



BARTLETT TREE

RESEARCH LABORATORIES

CHARLOTTE, NC



# Technical Report



## *Soil Drainage*

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**W**ater is essential for plant growth. However, either too little or too much water can result in decline and death of plants. For this reason, internal drainage characteristics of soils are possibly the one biggest factor that will determine which types of plants will grow on a particular landscape site. When soils retain too much water, or restrict water movement through them, the result can be root suffocation, root disease, and eventual root death.

On somewhat poorly drained sites plants may not die, but instead show chronic decline symptoms associated with root loss. These symptoms may include yellowing of leaves (chlorosis), defoliation, marginal scorching, dwarfed foliage, and dieback. Trees and shrubs experiencing root decline from excess water are also more susceptible to attack and invasion by secondary diseases and insects.

### **Why Are Some Soils Wet**

In addition to water, soil must contain air, or more precisely, oxygen. Roots absorb oxygen out of the soil and expel carbon dioxide into the soil in their normal process of respiration. This is done in spaces between soil particles called pores, which are not filled with water. Without this normal exchange of gases - carbon dioxide builds up; oxygen is less available so roots die.

A good soil, one termed well drained, has about half its volume in actual soil solids, and the other half as air space. Of this air space, about half is made up of large spaces and one half small spaces. Under normal periods of irrigation or rainfall the small pores spaces are able to hold water, the larger ones release the water to the pull of gravity and refill with air. This maintains a nice balance of air spaces and water capacity in the soil. Wet soils stay wet for several possible reasons. These include:

**Compaction** - When the surface of the soil has pore spaces removed by compression with heavy equipment, vibration or heavy foot traffic, water will not easily move into it. Instead water runs off if sloped or puddles on flat areas. Flat areas may then stay wet since the water does not readily move downward.

**Limiting Subsurface Layers** - Soils can have layers below the surface that restrict the natural movement of water down through them. In this case the water "perches" in the soil above the restrictive layer and keeps it wet. Some soils naturally have impermeable layers as a result of how they were created. A common man-caused impermeable layer or "hardpan" can be found on land, which was plowed for many years. This layer is usually located 8"-10" below the surface, the depth to the bottom of the plow.

**High Water Table** - When the water table is near the surface; the soil may be wet where roots grow. Water tables are highest in winter and spring.

**Clay Soils** - Soils vary tremendously in their makeup. Because of differences in texture and chemistry, the amount of large and pore spaces and the structure of the soil vary. These natural soil characteristics determine how quickly water move down through the soil to the water table. Soils with an over abundance of small pore spaces hold more water and for a longer period of time, thus restricting oxygen. On soils, which the main particle size is in clay range, the soil may naturally drain very poorly.

### Matching Plants to Soil Drainage

Nature does a great job of putting the right plant on a particular soil. Then as long as rainfall is normal, and soil drainage patterns are not changed, native trees and plants thrives. In horticulture we should try to do the same if we want healthy plants. A

big mistake is matching a poorly drained soil with a plant that requires good drainage. Lists of plants grouped according to their tolerances of "wet feet" can be found in many horticulture books or you may refer to Bartlett Technical bulletin entitled "Plants Tolerant of Wet Soils".

### Determining Soil Drainage Characteristics

There are a couple of ways to assess the drainage characteristics of a soil. The most reliable technique utilizes a soil expert to visually examine a soil looking at texture, color patterns, and limiting layers. Indicators of wetness include gray or white mottling.

Another simple method of assessing internal soil drainage is called a percolation test. The soils should not be excessively dry or saturated when this test is performed.

