

compact a plant as is florist demand, so our method is determined both by cultivar and ultimate market.

Another important element of our field production is our fertilization program. Sometime in early June when visual inspection of plants indicates it is necessary, we give an application of Sta-green 12-6-6. A second feeding follows usually about mid-July. We use about 80 pounds to each bed or about 4 pounds per 100 square feet. In the past we have fertilized our one year crop with a Vertagreen quick release 8-8-8 lawn and turf fertilizer before the end of August. The theory was that the plants could take up the fertilizer before it leached out, and growth would slow up and harden off before the advent of cold weather. However, we have decided to discontinue this quick release feeding. At the end of August we are going to a very light application of slow release 12-6-6, about 2 pounds per 100 square feet, which will not push the plants. When the temperature drops, the plants slow up, but they maintain a very good color and healthy appearance.

The final element in our field production of azaleas is winter protection. We place hoops of 3/4 inch conduit over the beds at 10 to 12 foot intervals. We then stretch a 6 foot wide piece of Saran shade cloth from the first pipe the whole length of the bed, and wire it down. We take care to pull the Saran down on the east side where the sun first hits the plants. This is to avoid a quick thaw of the leaf tissue, which is what we feel does the damage. Additional elements of field winter protection include maintaining a good nutritional balance in the field, and keeping the plants well watered. If we know a freeze is coming, we water the bed thoroughly. We feel that a well watered plant can survive the cold much better than one lacking water.

PRUNING AND TRAINING OF ORNAMENTAL NURSERY TREES

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All of you know how to prune a tree. There are many books on the theory of correct pruning and training, from the proper cutting angle, to developing main scaffold branches, to the proper time of year to prune. The problem in most nurseries is that you don't have time to trim all or any of your trees yourself, and furthermore may not have time to spend several seasons working with someone, teaching them by example how to prune. What I would like to focus on today is developing some

training aids to assist inexperienced pruners to do an acceptable job of pruning by your standards.

So first of all, what are your standards? You need to analyze:

1. What is your market? Homeowners want full-headed low-branched trees for the corner of the yard, while municipalities want street trees limbed up 5 to 6 feet for clearance.

2. At what size are you selling? A 1-1/4-inch tree limbed to 6-foot height may have few, if any, lateral branches left to form a head.

3. What are some growth characteristics of a particular species that almost always require corrections? For example, Norway maples often develop double leaders, and honeylocusts characteristically have excessive growth.

4. What action needs to be taken to get the desired finished production? That is, what should be the limbing up height at different tree calipers?

5. And, most importantly, what *guidelines* must you give fledgling pruners to get the *correct action* so that you get the *desired* finished product? This is the area where the communication with the pruning crew most often breaks down.

We have developed a handout to aid in this communication at our nursery. There is nothing sacred about the contents of this handout. Each of you would have different contents depending upon how you defined your standards of finished product, as we previously discussed. This handout was merely a result of my trying to analyze, back in October, 1975, exactly how I went about pruning a tree to get the effect I wanted. In addition, I tried to record some of the characteristics common to each species that often needed correcting. The handout has since been revised a couple of times and needs constant revision as new species and cultivars are added, as the market changes, and as more mistakes are invented by the people doing the pruning. (See appendix.)

We have a varied market. We sell trees from 1-1/4 inch to 4 inch caliper for residential as well as street planting. As for now, we don't designate at planting which trees are to be marketed at which size or for which type of market, although we are beginning to move in that direction. So we limb up the trees gradually, a little more each year as they develop caliper. This gives a well balanced tree at any size and avoids removing too large a branch at any one time. We try to obtain a limb-up height which is not too high for a homeowner, yet is high enough that the removal of just a few more branches will make the trees acceptable for street use. We also try to develop a cen-

tral leader and a dense branching habit that will be attractive as a 4 to 5 inch tree without sacrificing the balance and eye appeal of the younger tree. This is important since it may be sold at 1-1/2 inch or at 2 inch caliper.

The appendix is divided into two parts, one on limbing up and one on top pruning. As you can see, the limb-up heights are given for groups of genera, species, and cultivars, by age or caliper. Some exceptions are also given. For example, trees should not be limbed up more than one half of the height, and spindly or whippy trees would have the height reduced. It is important to give the pruning crew measuring sticks — “eyeball technique” hasn’t proven too successful although that is how the correct heights were originally determined.

