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Protecting Trees from Excavation Damage

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Carl P. Wiedeman, with Appendix by James W. Kelly

Summary

Recent requirements to assess impact of proposed construction have prompted searches for specific guides to predict, avoid, reduce, and repair damage to trees. Construction of sewers, roads, and buildings are likely to affect trees, primarily through root injury. Excavation can result in a serious decline or even death of trees and the injury may be compounded by the piling of soil around trunks, compaction of soil, mechanical injury to trunks, and by deicing salt. However, measures can be taken during and after root disturbance which will avoid or minimize physiological damage to the tree. These are known to competent arborists but many private landowners, municipalities, and their construction contractors are unaware of the seriousness of excavation damage, and they are unfamiliar with preventative measures.

Very little published information is available for use in protecting trees.

Basic Information on Tree Roots

While roots are not as apparent as branches and leaves, they are equally important. Roots anchor, enable entry of mineral nutrients and water, and provide storage room for carbohydrates. Digging or trenching near trees impairs these functions mainly through destruction of roots and by admitting disease organisms. A knowledge of the extent and location of the root system can aid in minimizing damage.

Contrary to popular belief, tree roots do not have the same growth habit of branches. Most roots grow horizontally, usually within three feet of the soil surface. Generally, the major root volume is usually located within the periphery of the crown (drip line). Very few roots actually grow down. Roots taper rapidly after leaving the trunk and then maintain a fairly constant diameter - sometimes growing twice to three times as long as the tree trunk. Roots continue to grow slowly during winter months when the soil is not frozen.

Unfortunately, there is no way to predict accurately the exact extent or location of the root system. Variations result from several environmental and physiological factors. In a heavy or poorly drained soil, for instance, root systems tend to be located nearer the surface. A similar pattern is true for trees surrounded by watered lawns. In local pockets of favorable and constant moisture conditions or high fertility, roots proliferate. The development of a root system is affected by the degree of competition from surrounding trees. They do not "fight" but both may reduce the soil moisture below optimal level. Open grown trees tend to have more extensive lateral roots than trees located close together. There is some variation among species. Some trees such as species of elm (*Ulmus* spp.) and sycamore (*Platanus* spp.) are supposed to be notorious sewer cloggers. Yet poplar (*Populus* spp.) and willow (*Salix* spp.) roots are the most likely to cause trouble, since they can live naturally in water or water-logged soil. Periodic application of copper sulfate is the standard poison for roots in drains. These trees do not "seek" water, as popular lore assumes, but simply grow prolifically where there is water. Other trees may be limited by oxygen requirements, even though water is available.

Stress Conditions

A tree's ability to recover or survive after excavation is dependent upon many factors. Age, general condition, and species, heredity influence the ability to withstand root loss. Older trees in poor condition are affected more than younger, healthier individuals. A vigorously growing species, like box elder (*Acer negundo*) is more resilient than the slower paper birch (*Betula papifera*). Root loss affects the health and survival of upper branches. The balance between the moisture absorbing surface of roots and the transpiring leaf surface is especially important in times of high moisture stress. Any significant loss in root surface results in wilting and loss of leaves and twigs primarily in upper limbs and branch extremities. The injury may be followed by the entry of bacteria and fungi or insects.

Measures to Minimize Damage

1. Avoid digging in areas occupied by tree roots; particularly avoid the area under the tree canopy.

2. When excavation is known in advance, it may be possible to stimulate "reserve" root growth through root pruning and fertilization. Common 5-10-5 or 6-12-6 fertilizer should be adequate.

3. Within the root zone, tunneling is preferable to trenching where tunnels are located at least three feet below the soil surface.

4. Excavation can be confined to seasons of low moisture stress (spring, fall) or dormancy (winter). Opportunity for root regrowth is provided and thus branch loss is reduced.

5. Fertilization of the root system after construction will stimulate development of the root system.

6. When a large root volume must be removed some top pruning will restore the leaf surface - root surface balance.

7. Damaged roots should be pruned with a sharp saw or pruning shears and painted with tree wound dressing (asphalt or latex paint will serve, but not linseed oil or oil paint).

8. Backfill as soon as possible. Drying of roots or soil around the root system from open trenches should be prevented by covering the exposed soil with wet burlap or mulch.

9. Care should be taken to avoid any permanent changes in the surface level of soil under the tree as a result of the construction. Excavated soil should not be piled around trunks, and the surface should be neither compacted by heavy machinery nor scoured around the base. Compaction or burying the surface under soil causes death after a few months or a few years.

10. Value of trees may be considerable. Two kinds of professional help should be sought in critical cases; determination of systematic and ecological value and the arborist's technical care.

Replacement or Acceptable Loss

Not all trees justify expensive measures to avoid damage. The tree may be in poor condition from insects, disease or old age. Short-lived or rapidly growing species such as boxelder or cottonwood (*Populus deltoides* and related species) are not valued highly by many people. In any event, their replacement time is shorter. The Norway maple (*Acer platanoides*) is a very common urban tree, which is rapid growing and less aesthetically appealing than sugar maple (*Acer saccharum*) or oaks (*Quercus* spp.). In value judgement, sugar maple and oaks deserve much more defense than Norway maples. Certain tree species, such as American elm, are very poor future risks because of widespread insects or diseases. The grouping of trees rather than individuals may be paramount; the loss of a single tree is less significant if there are similar trees close by. Finally, the cost of temporarily moving or even replacing an individual tree may be less expensive than trying to work around it without damage.

