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Trees and Shrubs for Acid Soils

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The trees and shrubs on your new home site are growing poorly, so you take samples to the Extension office and the agent suggests a soil test. Test results show that your soil has a pH of 4.5, which is rated as strongly acid. The agent suggests you either take corrective action to raise the pH or grow different plants.

What do the test results mean? What are "acid soils" and what does pH measure? Why does this matter to your plants? How can you correct the situation or what alternative trees and shrubs can you grow?

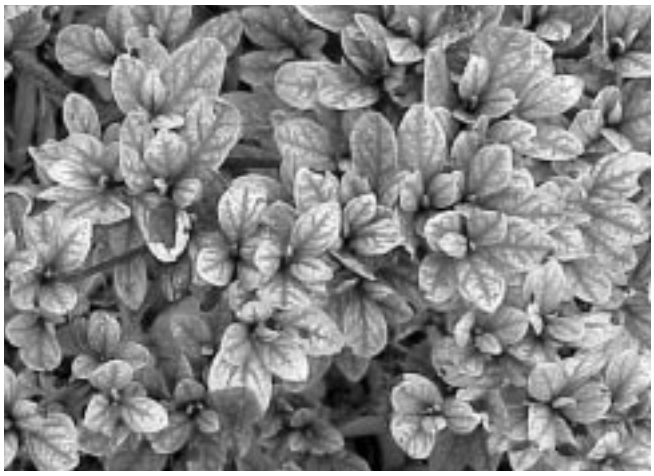
Acid soils

Acid soils are all soils that test lower than pH 7.0, which includes most soils east of the Mississippi River. In reality, most of these soils do not have significant acidity problems. Soils with pH's below 6.0 may need special treatment or plant selection. When soils become very acid, however, with pH's below 4.5, problems develop for many common landscape trees and shrubs. These strongly acid soils need either amendment to raise the pH or careful plant selection.

pH

pH measures the available hydrogen ions in a solution, and describes the relative level of acidity or alkalinity measured on a scale of 1 (acid) to 14 (basic), with 7.0 as neutral. Vinegar is a mild acid; battery acid (sulfuric acid) is a strong acid. Baking soda is a mild base when mixed with water; lye (Drano) is a strong base. Pure water is neither basic nor acidic, and has a pH of 7.0.

The pH scale is logarithmic, with 14 gradations. Each increment of 1.0 actually represents a difference of ten times either more basic (alkaline) or acidic (i.e., 6.0 is ten times more acid than 7.0, 5.0 is a hundred times more acid than 7.0, and 4.0 is a thousand times more acid than 7.0). Acid soils are often called "sour" soils and basic soils are often called "sweet" soils.



Interveinal chlorosis often develops when soil pH, that is either too high or too low for a particular plant, makes an important nutrient unavailable for plant absorption.

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Soil nutrients are available to plants for uptake and use only when they are dissolved in water as ions. Nutrient availability differs depending on the pH of the soil solution. A soil pH range of 6.0 to 7.0 provides the greatest compromise of nutrient availability for plants. Moving away from the pH 6.0 to 7.0 range makes some nutrients more available, while decreasing the availability of others. A decreasing or more acid pH not only makes some nutrients less available, but it may also cause others, such as Al and Mn, to become available in toxic concentrations.

Causes of acid soils

Acid soils may be due to natural conditions or human disturbance of the soil. The same methods for adjusting acidity are recommended for either situation. The primary difference is that naturally acidic soil will eventually return to that state after pH adjustment, while pH adjustments to disturbed soils present a more long term change. Naturally acid soils occur when bedrock from which the soil evolved provides the natural elements for acidity, when rainfall leaches or washes away basic elements in the soil, or when land has been naturally forested. All of these situations are present in Virginia soils.

Virginia soil pH's range from 4.0 to 8.0 with most in the 5.1 to 5.5 range. Virginia rainfall is high, averaging 40 to 45 inches per year. Over time this rainfall has carried away water-soluble basic elements (i.e., Ca, Mg, K, NA), thus resulting in acid soils. High rainfall has also supported Virginia's forests. In contrast, low rainfall tends to produce natural grasslands with minimal leaching and thus alkaline (basic) soils.

Manmade acidic soils occur as a result of mining operations, farming, construction site development, and similar events that remove topsoil and expose the naturally acidic subsoil, or that deplete the soil of basic-forming elements. What is left is usually lacking in organic matter and available nutrients. While pH recovery can occur naturally, it will be slow, as will be plant reestablishment.

Landscape fertilization practices can also affect soil acidity. Repeated use of high ammonium or urea fertilizers, especially to turf areas that cover tree roots, can compound acidity problems. In situations where the soil is too acid, it may be better to use more basic fertilizers, many of which are nitrate based. Water used for landscape irrigation can also contribute to acidity problems and, therefore, it is valuable to have both your soil and your water tested before taking corrective measures.

