# SELECTING TREES FOR CLAY SOILS [1]

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ABSTRACT. --The selecting of trees for urban planting in the Chicago region requires careful attention to the limitations of the widely prevalent clay soils. Springtime wetness may be partially alleviated by re-shaping the configurations of the landscape planting sites to improve drainage. Selection and improvement of urban trees tolerant of poor soil aeration continues to be of great importance in coping with clay. Ecological and environmental considerations are important in the search for better trees for metropolitan use.

The experiences and examples in this discussion are based primarily upon observations in the Chicago region. The cold winters and generally changeable weather present one set of adversities for urban trees and the widespread prevalence of clay soils presents another; the two are interrelated in their constraints on tree growth. The term "soil" is used primarily to refer to the medium in which tree roots are accommodated in urban areas, because the natural weathered mantle (or vertical sequence of horizons) is usually not intact in urban situations.

The Chicago region has extensive areas of soils derived from glacial till. These soils are often high in clay content, with very dense clay found at depths of two to three feet. Coping with these soils provides tree planting experience that is probably widely applicable to urban clay soils. Problems are intensified by soil disturbance accompanying large-scale construction projects, wherein surface and deeper materials are mixed. Most development involves extensive re-shaping of the land, producing a clay-rich and inhospitable medium for tree planting.

Springtime wetness is a major stress-maker for trees planted in clay material. Poor aeration is associated with failure of rootlets to develop or even the deterioration of rootlets, leading to transpiration stress in mid-summer because of impaired water uptake capacity. Also, proper nutrient uptake may be affected. Planting a tree in clay is essentially the same as planting one in a large container without a drain-hole.

[1] Metro. Tree Impr. Alliance (METRIA) Proc. 3:102-106, 1980.

In Illinois, farmers cope with soil wetness by installing vast underground tile systems that collect water and pour it into drainage ditches or streams. Such tile lines make it possible for spring planting to be done weeks earlier than would be possible without such artificial drainage. Even with tile systems, there are certain fields that remain unplantable for weeks during years of heavy spring rainfall. Flatness of the landscape contributes to the sluggishness of drainage in farm fields. The same poor drainage is often present in lawns, gardens, parkways, and other areas into which flat farmland has been transformed. Indeed, there is too little awareness and insufficient regard for the effectiveness of drainage provided by the tile systems when land is being considered for urban development.

Coping with clay is a demanding challenge for tree planters, and experience seems to be the best way of gaining respect for the adversities presented by clay soils. Losses of planted trees in clay soils are often quite great, and the most skillful landscape architects and contractors resort to facilitating drainage by creating undulating land surfaces or low berms. Berms and gentle swales are commonly seen around buildings in condominium and apartment complexes and in industrial parks. Sometimes the balled trees and shrubs are set in place on level ground and low berms built up around them. Because berms areusually constructed of excavated material high in clay, good drainage is not necessarily insured. All too often berms are compacted during their construction. The slopes of the berm facilitate drainage, but lateral gravel seepholes hidden under the sod may also be needed to attain sufficient drainage.

Homeowners may not have sufficient space for molding their yard surfaces significantly. Still there are possibilities of selecting suitable planting sites around homes or preparing sites more skillfully. Some guidelines might be: Plant on slopes rather than on flat areas where water may stand; plant on a gentle mound, making sure that settling will not create a depression around the tree; prepare a hole with an extensive width to promote proliferation of roots in the top six inches where aeration is most favorable; and use mulches for moderating moisture and temperature levels of the mulched area and for reducing grass competition. Areas with soil profiles intact should be preserved if at all possible,to utilize a more favorable planting medium.

Alkalinity of urban soils is a widespread problem, especially in clay. Re-shaping of land surfaces not only may increase the amount of clay at the surface but also may raise pH levels because of the calcareous nature of deeper materials. Years of lawn watering with hard water or use of granular lawn fertilizer may raise pH levels. Run-off from concrete surfaces (patios, drives, walks, streets, etc.) may also increase pH.

Regions with clay soils are mostly localized but rather numerous in the United States. The Nashville Basin in Tennessee is underlain by limestone that weathers into shallow clay soils. Calciphilic plants are common. For example, red cedar (<u>Juniperus virginiana</u> L.)

glades are quite conspicuous. The blacklands of Texas and Alabama are geologically related and are comprised of clay soils with numerous characteristic tree and shrub species. Cedar elm (Ulmus crassifolia Nutt. ) is a common tree along streets of towns in the Texas blackland regions . Still another region with calcareous soils is the Bluegrass Country of Kentucky.

Urban soils are often created by filling of low places or landscape re-shaping, utilizing raw geological material or dredged material. Much of the urban surface material of New Orleans is either deltaic clay or dredged clay. Spring wetness and alkalinity present problems similar to those of the Chicago region. The mixed materials underlying many urban areas become compacted, charged with lime and salt, and subject to excessive moisture because of drainage impediments.

Consideration of ways of lessening the limitations of a clay substratum is important, but the best prepared clay planting medium will accommodate successfully only certain species of trees. A useful rationale is that those trees successfully tolerating clay have certain physiological attributes in common. For example, floodplain and swamp species are generally successful urban trees. Not only do these species tolerate spring wetness but they also tolerate summer dryness, actually possessing a broad amplitude of endurance of adversity. American elm (U. americana L.), green ash (Fraxinus pennsylvanica var. subintegerrima (Vahl) Fern. ), and silver maple (Acer saccharinum L. ) are the main components of the floodplain forests of many of the rivers of eastern United States. All are successful urban street trees. Indeed, the widespread planting of American elm set the stage for Dutch elm disease devastation. Less common floodplain species are river birch (Betula nigra L. ), swamp white oak (Quercus bicolor Willd. ), and hackberry (Celtis occidentalis L. ). These three are also desirable urban trees. Of course, cottonwood (Populus deltoides Marsh. ) and black willow (Salix nigra Marsh. ) are both floodplain species and are sometimes seen as urban trees.