The second part of the appendix consists of notes on certain species and cultivars that require special attention apart from the normal structural pruning. It is also important to develop a list of specific mistakes a new person may make and have this available for the crew leader. This would include such things as cutting with the wrong side of the shears next to the trunk of the tree, cutting too close or too far away from trunk of the tree, using poor judgment on the exceptions to limb-up rules and limbing up trees grown intentionally low branched.

As mentioned earlier, techniques may vary some from nursery to nursery, depending on the product desired. I would like to mention a few specific points about techniques to use.

The types of pruning shears are chosen to fit the particular job and size of material. The ratchet type is used for pruning large tree roots before planting in the field. They do not make a clean cut and should not be used on the top of a tree.

We find that locusts require the most pruning. It is especially important on these trees to prune close to the bud and on a slant as the stub will die back to a bud. We try to eliminate double leaders.

Top pruning of larger trees is done with a combination of pruners and a fork lift. Working from the ground with long poles is very tiring, and it is nearly impossible to cut close to the bud. Even though two people are required using the fork lift, the work can be done much more effectively and efficiently.

Some trees that are planted as whips tend to get rangy. We try to leave some feathery growth on the trunks to encourage caliper growth. This growth is removed before it reaches pencil thickness.

It is important to emphasize that the distance a cut is made from the main stem is critical when removing side branches.

There is only about 1/16 inch difference between the location of a correct and an incorrect cut.

My main point is: Do not assume that your people know intuitively the way you want a tree pruned! Spell out the procedure in detail. Most employees can learn to prune a tree acceptably. The handout will not teach these people to prune, but we consider it an important aid in the learning process.

APPENDIX
Limbing Up Height

	1 yr.	2 yr.	1-3/4", 2" 2-1/2", 3" 3-1/1", 4"		
<i>Acer</i> spp., <i>Quercus</i> spp., <i>Ginkgo</i> sp., <i>Gleditsia</i> <i>triacanthos</i> 'Imperial', <i>G.</i> <i>triacanthos</i> 'Sunburst'	48"	48"	48" +	54"	60"
<i>Tilia</i> spp.	42-48"	42-48"	48" +	54"	60"
<i>Gleditsia</i> sp., <i>Fraxinus</i> spp., <i>Platanus</i> sp.	48"	48"	54"	60"	72"
<i>Gleditsia</i> sp. (whips only)	42"				
<i>Liriodendron</i> sp.	42"	48"	48"	54"	60"
<i>Liquidambar</i> sp.	42"	42"	42-48"	54"	60"
<i>Sorbus</i> sp., <i>Betula</i> sp., <i>Pyrus calleryana</i> 'Bradford'	36"	36-38"	40-42"	48"	
<i>Malus</i> sp.-broad upright, <i>Crataegus</i> spp., <i>Prunus</i> <i>cerasifera</i> 'Thundercloud', <i>Pyrus</i> <i>calleryana fauriei</i>	30"	30"	36"	42"	
<i>Malus</i> × <i>atrosanguinea</i> , <i>M.</i> <i>floribunda</i> & <i>M.</i> 'Bob White'	24"	24"	24-30"	30"	
<i>Malus</i> 'Mary Potter', <i>M.</i> <i>sargentii</i> 'Rosea', <i>M.</i> 'Van Eseltine', <i>Eleagnus</i> sp.	24"	24"	24-30"	30"	
<i>Malus</i> 'Red Jade', <i>M.</i> 'Oekonomierat Echtermeyer', <i>Betula</i> <i>pendula verrucosa</i> 'Youngii'	Limb up only high enough that the tips of branches do not quite touch the ground.				

Notes to Limbing Up

1. Do not limb up more than one half of the height, i.e., on short trees you cannot limb up to height shown.
2. On spindly or whippy trees, leave branches 6" to 1' lower than indicates.
3. Don't measure from top of soil ridge when it is extra high but rather from prevailing ground level.
4. For branches that are close to the cut-off height, whether to cut or not depends on the branch caliper relative to the main stem caliper. In general, if the branch's caliper is 1/2 or more of the main stem caliper, remove it.
5. As you limb up to a certain height one year, keep in mind what height the branches on that tree will be limbed up to the next year or two. You may need to do some corrective pruning on strong lower branches that grow close enough to the main stem to inhibit the growth of young branches from the stem.