Adjusting acid pH

Adding ground limestone, either calcium carbonate or calcium-magnesium carbonate (dolomitic lime) raises the pH of acid soils. Quicklime and slaked lime are also used and act faster, but are more expensive and disagreeable to use. The amount of limestone needed to change the pH of the top 8 inches of soil from 4.5 to a desired 6.5 varies according to soil type and ranges from approximately 150 lbs/1000 ft^2 for a sandy soil to 250-300 lbs/1000 ft^2 for a clay loam. The rate needed will be provided as part of the soil test results from a soil testing lab, if the soil type and the intended use of the land are listed when the soil sample is submitted.

Ideally, lime should be worked into the soil to a depth of at least 8 inches. This is possible when preparing a new site with bare ground. Lime incorporation can be combined with deep tilling and the addition of organic matter (compost/manures) and fertilizer to revitalize a site that has been stripped or over-farmed. Lime incorporated into the soil will increase the pH to the target level (i.e., 6.5) in about two years.

Raising the pH of an established landscape, however, is much harder because incorporating lime into the soil may damage existing plant roots. If the total quantity of lime recommended exceeds 50 lbs/1000 ft^2, split surface applications into a series of several smaller applications over time. Unfortunately, surface applications take longer to significantly change the pH below a 4 inch depth. Adding lime to the surface without incorporating it is not a desirable method for correcting acidity deep in the soil.

Trees and shrubs for acid soils

Many trees and shrubs that are tolerant of acid conditions (including strongly acid conditions below pH 4.5)

Soil pH categories

Strongly acid	Medium acid	Slightly acid	Very slightly acid	Very slightly alkaline	Slightly alkaline	Medium alkaline	Strongly alkaline
4-5.5	5.5-6	6-6.5	6.5-7	7-7.5	7.5-8	8-8.5	8.5-10

are available for Virginia landscapes. These plants may often be a better solution than attempting to adjust the soil to a higher pH, particularly where the native soil condition is by nature acidic. For the following trees and shrubs, check their hardiness and heat zone tolerances relative to their suitability for your particular area. Note that most trees and shrubs native to Virginia are adapted to at least slightly acid soils.

pH 5.0 to 6.5 and above

Trees

Common Name	Latin Name
Balsam and fraser fir	*Abies balsamea* and *A. fraseri*
Maples* (Red)	*Acer* species
Serviceberry*	*Amelanchier arborea*
Hinoki falsecypress	*Chamaecyparis obtusa*
Fringetree*	*Chioanthus virginicus*
China fir	*Cunninghamia lanceolata*
Franklinia*	*Franklinia alatamaha*
Hollies* (Some)	*Ilex species*
Larch	*Larix decidua*
Sweetgum*	*Liquidambar styraciflua*
Magnolias* (Some)	*Magnolia species*
Crabapples	*Malus species*
Norway and Colorado spruce	*Picea abies* and *P. pungens*
Longleaf pine*	*Pinus palustris*
Eastern white pine*	*Pinus strobus*
Scots or Scotch pine	*Pinus sylvestris*
White and red oak*	*Quercus alba* and *Q. rubra*
Weeping willow	*Salix babylonica*
Sassafras*	*Sassafras albidum*
Mountain ash	*Sorbus aucuparia*
Japanese stewartia	*Stewartia pseudocamellia*
Japanese snowbell	*Styrax japonica*
Canadian hemlock*	*Tsuga canadensis*

Shrubs

Common Name	Latin Name
Carolina allspice*	*Calycanthus floridus*
Summersweet*	*Clethra alnifolia*
Scotch broom	*Cytisus scoparius*
Cleyera or ternstroemia	*Cleyera japonica*
Redvein enkianthus	*Enkianthus campanulatus*
Gardenia	*Gardenia jasminoides*
Witchhazel*	*Hamamelis virginiana*
Bigleaf hydrangea	*Hydrangea macrophylla*
Hollies* (Some)	*Ilex* species
Anise	*Illicium floridanum*
Virginia sweetspire*	*Itea virginica*
Drooping leucothoe*	*Leucothoe fontanesiana*
Mountain stewartia*	*Stewartia ovata*

pH 5.0 and below

Trees

Common Name	Latin Name
River birch*	*Betula nigra*
Flowering dogwood*	*Cornus florida*
Japanese dogwood	*Cornus kousa*
Japanese cedar	*Cryptomeria japonica*
American beech*	*Fagus grandifolia*
Carolina silverbell*	*Halesia carolina*
Black gum*	*Nyssa sylvatica*
Sourwood*	*Oxydendrum arboreum*
Loblolly pine*	*Pinus taeda*
Virginia pine*	*Pinus virginiana*
Golden larch	*Pseudolarix kaempferi*
Douglas fir	*Pseudotsuga menziesii*
Pin oak*	*Quercus palustris*
Willow oak*	*Quercus phellos*

Shrubs

Common	Latin Name
Bottlebrush buckeye*	*Aesculus parviflora*
Heaths and heathers	*Erica* species
Fothergilla*	*Fothergilla* species
Junipers*	*Juniperus communis* and *J. horizontalis*
Mountain laurel*	*Kalmia latifolia*
Loropetalum	*Loropetalum chinense*
Japanese pieris*	*Pieris japonica*
Azaleas and rhododendrons* (Some)	*Rhododendron* species and hybrids
Blueberries, huckberries, etc.* (Some)	*Vaccinium* species

*Native to Virginia