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(6) Home & Garden Bulletin No. 285, *Protecting Trees Against Damage from Construction Work*, U. S. Dept. of Agriculture, 1964, 26 pp (More comprehensive than (5) above), also available from the Federal Supt. of Documents and possibly through the Cooperative Extension Service.

Appendix. Tolerance of Some Tree Species to Disturbance by Excavation and Related Damage - by James W. Kelly

Tolerance to disturbance by all species generally decreases with advanced age. In addition, the degree of damage from a single factor such as excavation, is related to effects of other factors: salt, moisture stress, fungus infection.

Maples:

Since sugar maple (*Acer saccharum* L.) is probably New York's most common native species, and it was planted as first choice tree along highways and streets until a generation ago, particular attention is warranted. Sugar maples live long and die slowly. Popular values may consider dead limbs unsightly, and aggressive commercial arborists may advise removal of any tree when some limbs have died. Yet, dead limbs are characteristic of the same trees in natural communities.

Sugar maples are superb street and shade trees in most of New York. They are affected by salting which destroys roots and results in leaf scorch during dry summer weather due to a decrease in the water entering the tree.*

* See Holmes, L., *"Environmental Effects of Deicing Salts: Introductory Bulletin"*, RCSI Bulletin #166, December 1973, pp 5-7

Local climate and human ecology affect the health of trees. Sugar maples do best where the climate is cool. They are under less stress if the summers are not extreme, but thrive when the winter temperature reaches -20°F. for extended periods. In urbanized areas, where the temperature is raised somewhat from combustion, there is an added stress of disrupted soil drainage. The effects are compounded because more salt is used in urban areas. Given a cool, upland village or rural setting, trees are likely to be healthier both for climatic reasons and also because less salt is used for deicing. The final compounding factor is infection by fungi which cause heart rot and other disease symptoms. Thus, construction of sewer lines most seriously affects species which are subject to other stresses. Nevertheless, with due care, excavation may be planned so as to insure minimum impact on groups of trees. Shortening of life, reduction of health, and removal of individual trees may be kept within acceptable range even with species as sensitive as sugar maple.

Norway maple (*Acer platanoides* L.):

These are commonly planted in Northeastern United States. Both its usual green form and those with added red pigment are popular. They lack the grandeur, fall coloring, and long life of sugar maples, but seem desired for their quick growth. Their salt tolerance is advantageous in areas of high application. On the other hand, they require at least a 10-foot pavement free space around them (e.g. between curb and sidewalk) if they are to live after maturity. Older trees are susceptible to heart rot after roots have been severed, when younger trees will be less affected.

Swamp maple (*Acer* x *Freemannii* E. Murray.):

This is the native species, commonly identified as one of the two parent species of the hybrid population, red maple and silver maple. Red maple (*Acer rubrum* L.) does grow native on some hillsides, but the only silver maple (*Acer saccharinum* L.) are street plantings of stock shipped from farther south.

Swamp maple is similar to sugar maple in its susceptibility to root damage.

Box elder (*Acer negundo* L.):

This "ash-leafed" maple is rarely planted, but it is a frequent "weed tree" and a characteristic species of native river bank communities. It grows rapidly and is rather tolerant of disturbances, but it does not live long nor produce a sturdy grand tree.

Elms (*Ulmus* spp.):

These trees are highly tolerant. Indeed, except for Dutch Elm disease, they would have been ideal city trees. Heavy damage to bark, removal of as much as a third of their root system, and paving around the base will not kill a healthy elm.

Red Ash (*Fraxinus pennsylvanica* Marsh.):

The red ash, and its variety *lanceolata* Borkh., the green ash, rank close to the elms in ability to absorb abuse.

Horsechestnuts and buckeyes:

At one time, possibly inspired by Paris, many European horsechestnuts (*Aesculus Hippocastanum* L.) were planted. Two related species, the Japanese horsechestnut (*A. turbinata* Blume) and the yellow buckeye (*A. octandra* Marsh) are better trees, however. All are moderately tolerant to disturbances.

Locust:

Native species of both *Robinia* (black locust) and *Gleditsia* (honey locust) are found in urban areas. Moraine locust (*Gleditsia tricanthos* L. form *inermis sterilis* (Persh) Schneid), a horticultural form of honey locust, has been promoted widely for street plantings in recent years. Locusts are highly tolerant of disturbance.

Oaks:

Particularly pin oak (*Quercus plaustris* Muensch.) can tolerate root cutting if not subjected to heavy salting. Salt produces a leaf yellowing (chlorosis) and frequently causes death.

Pines:

The pines (*Pinus* spp.) and spruces (*Picea* spp.): with the limited information available, these genera appear to be moderately tolerant of root cutting.

Walnuts:

Particularly, black walnut (*Juglans nigra* L.)appears to be tolerant of excavation. The root system tends to be deeper than most trees, hence damage is avoided.

Willows (*Salix* spp.):

Like box elder, these grow rapidly and are highly tolerant of disturbance.