The University of Georgia

WARNELL
SCHOOL OF FORESTRY AND NATURAL RESOURCES
THE UNIVERSITY OF GEORGIA

WSFNR10-16 Tree Health Care Series April 2010

Training Young Trees

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The five components of life-long tree care are biology-first design, tree installation and establishment, young tree training, mature tree tune-ups, and risk management. A carefully prepared program of tree health care practices that effectively moves from life stage to life stage is critical to quality management of trees. Through total quality management, tree health care providers can generate a high quality of life for trees and tree owners.

One life stage management component most frequently overlooked is training of young trees. Young trees can be pruned into biologically efficient forms that minimize potential for future liability problems. Liability risks identified in mature trees can be easily corrected in young trees. Tree health care providers need to market the value of their skills in training young trees.

Health Provider's Role

Arborists assist trees to survive and thrive in their environment. Understanding tree growth and development is critical. Internal and external tree resources must be developed and controlled. Tree health care providers can assist trees to maximize resource acquisitions which include physical space and interference (i.e. competition and allelopathy) control.

Tree health care providers can assure a long, useful tree life through cultivation of proper form and management of structural components. Arborists have a long history of remedial and terminal health care. The purpose of tree training is to guide young trees into acceptable forms and meet tree owner objectives. Tree training uses knowledge of mature tree problems to minimize young trees developing these attributes.

Training Concepts

Tree training can not generate great trees from poor stock. Training can make good trees better. Through training, tree health care providers partner with clients to generate better trees that will significantly

out perform non-trained trees over the expected life-span of a species on a particular site. Poorly applied training techniques can damage the best stock, assuring loss of tree quality and increased liability risks.

Training is not considered to have major aesthetic objectives. Shaping, crown sculpting, propping, cabling for form, and architectural blending are not covered here. Training is concerned primarily with tree structure and prudent treatments. The image of a native tree on an average site is used to frame training concepts. A single, well-developed stem with no structural faults would be ideal.

Training begins in the nursery or holding area where tree faults and growth form can be clearly seen and manipulated. Arborists should work closely with tree producers to generate trees with natural forms for yards, streets and parks. After planting, allow trees to effectively control site resources before starting a training program. Internal resource reorganization must be completed by the tree before you modify growth conditions. Give trees at least one full growing season before training begins.

Training Concepts

There are six main concepts in tree training: tree imaging, development of a dominant leader, use of temporary branches, manipulating living crown area, assuring proper pruning, and controlling stem / branch attachments. Each of these components will be reviewed separately.

Tree Imaging -- Trees that function well over long periods of time share a number of characteristics that can be emphasized when training new trees. Characters that can be affected by cultural treatments and selection include identification of the primary and secondary axis, leaf and branch density, branch attachments, and crown shape, and crown extent in all dimensions. Training is concentrated on the above-ground portion of a tree. Before a tree is touched, a mental image should be developed that represents views of the tree owner, experience of the tree health care provider, and natural values of a tree on a specific site. Arborists need to image what a tree should ideally look like in a particular situation and then allow the tree to develop toward that ideal form over its life.

Imaging what a tree should look like should consider the site and biological constraints present. Past damage, mismanagement, and neglect can yield a tree that may need removal, even though young. Some trees will need little training to reach a biologically efficient form that is structurally sound. An arborist needs to develop an image of the tree though understanding how the modular tree parts are connected and how they interact. Trees grow and develop in discrete units (nodes and internodes) and can be carefully dismantled in these same units. Selective and prescribed removal of these parts can be completed in an organized manner which is the process of training.

Dominant Leader -- Trees have a strong growth regulation system that can quickly and effectively react to environmental changes. Arborists can assist a tree to effectively react to changes around them. Minimizing stress components of internal and external environments, while maximizing biological efficiency, can be attained by prescribed training of trees into a general form. Form affects how a tree reacts to changes in its environment.

The single primary axis or dominant leader is a type of form visible on many juvenile forest and landscape trees. This form is partially a result of strong growth control to effectively capture resources. Most trees in normal use should be developed into a single stem form with the primary axis being vertically, directly above the tree base. The primary or dominant bud or bud group should be positioned to be in the most direct vertical line to the roots. This primary bud group should be conserved because of its growth control / resource allocation role in a young tree.

