TRAINING YOUNG TREES for Structure and Form

By L.R. Costello

Training young trees is a highly important arboricultural practice. Harris et al. (1999) state, "Training young trees provides the greatest benefit of any cultural practice in influencing the future structure, appearance, and maintenance costs of landscape trees." Unfortunately, many municipalities in the United States and elsewhere do not train young trees. Two reasons are often cited: lack of budget and lack of knowledge about training methods.

Benefits of Training

Three of the primary benefits of training young trees are

- **Improved structural strength.** Removing such defects as weak branch attachments and codominant stems means that trained trees are structurally stronger than untrained trees. Being structurally stronger, they have a lower failure potential, lower hazard potential, and lower liability risk.
- **Reduced maintenance costs.** Trained trees require less maintenance when they are mature. Typically, trained trees have fewer branches than untrained trees, which means less pruning. In addition, well-spaced branches provide easier access for arborists, and pruning can be accomplished in a shorter period of time. Finally, costs associated with structural defect correction, such as cabling, bracing, canopy thinning, and codominant stem removal, can be avoided.
- **Increased tree longevity.** Being structurally stronger, trained trees are likely to remain a part of the urban forest for a longer period of time than untrained trees. Trees that have sustained partial failure (such as limb or stem failure) often need to be removed because they are hazardous or unsightly. Simply by remaining intact longer, trained trees continue to serve as functional components of the urban forest for a longer time than untrained trees.

What's the investment? It's minimal—a relatively small amount of time and some basic equipment: hand pruners, loppers, pole pruner, handsaw, and ladder.

When considering the benefits relative to the costs, it is clear that we can't afford *not* to train young trees.

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Five Steps for Training Young Trees

This article outlines the five simple steps that produce well-trained trees. The steps apply to most deciduous and broad-leaved evergreen trees, regardless of species or use (for example, park, street, or residential). Conifers are addressed separately. The five steps do not apply to specialty-pruned trees (espaliered or pollarded) or to multi-trunk trees.

The five steps should be followed in sequence. If you encounter a situation that makes it difficult to apply anyone of the steps, check the troubleshooting section (see **Troubleshooting,** last page) for help. For information on types of pruning cuts and how to make cuts, see ISA's *Tree-Pruning Guidelines* or the ANSI A300 pruning standard. For further information on training young trees, refer to the *Training Young Trees* video (Costello 2000), *Arboriculture: Integrated Management of Landscape Trees, Shrubs, and Vines* (Harris et al. 1999), and *An Illustrated Guide to Pruning* (Gilman 1997).

Step One—Remove broken, diseased, dying, or dead branches. Look around the tree. If you see any broken, diseased, dying or dead branches, remove them behind the point of injury. In some cases, the whole branch may need to be removed. In other cases, just the injured part can be cut off.

Figure 1. Many young trees are either pruned incorrectly or not pruned at all, both of which lead to structural defects and higher maintenance costs as the tree matures.

Step Two—Select a leader and remove competing leaders. The leader is the central stem of the tree. Carefully follow the trunk of the tree from the bottom to top. The trunk should narrow into a single stem that is in a vertical position. This is the leader. There should be only one leader. If more than one leader exists (competing leaders), then the strongest and most vertical stem should be selected as the central leader and the other stems removed, cut back, or possibly selected as permanent branches (see step four).

