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Wet and Dry Sites

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To grow, all trees require air, light, water and nutrients. Some trees can survive over a wide range of climatic and soil conditions, whereas others are very site specific. Both wet and dry sites present establishment and growth challenges, making selection of the right tree for the right site very important.

Know the site's soil

When selecting trees relative to soil moisture, begin by identifying the site's soil type. Soil maps are available for most areas in Virginia (contact your local Virginia Cooperative Extension office). Keep in mind, however, that construction activities (compaction, cut and fill, topsoil removal) may have altered the native soil.

Soil moisture should be viewed in two major ways - drainage down through the soil and runoff water across the site. Soil drainage is the rate at which water moves down through the soil. Drainage is influenced by soil texture (percent of sand, silt and clay) and soil structure (arrangement of soil particles). The presence of water, land slopes, impervious subsurface layers, and compacted soil surface can also affect drainage. After a rain and normal drainage, an ideal silt loam soil for growing trees would consist of 50% solid (45% mineral, 5% organic matter) and 50% pore space (25% air, 25% water).

To roughly gauge the rate of drainage for a particular soil, try the "hole test." Dig a hole approximately one foot deep and fill it with water. Time the rate (on an hourly basis) of water drainage out of the hole. If the water drains away at about one inch per hour, you have a desirable, well-drained soil. If drainage is much faster, your soil is probably high in sand, and if much slower, your soil is probably high in clay. If drainage is either very fast or very slow, consider the dry or wet soil solutions offered in this publication.

Determine soil drainage with the "hole test."

Wet sites

Wet sites are sites where water either stands for long periods of time, or where drainage is slow (on average less than 1"/hour). Wet sites also can be sites that receive considerable runoff from higher elevations. In wet soils, too much water in the soil fills the air spaces, resulting in low oxygen levels. Where oxygen is lacking, water and nutrient uptake stops, plant processes and growth cease, and trees begin to decline or die.

The presence of moss may indicate a wet or poorly drained soil.

Standing water may be an indication of either a wet site or slow drainage.

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Adapting to wet sites

Many trees have adapted to growing in wet sites. For example, when growing in or around water, bald cypress produces protruding knobs ("knees") that extend above water or the saturated soil. These knobs are thought to help with air absorption into the roots. Willows and ashes, when stimulated by flooding, produce new air-filled roots to replace roots killed by excess moisture.

Bald cypress is a species very tolerant of wet sites.

Bald cypress produce knobs or "knees" that may help with air absorption.

Some tree species switch to anaerobic respiration (respiration requiring no oxygen). Anaerobic respiration produces byproducts, but trees are usually able to convert them into organic acids for use in leaf growth. Other trees, in response to flooding, produce tiny bark openings - called *lenticels* - which serve as breathing pores, allowing air into the interior of roots and branches.

Wet sites: natural and man-made

On *wet sites* the soil is saturated for most of the growing season except during extended drought. On *moist sites* the soil stays damp and is occasionally saturated. These situations can be found naturally along ponds, rivers, streams, lowlands and on sites with high water tables. To test for a high water table, dig several two-foot deep holes at the planting site and check in two to three hours. If water has collected in the holes, the water table is high.

Man-made situations also can be the cause of wet sites. Run off from pavement, roofs and other impervious structures can flood a site with excess water. Cleared and graded slopes, where natural vegetation would normally absorb excess water, may shed runoff down slope. Soil compacted by heavy machinery or even heavy foot traffic can have drainage problems because water may be unable to drain through the soil.

Wet site solutions

- Plant cleared slopes with ground covers.
- Use mulches to slow water and help it soak into the soil.
- Divert runoff using perforated drainpipes laid on or under the soil.
- Dig shallow trenches or build retaining walls to channel away problem water.
- Plant tree balls high (several inches of root ball left above ground and covered with mulch) or construct planting berms.
- ***Select trees tolerant of wet sites.***

Eastern white pines that are growing well at the top of the man-made berm where drainage is good, but declining at the bottom of the berm due to excess drainage water.

Dry sites

A dry site is one on which tree water deficits are likely to be more frequent, severe or longer than is normal for the local climate. Sites become dry due to insufficient precipitation (drought) or irrigation, insufficient soil volume in the planting area, or various soil texture characteristics.

Kousa dogwood adversely affected by insufficient moisture.