### Shrubs For Poorly Drained Soils

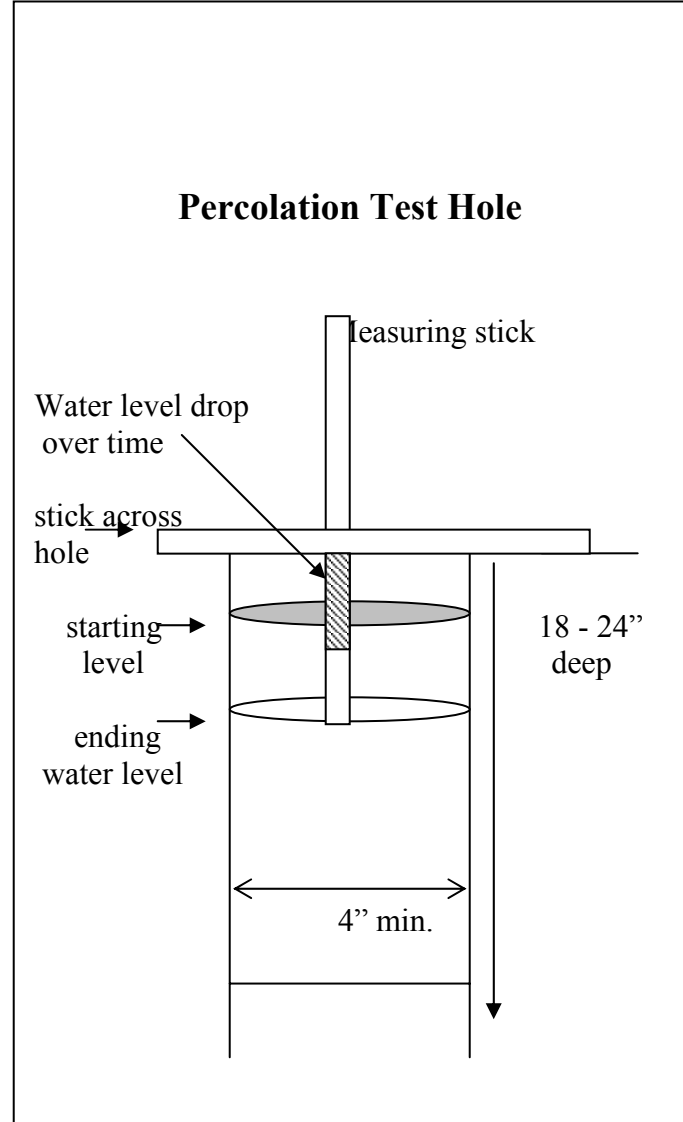
Florida Anise  
Sarcococca  
Viburnum species\*  
Inkberry Holly  
Yaupon Holly  
Winterberry Holly  
Chinese Witchhazel  
Butterfly Bush  
Sweetshrub  
Summersweet Clethra  
Crapemyrtle  
Mockorange  
Arborvitae

Illicium floridanum  
Sarcococca hookerana  
Viburnum spp.  
Ilex glabra  
Ilex vomitoria  
Ilex verticillata  
Hamamelis mollis  
Buddleia davidii  
Calycanthus floridus  
Clethra alnifolia  
Lagerstroemia indica  
Philadelphus coronaries  
Thuja spp.

\*Numerous evergreen and deciduous viburnum are available. Consult Dirr (Manual of Woody Landscape Plants) for a complete listing and description of species and cultivars.

## Instructions For Performing A Percolation Test

1. With a shovel or posthole digger, dig hole 18" to 24" deep. Hole diameter should be a minimum of 4 inches. The diameter of the hole should be uniform from top to bottom with the bottom being flat.
2. Fill hole with water to the top and let stand for at least an hour to pre-wet the soil.
3. Refill hole to within a couple inches of the top. Don't overflow the hole.
4. To aid in measurement, place a stick across the top of the hole and use a ruler or measuring tape to mark periodic drops in water level.
5. Allow the hole to drain for at least one hour. A longer period of time (2 to 3 hours will give a more accurate reading of average percolation rates.
6. Determine average drop in water level per hour and refer to the table below to interpret results.



How To Interpret Results	
<i>If water level in hole drops ...</i>	<i>Site is...</i>
Less than one-half inch per hour	Poorly drained and suited to wet-site species
One-half inch to one inch per hour	Moderately well drained and acceptable for many species including wet site species
More than one inch per hour	Well drained and suitable for all species including sensitive species