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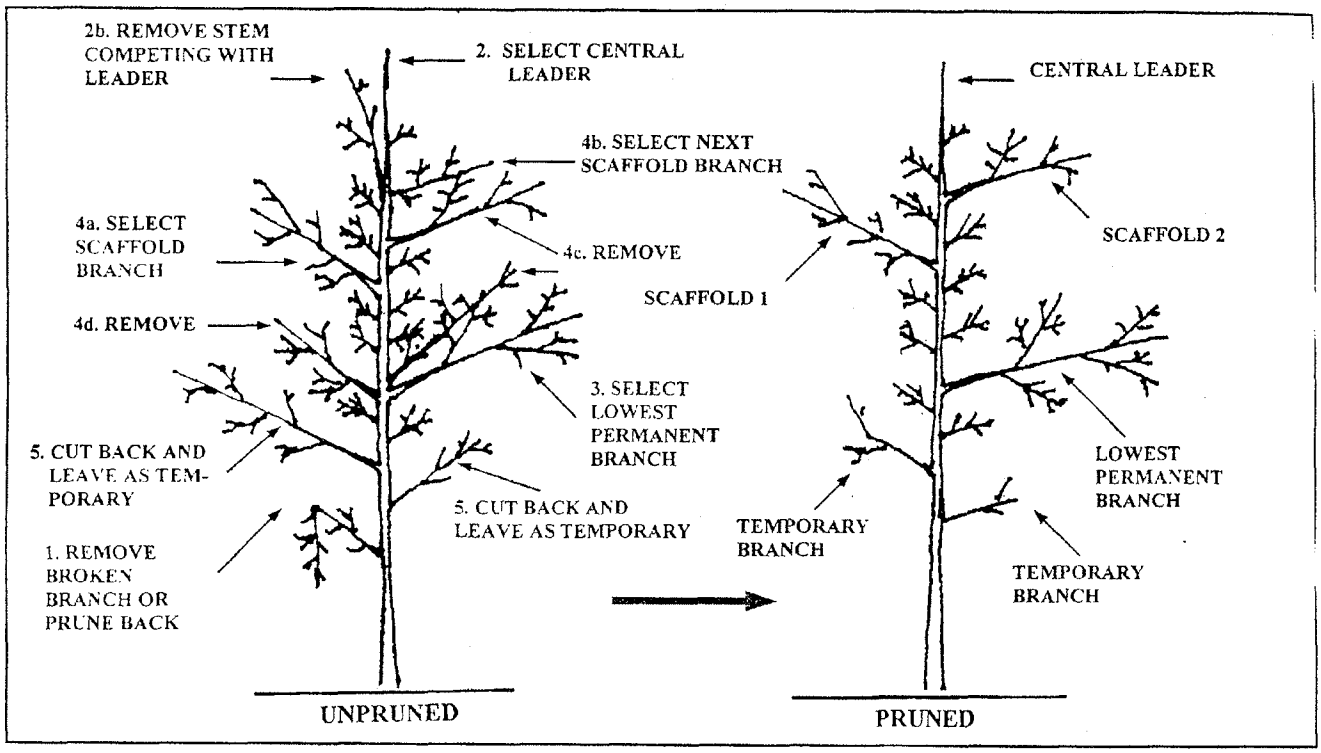

Figure 2. Applying the five steps to the unpruned tree (left) creates strong structure and attractive form in young trees. The numbers on the drawing correspond to each of the five pruning steps to produce the tree on the right.

Step Three—Select the lowest permanent branch (also called the lowest scaffold branch). The lowest permanent branch is the lowest branch attached to the trunk that will remain on the tree throughout its life time. The location and use of the tree usually determine the position or height of the lowest permanent branch. For a street tree, the lowest permanent branch over the side walk might be 8 feet (2.4 meters), while over the street at least 14 feet (4.3 meters) of clearance may be required. Branch heights for street trees often are mandated by local ordinance. For a tree in a parking strip, the lowest permanent branch might be 6 or 7 feet (1.8 or 2.1 meters) from the ground if it is positioned parallel to the parking strip. The lowest permanent branch for a tree in a park or yard often will be lower than that for a street tree, but the amount of clearance depends on specific use and maintenance considerations.

Look for a vigorous branch with a strong attachment that meets the height requirement. Its stem diameter should be one-half (or less) of the trunk diameter where the branch attaches to the trunk. You may want to label or tie a piece of string on this branch so you can identify it later. If the tree is too small for you to select a branch at the desired height, then you'll have to wait until the tree grows taller (see step five).

Smaller temporary branches should be left close to the lowest permanent branch. Larger temporary branches should be pruned back to one or two buds (see "***Temporary Branches***" below for more information).

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Temporary branches

Temporary branches are branches that remain on the tree during the first few years of its life and then are removed. They're important because they provide photosynthate for trunk growth and taper development, they shade the trunk (particularly in the afternoon, equator-side), and they reduce the risk of tree damage from vandalism. When possible, leave temporary branches on the trunk and between scaffolds. In many cases, it is useful to shorten their length to two to four buds and keep them cut back during the growing season. Preferably, you should select less vigorous twigs rather than more vigorous branches as temporaries. If more vigorous branches remain as temporaries, keep them pruned to within 1 foot (30 centimeters) of the trunk.