Drought can be caused by less than normal rainfall. It can also be caused by hot or cold temperature extremes. In northern and western regions of Virginia, where the top several inches of soil may freeze, roots may be unable to take up water. Reduced water uptake in the winter can make trees, in particular evergreens, more vulnerable to

Dry site due to limited soil volume in the street tree pits. Bald cypress, that adapts well to wet sites, also adapts well to dry sites

desiccation or drying. Be sure to water in the winter if the ground is dry, including soil in containers and raised planters.

Most trees, and especially urban trees and trees in containers, become stressed when they have a disproportionately small volume of soil for their roots. Reduced soil volume leads to a site that dries rapidly as the root system absorbs moisture, often causing a chronic water deficit for the trees. General signs of water stress include reduced growth, poor flower or fruit production, limp, slightly curled or scorched leaves, and changes in leaf color.

Sandy soils tend to drain rapidly making the soil drier than silt loam soils. Clayey soils tend to have dry to very wet moisture extremes depending on rainfall amounts.

Dried or scorched leaf margins on kousa dogwood.

Dried tip and needles on an eastern white pine.

Adapting to water deficits

To survive prolonged water stress, trees must be able to prevent or reduce water loss from certain tissues. Common leaf adaptations include thickened waxy layers on leaf surfaces, increases in leaf thickness, and coverings of short hairs (pubescence). Some trees reduce moisture loss by closing stomates (leaf pores) or decreasing leaf surface or size of new leaves, both of which decrease the amount of water loss (transpiration). Narrow or spiky leaves of conifers enable them to survive not only the droughts of hot summers but also the cold induced droughts of winter. An extreme form of dealing with water deficits is leaf drop.

Some trees adapt to dry conditions by developing massive, spreading roots, or deep roots, either of which can enable the tree to absorb larger volumes of water. Expansive roots can be a problem in confined soil volumes. losses are high. Water uptake is more efficient in early morning or in the evening when trees are less stressed. Avoid light sprinkling – slowly soak the root zone if you water with a hose.

Soil compaction

Soil compaction over a tree's roots, due to equipment operation, material storage, or paving, can prevent moisture from reaching roots. As a result of construction, the grade around a tree may be lowered, altering drainage patterns and making the site either wet or dry.

To improve soil tilth (workability) and water retention, incorporate organic matter into the top 6 to 9 inches of soil of an entire planting site at a rate of 3 cubic yards of compost or pine bark per 1,000 square feet. In sandy soils increase the rate to 5 cubic yards per 1,000 square feet. Do not incorporate sand into clayey or compacted soil – compaction will increase and drainage decrease.

Drying winds

Drying winds can seriously increase the effects of drought. In coastal regions, winds carry both salt and sand, causing abrasions to leaves and stems as well as desiccation. Wind can damage trees suffering from lack of moisture at any season. In exposed coastal gardens, trees tolerant of both wind and salt spray include Russian olive, white poplar, eastern redcedar, and loblolly and Japanese black pines.

Dry site solutions

- Install efficient irrigation. Drip irrigation provides more efficient water use than overhead sprinklers. Drip irrigation ranges from inexpensive "soaker" hoses to elaborate computerized systems.
- Reduce fertilizer use during droughts. Fertilizers are salts that can further stress or kill trees if water is inadequate. Salt concentrations can build up in the soils due to decreased water availability. Even controlled release fertilizers may release much more rapidly during hot weather, causing excessive salt levels.
- Apply mulches. Application of mulch can improve the water status of trees. Mulches also reduce the impact of water droplets hitting the soil surface, thereby reducing soil erosion and crusting and increasing water penetration into the soil. Mulches should be applied 2" to 4" deep depending on particle size (larger particles require a thicker layer). Despite its many benefits, mulch can be harmful when applied too thickly or piled against tree trunks.