Temporary Branches -- Depending upon species, past management history, site and chance, some branches will always be occupying inappropriate areas for a particular use or value objective. Risk management dictates that out-of-place branches, or branches that will become problems for a tree structurally be removed early. Remove branches that are too low, growing in the wrong direction, or will be prone to structural weakness due to position or form.

Most branches that exist today on a small tree will have been removed by the time a tree reaches maturity. These temporary branches are critical to growth regulation, food production and allocation, and resource capture. Selective lower branch removal over time will be important but must be carefully completed. Treat these lower branches as temporary food production and storage facilities that will allow a tree to grow large quickly, and develop effective taper. If allowed by site use and risk assessment, keep temporary branches on a tree as long as possible if they represent no structural problem. Lower green branches represent a great asset for a tree and should not be removed without serious consideration.

Over time, branch clearances will be important for a tree in a landscape. Different clearance heights are required for safety and risk aversion. Walking, skating, or bike riding beneath a tree requires 3-4 meters in clearance, while trees bordering roadways may need 7-8 meters clearance. Some clearances are set by ordinances or regulations. Trees that normally maintain branches down to ground level should, at a minimum, be pruned-up so rain-burdened branches do not have contact with soil. Arborists should assure that tree crowns are not raised too quickly which will permanently damage trees, destroy values of taper development, and make them more susceptible to stress problems. Do not over-dose trees with severe crown raising for the amount of live crown it holds.

Live Crown Ratios -- Young trees require as much leaf area as possible to maximize growth rates and minimize stress problems. Young trees with plenty of leaf area will be highly reactive to changes in their environment. Leaves produce food, and the last few annual rings immediately behind leaves, store food in the form of starch. Excessive living branch removal will disrupt food production, allocation, and storage. Excessive pruning, especially on young trees, will disrupt root growth and decrease the ability of a tree to adequately react to changes in the environment.

Strive to leave at least 2/3 of the total tree height in living crown. For example, if the total height of a tree is 3 meters, do not prune beyond a point where the living crown occupies less than 2 meters. The living crown ratio (height of the living crown over total height of the tree) can be used to judge pruning practices and can be specified in contracts. A 2-3 year pruning cycle should be installed. Always leave one full growing season between major pruning treatments in order for trees to react to changes.

Proper Pruning -- Training involves different types of pruning and branch cutting. Training should remove a branch without damaging the stem flange at the branch base. Disruption of the stem flange area initiates incomplete defensive reactions as well as structural damage which is then grown over by annual stem expansion. This process of "flush cutting" damages young trees for life and can be compounded into major structural faults with age. Proper pruning minimizes potential structural problems by allowing the stem flange area to reinforce defensive walls and be as structurally isolated as possible from primary mechanical stress columns and cross sections in the tree. Biological efficiency and structural integrity can be managed by the tree health care provider to generate a long-lived, safe, and healthy tree that meets its owner's objectives

Most landscape trees could benefit from training of branches and crowns using proper pruning techniques. Unwanted, damaged or misplaced branches can be removed early before too many resources are wasted or before structural adjustments are made within a tree. Begin training when a tree is young with

branches and twigs for removal less than 2 cm in basal diameter. The larger the branch, the greater chance of collateral damage, externally and internally over growing seasons to come. Always strive to minimize heartwood exposure. It will be more cost effective and biologically efficient to train young trees with small branches, than manipulate and severely damage large trees to reach owner objectives.

Remember that a tree provides clear targets for proper pruning. A branch is meant to be disposable. A stem establishes a flange around the base of the branch to hold it onto a tree and defend the tree from branch-centered problems. In pruning, an arborist would cut the branch outside the stem flange edge, and not nick the stem flange at any point. At the other extreme is stub cutting. Leaving a stub or internodal cut prevents effective defense and sealing-off of the stem flange area, which accentuates major structural problems. In addition, internodal cuts provide an avenue of entry and a energy source for pests. Trees are put together in units or modules, and should only be taken apart in modules (i.e. at the nodes). Internodal cutting should be completely avoided.

Timing is critical for training trees. Avoid pruning living branches and foliage during the spring period between the beginning of bud swell and full leaf expansion. From a tree's standpoint, prune after full leaf expansion if there are no pest related concerns. Late dormant season pruning is also acceptable. The key is pruning when a tree can react effectively to wounding and still maintain normal growth processes. Extremely stressed trees should only be pruned after full leaf expansion.