When assessing whether branches should remain as temporaries or be removed, keep in mind that when training is complete, at least one-half of the foliage should be on branches arising from the lower two-thirds of the tree's height. To achieve this distribution, it may be important to leave certain branches as temporaries, particularly lower ones.

Step Four—Select scaffold branches and cut back or remove competing branches. Scaffold branches are the permanent branches of the tree and constitute much of its frame-work. Scaffolds are located above the lowest permanent branch and are selected based on spacing and size considerations.
Remove branches that have weak attachments (for example, those with included bark). Such branches sh 1 not be used as scaffolds.

Vertical spacing between scaffolds depends on the expected size of the tree at maturity. Scaffold branch spacing should be 18 inches (45 centimeters) or more for trees expected to achieve a trunk diameter of 12 inches (30 centimeters) or more at maturity. For smaller trees (trunk diameter less than 12 inches at maturity), scaffold spacing of 12 inches or more is recommended.

Scaffold branches also should be spaced radially around the trunk, like spokes in a wheel. This vertical and radial spacing of scaffolds gives the tree good balance and form. Select scaffold branches starting with the lowest permanent branch and proceed up and around the trunk

If scaffold selection is difficult because of the selection of the lowest permanent branch, then it might be better to determine which vertical and radial branches will provide the best overall scaffold system. In some cases, it will be necessary to go back to step three and select another lowest permanent branch based on the best combination of scaffolds.

Selected scaffolds should have strong attachments. Branch diameter should be no more than one-half of the diameter of the trunk at the point of attachment. Remove branches that are close to the scaffolds (within 4 inches, or 10 centimeters) and are of equivalent size. If competing branches are needed to maintain canopy size, reduce their length by 50 percent or more to subordinate and reduce growth. Leave small-diameter branches as temporaries.

Keep in mind that as the tree grows, branch size and the space it occupies change, and you may find that some branches are no longer suitable as scaffolds. In this event, a scaffold may need to be removed (for example, if it has grown too large and is crowding other branches) or a new scaffold may need to be selected. Be prepared to reevaluate scaffold selection as the tree develops.

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Figure 4. Before pruning (left), this American elm (*Ulmus americana*) has competing leaders and highly vigorous scaffold and temporary branches. After pruning (right), the central leader has become re-established, upper scaffold branches have been reduced in size to direct and slow their growth, and many temporary branches have been retained but reduced in size.

Step Five—Select temporary branches below the lowest permanent branch. Some or all of the branches located below the lowest permanent branch can be retained as temporary branches. Remove branches with a diameter greater than one -third of the diameter of the trunk at the point of attachment. Shorten the length of temporaries to two to four buds.

How Much to Prune

Generally, no more than 25 percent of a young tree's canopy should be removed in any one year. In many cases, removing only 5 or 10 percent of the canopy is sufficient to develop good structure and form (for example, for trees with an excurrent form such as sweetgum, *Liquidambar styraciflua*).

In other cases, more than 25 percent may need to be removed. For instance, in cases where significant defects occur (such as codominant stems or weak attachments), a large branch or stems representing more than 25 percent of the canopy may need to be removed. Particularly vigorous trees such as species of elm *(Ulmus),* maple *(Acer),* or acacia *(Acacia)* may require more aggressive pruning to achieve branch spacing recommendations.

When to Prune

Both deciduous and broad-leaved evergreen trees should be trained primarily in the winter months when the trees are dormant. Dormancy is a time of minimal physiological activity, and pruning will have the least impact on subsequent growth and development. Dormancy periods change with

location and species, however. For instance, in much of California the dormancy period is December to February for most species. In Maine, many species will be dormant from November to March. At the earliest, wait until the leaves have fallen before pruning deciduous trees. At the latest, prune well before buds swell and new leaves begin to develop in the spring for both deciduous and broad-leaved evergreen trees.

