Soils are the single most important factor responsible for tree growth. Soils provide trees and shrubs with water, nutrients, and root anchorage. Under normal and undisturbed conditions, Iowa has the best soils in the world for tree growth. But, we have great variability in soils and soil types; not all soils are equally suited for all species of trees and shrubs. Soils are often modified in the urban environment to the disadvantage of tree growth through such activities as topsoil removal, addition of soil or fill, compaction of soil, burial of construction materials, construction of pavements, drainage impediments, and other activities. Successful establishment of urban plantings is dependent on an understanding of soil characteristics affecting tree growth, defining the soil limitations of the planting site, and matching species to the existing soil conditions.

The volume of soil available can limit plantings or reduce growth and vigor of trees and shrubs. Ideal conditions require 15 to 24 inches of top soil, that is well drained contains nutrients required for tree growth, and has the capacity to hold air, water, and organic matter. As topsoil depth decreases, the potential for survival and growth of woody vegetation decreases.

Soils have chemical, physical and biological properties. Chemical properties that vary from site to site include available nutrients, soil pH, and organic matter content. Lack of nutrients or the unavailability of nutrients will limit plant growth. Soil pH, a measure of acidity or alkalinity, affects the availability of some nutrients. The ideal pH range for tree growth is 5.5 to 6.5. Some trees begin to exhibit nutrient deficiency symptoms (especially iron) at higher soil pH’s. Organic matter in the soil contributes to tree growth by improving soil structure, nutrient availability, and water holding capacity. The physical aspects of the soil are as important as the chemical properties. Soil texture (proportion of sand, silt, and clay) is an important factor in water holding capacity. Soils with large open spaces (sand) retain less moisture than fine soils; soils containing mostly clay will be wet or poorly drained. Under optimum conditions, the pore space in soil should be 50% air and 50% water. Compaction of soils decreases pore space and increases plant stress by reducing availability of oxygen to the roots. Soils also are alive with a wide range of bacteria, fungi, and other organisms which contribute favorably to the soil environment.
Soils and sites in the urban landscape are often modified to the detriment of tree growth. Sites should be thoroughly evaluated before planting begins. Soil and site characteristics to evaluate include: **Soil depth**—very shallow soils (less than 8 inches of topsoil) or soils which contain foreign material (rock, old concrete, paving) will limit tree growth because they limit root development.

**Soil drainage**—soils with very high clay content, sites with a barrier which reduces water drainage, or sites which are low and accumulate drainage water will result in poor tree growth. Soils that have high amounts of sand or gravel are often very droughty and have poor moisture holding capacity.

**Soil pH**—In Iowa excessively low soil pH (acidic) is seldom a problem. However, many soils and sites in Iowa have a soil pH which is too high (basic) for optimum tree growth. Avoid planting trees intolerant of alkaline soils. Changing soil pH is a very difficult and expensive process.

**Soil fertility**—soil tests will establish levels of nitrogen, phosphorus, and potassium. Correction of low soil fertility is relatively easy through proper fertilization.

If the soil has little limitation with respect to soil depth, soil drainage, pH, or soil fertility, plant selection is easy. For those soils with limitations, select species better adapted to these adverse site conditions.

### Trees Tolerant of Alkaline Soils

- **Celtis occidentalis**—Hackberry
- **Crataegus spp.**—Hawthorn
- **Platanus x acerifolia**—London Planetree
- **Catalpa speciosa**—Catalpa
- **Gleditsia triacanthos** var. inermis—Thornless—Honeylocust
- **Fraxinus quadrangulata**—Blue Ash
- **Gymnocladus dioicus**—Kentucky Coffeetree
- **Quercus macrocarpa**—Bur Oak
- **Quercus muehlenbergii**—Chinquapin Oak
- **Quercus Shumardii**—Shumard Oak

### Trees Intolerant of Alkaline Soils

- **Acer rubrum**—Red Maple
- **Betula nigra**—River Birch

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**Trees for Poorly Drained Soils**

- **Aesculus glabra**—Ohio Buckeye
- **Acer rubrum**—Red Maple
- **Acer saccharinum**—Silver Maple
- **Betula nigra**—River Birch
- **Carpinus caroliniana**—American Hornbeam
- **Celtis occidentalis**—Hackberry
- **Fraxinus pennsylvanica**—Green Ash
- **Larix decidua**—European Larch
- **Platanus x acerifolia**—London Planetree
- **Quercus bicolor**—Swamp White Oak
- **Taxodium distichum**—Baldcypress

**Thuja occidentalis**—American arborvitae

### Trees for Dry Soils

- **Acer tataricum**—Tatarian Maple
- **Celtis occidentalis**—Hackberry
- **Corylus colurna**—Turkish Filbert
- **Crataegus crusgalli** var. inermis—Thornless Cockspur Hawthorn
- **Fraxinus pennsylvanica**—Green Ash
- **Gymnocladus dioicus**—Kentucky Coffeetree
- **Juniperus scopulorum**—Rocky Mountain Juniper
- **Juniperus virginiana**—Eastern Redcedar
- **Malus spp.**—Flowering Crabapple
- **Pinus ponderosa**—Ponderosa Pine
- **Prunus virginiana**—‘Schubert’—Shubert chokecherry
- **Quercus macrocarpa**—Bur Oak
- **Robinia pseudoacacia**—Black Locust
- **Tilia americana** ‘Redmond’—Redmond Linden

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