciosa	northern catalpa
Cedrus libani	cedar of Lebanon*
Celtis occidentalis	hackberry
Cercis canadensis	eastern redbud
Cladrastis kentukea	yellowwood
Corylus colurna	Turkish filbert
Crataegus spp.	hawthorns (most)
Diospyros virginiana	persimmon
Elaeagnus angustifolia	Russian olive
Ginkgo biloba	ginkgo
Gleditsia triacanthos	honey locust
Gymnocladus dioicus	Kentucky coffeetree
Koelreuteria paniculata	goldenraintree
Maclura pomifera	osage orange
Morus alba	white mulberry
Ostrya virginiana	hop hornbeam*
Parrotia persica	Persian parrotia*
Phellodendron amurense	amur corktree
Picea omorika or P. pungens	Serbian spruce/Colorado spruce
Pinus spp.	pines (most)
Platanus x acerifolia	London plane tree
Populus tremuloides	quaking aspen
Prunus cerasifera	cherry plum
Quercus macrocarpa	bur oak
Quercus prinus	chestnut oak
Quercus muehlenbergii	chinquapin oak
Quercus rubra	red oak
Quercus alba	white oak
Robinia pseudoacacia	black locust
Sassafras albidum	sassafras
Styphnolobium japonicum	Japanese pagodatree
Syringa reticulata	Japanese tree lilac
Tilia tomentosa	silver linden
Ulmus parvifolia	lacebark elm
Ulmus propinqua	Japanese elm
Zelkova serrata	Japanese zelkova*

Scientific Name	Common Name
Shrubs	
Abelia x grandiflora	glossy abelia
Acanthopanax sieboldianus	fiveleaf aralia
Amorpha fruticosa	indigobush
Aralia spinosa	devil-walkingstick
Aronia arbutifolia	red chokeberry
Aronia melanocarpa	black chokecherry
Buddleia davidii	butterfly-bush
Calycanthus floridus	sweetshrub*
Calycarpa dichotoma	purple beautyberry*
Caragana arborescens	Siberian peashrub
Caryopteris x clandonensis	blue mist shrub
Ceanothus americanus	New Jersey tea
Ceanothus ovatus	inland ceanothus
Cephalotaxus harringtonia	Japanese plum yew
Chaenomeles speciosa	flowering quince
Chionanthus virginicus	white fringetree
Cornus racemosa	gray dogwood
Corylus avellana	European hazel
Cotinus coggygria	smokebush
Cotoneaster spp.	cotoneasters (most)
Cytisus scoparius	Scotch broom
Deutzia gracilis	slender deutzia
Diervilla sessifolia	southern bush honeysuckle
Eucommia ulmoides	hardy rubber tree
Genista tinctoria	woadwaxen
Hamamelis virginiana	common witch-hazel*
Hamamelis vernalis	vernal witch-hazel*
Indigofera kirilowii	kirilow indigo
Itea virginica	Virginia sweetspire
Juniperus spp.	junipers (all)
Kerria japonica	Japanese kerria
Kolwitzia amabilis	beautybush
Lavandula angustifolia	English lavender
Ligustrum vulgare	common privet
Myrica pensylvanica	northern bayberry
Perovskia atriplicifolia	Russian sage
Physocarpus opulifolius	ninebark
Potentilla fruticosa	bush cinquefoil
Prunus x cistena	sand cherry
Prunus glandulosa	dwarf flowering almond
Prunus maritima	beach plum
Prunus tomentosa	Nanking cherry
Pyracantha coccinea	scarlet firethorn

Scientific Name	Common Name
Shrubs *(continued)*	
Rhodotypos scandens	black jetbead
Rhus aromatica	fragrant sumac
Rhus typhina	staghorn sumac
Ribes alpinum	alpine currant
Rosa spp.	roses (most)
Spiraea spp.	spireas (most)
Symphoricarpos x chenaultii	Chenault coralberry
Symphoricarpos orbiculatus	coralberry
Syringa vulgaris	common lilac*
Tamarix spp.	larches (most)
Viburnum lantana	wayfaringtree viburnum
Viburnum prunifolium	blackhaw viburnum
Viburnum rufidulum	rusty blackhaw viburnum
Yucca filamentosa	Adam's-needle yucca
Groundcovers and Vines	
Arctostaphylus uva-ursi	bearberry
Campsis radicans	trumpet vine
Celastrus scandens	American bittersweet
Clematis tangutica	golden clematis
Clematis texensis	scarlet clematis
Euonymus fortunei	wintercreeper euonymus*
Hypericum prolificum	shrubby St. Johnswort
Juniperus horizontalis	blue rug juniper
Juniperus procumbens	Japanese garden juniper
Juniperus sabina	'Tamariscifolia' tam juniper
Liriope spicata	lily turf
Lonicera japonica	Japanese honeysuckle
Lonicera sempervirens	trumpet honeysuckle
Microbiota decussata	Russian arborvitae
Parthenocissus quinquefolia	Virginia creeper
Parthenocissus tricuspidata	Boston ivy
Sedum spp.	sedum (all)
Vaccinium angustifolium	lowbush blueberry
Wisteria spp.	wisterias (most)

**This species is quite tolerant once established.*

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