Best management practices for tree pruning include:

NEVER trim, hedge, tip, top, or round-over a tree utilizing internodal cuts;
NEVER leave a stub;
NEVER flush cut;
NEVER leave tattered and raged bark tears around pruning wounds; and,
NEVER remove living branch tissue without a strong structural or health reason.

Always cleanly prune trees at the nodes or structural unit lines. Assist a tree to effectively and efficiently react to changes in its environment by properly assessing, timing, targeting, and carefully completing pruning cuts.

Stem / Branch Attachments -- Branch connection areas are structurally weak zones that generate many mature tree problems. To minimize this concern, proper training concentrates upon branch location and attachment. In broad-leaved or hardwood trees, branches should be attached alternately along the main stem. Tree health care providers should not allow two or more branches to survive attached across from each other at the same horizontal position on a stem. Branches should alternate from one side of a stem to the other as height increases. Distance between major, alternately placed branches on the primary axis of the tree should minimally be 3% of total height, or 5% of live crown height.

Trees that normally develop branches in an opposite pattern should be corrected back to alternate branching for as high as possible. Thereafter, a tree can be allowed to revert to natural branching patterns. The key is to quickly develop an inherently strong stem and bury compartmented weak zones deep in the center of a tree as it ages.

Do not alternately train evergreen needled trees that develop many branches per whorl separated by a long internode. Thinning the number of branches on each whorl to 3 or 4 in independent locations around the stem should be completed. Stagger branch locations on adjacent whorls so one branch is not directly over the top of another. Training generates a natural looking tree that can safely and efficiently develop over time.

Correctable Tree Faults

There are a number of correctable tree faults that a tree health care provider can modify through training. Correcting double stems or forks is a major training concern. Within a forked stem, bark can be included or grown around. This bark-included confluence of stems then has reduced strength and a tendency to split. Forks should be corrected early in the life of a tree before large amounts of stress and strain are concentrated around the confluence. Retain the stem that is largest, more fully crowned, more vigorous, and/or in a more direct vertical line from the top to the roots. Trees with opposite branching should have forks removed for at least the first 7-8 meters to provide a strong and safe supporting structure.

Branches with a narrow confluence with the stem are similar to stem forks in potential for structural weakness. The narrower the confluence angle or the more upright a branch grows, the weaker the connection and the greater chance of branch failure. Depending upon its length, an average branch should occur with a near ninety degree (90^{o}) branch angle to its stem.

Tree growth control is formulated by meristem areas using growth regulators as messengers. Disruption of these patterns of message transfer can lead to many structural and stress related problems. One of the most noticeable negative impacts seen in young trees is a side branch being taller than the main axis. Training should maintain a single main stem in the most direct vertical line to the roots. Reduce side branches that attempt to take control of a tree. With a vigorous main terminal, side branches do not need to be removed, but can be reduced below the main axis height. An associated problem is rapid growth and expansion of side branches in extent and leaf volume, compared to the rest of the tree. Controlling these "renegade" branches by reduction is essential for proper young tree development. Do not allow branch diameters to exceed 1/3 of stem size at its connection point.

The litany of tree faults that can be corrected with training is long and varied. But a few educated pruning cuts made early will lead to a long, healthy and structurally sound life for a tree and an improved quality of life for the tree owner. Correctable faults that can be, at least partially, trained away include:

1. multiple leaders;
2. tall and expanding side branches;
3. flat tops;
4. large side branches;
5. forks;
6. mechanical or chemical damage to the circumference of the stem or main roots;
7. sprouts on the main stem and around the base of a tree;
8. new sprouts from woundwood areas;
9. any confluences with included bark;
10. branches that rub, cross, or heavily shade each other;
11. opposite branching;
12. rapidly growing, vertical sprouts on the inside of the crown;
13. excessively crooked, swept, or bent branches; and,
14. excessively drooping or weeping branches.

Conclusions

Tree training can be a cost-effective and biologically efficient means for guiding young trees into acceptable growth patterns that minimize future liability problems. Tree health care providers must educate consumers to call tree professionals for "cradle to grave" or "planting to removal" tree care.