Pin oak (Q. palustris Muenchh. ) is a native of poorly drained flat areas that have acidic soils. Pin oak thrives in well-drained soils but often develops chlorosis in alkaline urban soils. Because acidification of such soils is often difficult, selection of oak species with more suitable ecological attributes seems to be a better direction. Requirements for such an urban oak should include the tolerance of both clay and alkalinity. Both Shumard oak (Q. shumardii Buckl. ) and its close relative Texas red oak (Q. texana Buckl. ) get along well on alkaline clay soils. Chinquapin oak (Q. muehlenbergii Engel.) is another oak at home on alkaline clay soils. Northern red oak (Q. rubra L.) does moderately well on slightly alkaline soils if drainage is adequate. Bur oak (Q. macrocarpa Michx. ) is an excellent oak for heavy soils but its large size and broad crown may make it less appropriate than other oaks as a street tree.

Recommended tree lists exist for many of the towns and villages of the Chicago region. These lists are usually quite short and show considerable similarity. Green ash, honey locust (Gleditsia triacanthos L. ), Norway maple (A. platanoides L. ) sugar maple (A. saccharum Marsh. ) red maple (A. rubrum L.), and hackberry are on most of the lists. 'Greenspire' and 'Redmond' lindens are on some of the lists, as is red oak.

Generally excluded are silver maple, pin oak, and Siberian elm (U. pumila L. ). Still, in new neighborhoods the numbers of these three are quite great, mainly because homeowners insist upon quickly produced shade. However, recent large-scale contract plantings seem to emphasize green ash, honey locust, Norway maple, and red maple. Experienced landscape contractors in the Chicago region consider red maple and pin oak appropriate for those sites where the soil profile has been preserved intact, insuring a neutral to slightly acid topsoil. Both red maple and pin oak are subject to chlorosis on re-molded landscapes because of the predominantly alkaline clay root environment.

Some of the little-use and little-known tree species with considerable stress-tolerance are: blue ash (F. guadrangulata Micbx. ), Hesse European ash (F. excelsior L. 'Hessei'), pumpkin ash (F. tomentosa Michx. ), European black alder (Alnus glutinosa (L. ) Gaertn. ), lacebark elm (U. parvifolia Jacq.), Japanese elm (U. japonica (Rehd.) Sarg. ), Amur maple (A. ginnala Maxim. ), hedge maple (A. campestre L. ), and black maple (A. nigrum Michx. f.) Some suitable conifers are: European larch (Larix decidua Mill. ), baldcypress (Taxodium distichum (L. ) Richard), and limber pine (Pinus flexilis James). Northern white cedar (Thuja occidentalis L. ) is rather commonly used and is surely one of the most utilitarian conifers for screening or hedge use.

The hawthorn group contains numerous species at home on clay soils. Hawthorns are often associated with disturbed landscapes, especially overgrazed and compacted pastures. Many hawthorn species are susceptible to cedar-hawthorn rust and its conspicuous disfiguration of foliage. Washington hawthorn (Crataegus phaenopyrum (L. f. ) Med. ) is relatively free of problems and has become one of the most commonly planted multiple-stemmed trees in midwestern states. It is especially satisfactory in landscape plantings of shopping centers. Because hawthorns generally fare satisfactorily in clay soils, the group may be considered as a source for new forms. Use of thornless cockspur hawthorn (C. crus-galli L.) might overcome some of the homeowners' dislikefor the thorny branches.

Some of the species that present recurrent problems when planted in clay soils, and the use of which is generally discouraged in the Chicago region, are: paper birch (B. papyrifera Marsh. ), mountain ash (Sorbus aucuparia L. ), Japanese maple (A. palmatum Thunb. ), and flowering dogwood (Cornus florida L.). These species are climatically hardy in the Chicago region but are not at home on clay soils. Those successful specimens of these species occasionally encountered in this region are usually found on soils overlying gravel deposits.

Where does one look for suitable new trees for clay soils? There are perhaps dozens of potentially useful kinds in areas of Asia climatically similar to the eastern U.S. These might be species, subspecies, or ecotypes. The presence of scores of mountain ranges enhances this possibility because the same species may vary physiologically and ecologically from range to range. Moreover, a wide variety of habitats, exposures, and substrata is found in each range. Better knowledge of provenance of some of the species commonly planted (such as Norway maple and little-leaf linden) should be sought. Improved material for understocks is especially needed.

The floodplains and swamps of North America contain additional species which have not been sufficiently utilized. The lower Mississippi Valley is home to quite a number of species little used even though most tolerate soil wetness and clay quite well. Hardiness, of course, poses possible limitations for use in northern urban areas.

Upgrading some familiar but often lowly regarded species is also a desirable direction. Single-stem (excurrent) forms of silver maple, box elder (A. negundo L. ), and Siberian elm might make acceptable street trees because of better endurance of wind and ice storms.

Thus in selecting trees for clay soils, the study of functional attributes of trees, especially root system physiology, leads one to the natural landscapes of the world where tree species are at home on substrata with adversities similar to those of clay soils. These soil-stress tolerant populations are reservoirs from which can come aesthetically pleasing selections already possessing good survival qualities.