Pruning during the growing season may be needed to remove diseased or insect-infested wood (for example, shoots killed by fire-blight), to direct growth, to remove growth that obstructs signs or windows, or to control watersprouts or suckers. Such pruning should be kept to a minimum so as not to unnecessarily reduce tree growth and development. In some cases, pruning during the growing season should be avoided entirely for pest management reasons (for example, to avoid attracting bark beetles). For trees with a tendency to develop suckers, it is important to remove the suckers frequently during the growing season, particularly those within 6 inches (15 centimeters) of the ground.

It is generally recommended that newly planted trees not be pruned or pruned very lightly the first year. This recommendation is more important for bare-root or balled-and-burlapped trees than for container stock. It is recommended that steps one and two be applied in all cases. For container stock, steps three and four can be applied if tree size is sufficiently large. For all stock-types, temporary branches along the trunk should be selected and cut back (step five).

What About Next Year and Subsequent Years?

You probably won't be able to develop the tree's permanent framework (central leader and scaffold branches) in the first year. In fact, you may not even be able to select the lowest permanent branch or scaffolds. Pruning in subsequent years is necessary in almost all cases. Plan to go through all steps each year until good structure and form are achieved.

Conifers

The five steps can be applied to conifers but with some modifications. Steps one and two are important. Damaged branches and competing leaders need to be removed. Step three is important, depending on tree location. If clearance is needed for vehicles, equipment, or people, then step three should be applied. Step four is not as important for conifers as for hardwood species. In many cases, step four can be bypassed entirely. Look for and remove branches with weak attachments, however. Step five will be necessary if a lowest permanent branch is established.

Field Practice

It is important to practice the five steps before applying them. Review each step with a coworker before making cuts. Tie a string or ribbon around the leader, the lowest permanent branch, and scaffolds. Discuss reasons for your selections and step back to evaluate potential impacts on tree form and size. After you are confident of your selections, make your cuts. Again, step back from time to time to assess changes in canopy size and form. Remember that species and conditions vary

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considerably and you will always need to use good judgment. Understand the reasons for the five steps and make reasonable adjustments in the field.

Troubleshooting:
Suggested remedies for commonly encountered problems

LEADER

Problem: The leader is broken or has been cut. Remedy: Avoid nursery trees with cut or broken leaders. If the tree has already been planted, you will have to train a branch to become the leader. Select the most vertical branch that is large enough to develop as a leader. If the leader is broken, you may be able to cut the remaining portion back to an upright directed bud.

Problem: Two stems are in the leader position. One is more vigorous, while the other is straighter (more vertical). Remedy: This is a difficult choice. Select the more vigorous stem if it looks like it will grow in an upright position (after the other stem is removed). Otherwise, choose the straighter stem.

Problem: The leader is bent. Remedy: If the bend is not severe, leave it alone and the stem will probably straighten itself. If it needs to be straightened, use two stakes placed on either side of the tree and tie the leader in an upright position between the stakes. Ties should allow the leader to move in the wind. If staking will not straighten the leader, then cut it back to a bud that will develop in the upright position. Prune in the summer to direct new growth.

LOWEST PERMANENT BRANCH

Problem: The tree has not developed branches above the minimum height (such as 8 feet for the lowest permanent branch over a sidewalk). Remedy: Wait until next year, or the year after, for the tree to grow taller. Be sure the central leader is well established: It will give rise to the lowest permanent branch. Keep lateral branches (temporaries) that are below the minimum height pruned back to encourage height growth.

Problem: Several branches of equivalent diameter occur at the position selected for the lowest permanent branch. Remedy: Select the most vigorous branch growing in desired direction (it should have a strong attachment and a diameter no more than one-half of the trunk diameter). Remove competing branches, or reduce their length by 50 percent or more and use as temporaries.

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SCAFFOLD BRANCHES

Problem: The best scaffold branches are all on one side of tree. Remedy: Try to invigorate smaller branches on the other side by removing existing branches or reducing their size. Develop the leader to encourage branch development on the desired side. Remove or cut back competing branches.

Problem: Potential scaffold branches are closely spaced on the trunk and leader. Remedy: Select a vigorous branch that has a strong attachment and is in a desirable position. Remove competing branches or reduce their length by 50 percent or more and use as temporaries.

TEMPORARY BRANCHES

Problem: You can't decide whether a branch should be left on as a temporary or be removed. Remedy: Remove the branch if it is greater than one-third of the diameter of the trunk.