- Water in early morning or evening. For most landscape trees approximately 1" of water (total rainfall plus irrigation) per week is sufficient. For sandy soils divide the total into two half-inch waterings per week. Don't water in the middle of the day when evaporation
- Plant trees in groups instead of individually to increase the amount of unpaved surface around each tree.
- Select trees tolerant of dry sites

Trees for wet sites

Deciduous trees

Common name	Latin name
Box elder	*Acer negundo*
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
Common alder	*Alnus glutinosa*
Downy serviceberry	*Amelanchier arborea*
Shadblow serviceberry	*Amelanchier canadensis*
River birch	*Betula nigra*
American hornbeam	*Carpinus caroliniana*
Pecan	*Carya illinoensis*
Northern catalpa	*Catalpa speciosa*
Common hackberry	*Celtis occidentalis*
Fringetree	*Chionanthus virginicus*
Persimmon	*Diospyros virginiana*
Green ash	*Fraxinus pennsylvanica*
Thornless honeylocust	*Gleditsia triacanthos* var. *inermis*
Deciduous hollies	*Ilex decidua, I. verticillata*
Sweetgum	*Liquidambar styraciflua*
Tulip tree	*Liriodendron tulipifera*
Sweetbay magnolia	*Magnolia virginiana*
Dawn redwood	*Metasequoia glyptostroboides*
Water tupelo	*Nyssa aquatica*
Black tupelo	*Nyssa sylvatica*
Paulownia	*Paulownia tomentosa*
London planetree	*Platanus* x *acerifolia*
Amer. sycamore	*Platanus occidentalis*
Eastern cottonwood	*Populus deltoides*
Swamp chestnut oak	*Quercus bicolor*
Cherrybark oak	*Quercus falcata*
Water oak	*Quercus nigra*
Pin oak	*Quercus palustris*
Willow oak	*Quercus phellos*
White weeping willow	*Salix alba*
Weeping willow	*Salix babylonica*
Bald cypress	*Taxodium distichum*
American elm	*Ulmus americana*

Evergreen trees

Common name	Latin name
Chamaecyparis	*Chamaecyparis* spp.
Japanese cryptomeria	*Cryptomeria japonica*
American holly	*Ilex opaca*
Southern magnolia	*Magnolia grandiflora*
Austrian pine	*Pinus nigra*
Loblolly pine	*Pinus taeda*
Arborvitae	*Thuja* spp.

Trees for dry sites

Deciduous trees

Common name	Latin Name
Amur maple	*Acer ginnala*
Box elder	*Acer negundo*
Silver maple	*Acer saccharinum*
Tatarian maple	*Acer tataricum*
Ohio buckeye	*Aesculus glabra*
Pawpaw	*Asimina triloba*
Chinese chestnut	*Castanea mollissima*
Northern catalpa	*Catalpa speciosa*
Common hackberry	*Celtis occidentalis*
Red bud	*Cercis canadensis*
Yellowwood	*Cladrastis kentukea*
Filbert	*Corylus* spp.
Smoke tree	*Cotinus coggygria*
Hawthorn	*Crataegus* spp.
Russian olive	*Elaeagnus angustifolia*
European beech	*Fagus sylvatica*
Green ash	*Fraxinus pennsylvanica*
Ginkgo	*Ginkgo biloba*
Thornless honeylocust	*Gleditsia triacanthos* var. *inermis*
Black walnut	*Juglans nigra*
Goldenraintree	*Koelreuteria paniculata*
Flowering crabapple	*Malus* spp.
Chinese pistache	*Pistacia chinensis*
London planetree	*Platanus* x *acerifolia*
Amer. sycamore	*Platanus occidentalis*
Hardy orange	*Poncirus trifoliata*
Purpleleaf plum	*Prunus cerasifera*
Callery pear	*Pyrus calleryana*
Black locust	*Robinia pseudoacacia*
Red oak	*Quercus rubra*
Japanese pagoda tree	*Sophora japonica*
Lacebark elm	*Ulmus parvifolia*
Japanese zelkova	*Zelkova serrata*

Evergreen trees

Common name	Latin name
Atlas cedar	*Cedrus atlantica*
Deodara cedar	*Cedrus deodara*
Leyland cypress	*X Cupressocyparis leylandii*
Chinese holly	*Ilex cornuta*
'Nellie R. Stevens' holly	*Ilex x 'Nellie R. Steven's'*
Chinese juniper	*Juniperus chinensis*
Eastern redcedar	*Juniperus virginiana*
Colorado spruce	*Picea pungens*
Austrian pine	*Pinus nigra*
Longleaf pine	*Pinus palustris*
Loblolly pine	*Pinus taeda*
Japanese black pine	*Pinus thunbergiana*
Live oak	*Quercus virginiana*