General Pruning Notes

1. Summer pruning — work on leader, limb up and correct branching (locust and ash head back in summer also).
2. Winter pruning — head back and work on branching.
3. Locust — Heading Back
 - (A) In the late spring and summer as the trees get about 18 inches of new growth, remove approximately 1/2 of new growth on young trees up to 1-1/2 inches. 1/3 of new growth on 1-1/2 inches and 1-3/4 inches, less than 1/3 and spot prune on 2 inch and up. Repeat with each flush of growth.
 - (B) Prune more off each branch the higher it is in the tree so you get a broad pyramidal growth habit.
4. Prune out any dead branches 2 to 3 inches behind the dead part.

Special Varietal Notes

Acer platanoides cultivars

Often have one or two branches too long, strong and out of balance — so cut back; cut to single leader.

Acer rubrum cultivars

Cut to single leader (almost always double)

Crataegus

Crataegus oxyacantha *superba* 'Crimson Cloud' (P.P. 2679) needs heading back severely. Do not try to establish a leader and do not thin out too much.

Fraxinus

Fraxinus pennsylvanica var. *lanceolata* 'Marshall' — Needs to be headed back. Cut to central leader.

Fraxinus excelsior 'Hessei'-Head back somewhat. Often has just one or two strong growing branches.

Gleditsia triacanthos cultivars (General notes)

Needs heading back.

Watch for bad (too narrow) crotches and correct.

Prune to bud where possible, inside or outside depending on direction you want new branch to take.

Cut back any lower branch tending to dominate leader.

In general, prune from the upper branches to the lower branches (*i.e.*, the upper ones first).

In general, prune 1-1/2 inches and below hard, 1-3/4 inches moderately, 2 inches and above prune very lightly.

'Imperial' — A globe headed tree. Do not try to shape like a 'Skyline'.

Do not worry about a central leader, just keep branches from becoming too rangy.

'Skyline' r (P.P. 1619) — Pyramidal shape. Do not prune lower branches too severely in relation to top branches.

'Sunburst' r — Tends to become rangy. Prune 2-3 times lightly in summer.

'Green Glory' (P.P. 2786) — Broad oval shape, strong grower. Do not prune upper or lower branches too severely in relation to each other. Top leader must be cut back as it grows too vigorously.

'Moraine' T.M. — broad oval shape. Similar in habit to 'Green Glory', only not quite as vigorous.

Malus

Malus × *atrosanguinea* and *M. floribunda* — head back; reduce clutter or thin out some branches.

M. 'Inglis' — Head back severely, especially lower branches in young trees.

M. 'Van Eseltine' — should be narrow upright — but top the young trees to encourage fullness.

Prunus subhirtella 'Pendula' — Watch for one or two strong shoots that aren't weeping.

Quercus species

Work hard to get a central leader

Head back the occasional wild branch.

Lift branches

Tilia species

Watch for leader bent over; prune back to straight bud.

Tilia cordata and *T. cordata* 'Greenspire' (P.P. 2086) — Occasionally head back some branches.

Thin out branches from main stem at least 6-8 inches apart vertically or 120° radially. Prune to central leader. Watch for bad crotch and correct.

Tilia × *euchlora* — Head back. Thin out some branches. Watch bad crotches.

Tilia × *euchlora* 'Redmond' — Head back, especially strong lower branches which tend to crowd main stem and inhibit lateral branching from main stem.

Trim to outside bud since these strong branches tend to grow tight to stem.

HOW SOIL CHEMISTRY CAN WORK FOR YOU

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Developing maximum plant quality with minimum cost can only be realized by proper monitoring of the nutrient level in the soil. An understanding of the optimum nutrient levels and balance in the soil will prevent "hidden hunger" or phytotoxicity, which can happen to even the best grower of containerized nursery stock.

Proper selection of media is essential. A guaranteed supply of uniform ingredients (media and fertilizer) which will provide proper drainage and porosity is needed. Media containing heavy metals or other toxic compounds should be avoided.

A representative sample of each component in the mix and a composite sample of the final mixture, before any nutrients are added, should be submitted for analysis. The analysis of the individual components will provide information on which fraction is providing the most nutrients to the final product. Nutrients should be added to the medium based on the soil analysis. Excess or deficiency of nutrients can cause an imbalance, which can result in abnormal plant growth. The optimum balance of cations (H, K, Mg, Ca and Na) for maximum growth is shown in Table 1.

Modifying the soil chemistry in the medium prior to planting is the ideal time to make adjustments. Topdress applications are time consuming and are less effective. The pH and