Top Pruning

By Thomas D. Landis

Controlling plant height is always a challenge because shoot growth is stimulated in modern nursery environments (Figure 1). To further aggravate the problem, economics forces nurseries to grow their stock at high densities and so plants want to outgrow their neighbors. Inducing mild stresses helps to slow height growth but this has only limited application. Chemical treatments like paclobutrazol have proven effective with floral crops, but have not found wide application in forest and conservation nurseries. Therefore, many growers resort to top pruning which is also called top mowing or clipping.

*Figure 1 - Top pruning is often the only option for crops like quaking aspen (*Populus tremuloides*) that produce tall shoots with minimal fertilization.*

Top pruning has become a routine cultural practice in many bareroot conifer nurseries. Over 90% of bareroot pine growers in the Southeast routinely prune their stock (Duryea 1986) and, in a survey of Pacific Northwest nurseries, 92% top pruned Douglas-fir (Duryea 1984). Since these surveys, top pruning has gained wider acceptance with bareroot conifers and hardwood nurseries. Container growers have been slower to adopt top pruning although controlling shoot height is much more difficult in greenhouses. Much of the concern comes from foresters and other seedling users who believe that top pruning causes forked or multiple stems. Let's consider the evidence.

Crop Growth Patterns

Position of Shoot Meristem and Type of Tissue. With top pruning, the location of the shoot meristem and whether the crop produces woody or nonwoody tissue is the first thing to think about. Grasses, sedges and other non-woody plants have their growing point at ground level and never produce woody tissue. So, these crops can be pruned regularly without any problems. Meristems of woody plants, however, are located at the tips of the terminal shoot and branches, and so shoot pruning is more problematic.

Types of Woody Plant Shoot Growth. In the temperature zones, woody plants exhibit either determinate or indeterminate growth. Pine, spruce, hickory and oaks exhibit determinate shoot growth in which foliar buds break in the spring, and shoots expand before setting another bud in mid- to late summer. In nurseries, determinate species sometimes produce another late growth spurt known as lammas growth. On the other hand, shoots of indeterminate species such as western redcedar, junipers, and elm do not have true dormant buds and produce several growth spurts during the summer. In general, top pruning of indeterminate species poses few problems whereas there is a narrow window for determinate plants.

Reasons for Top Pruning

Growers top prune their stock for several reasons:

To Control Shoot Height. This is the most obvious and common reason to top prune, and over half of southeastern nurseries gave this as their primary reason in a 1986 survey (Duryea 1986). Removing the newest shoot tissue temporarily slows shoot production and allows more photosynthate to be diverted to stem and root growth.

To Achieve a Uniform Crop Size. This was the second most common reason to top prune in the southern survey (Duryea 1986). Due to differences in seed germination timing and initial growth rates, nursery crops do not grow uniformly. At the high growing densities in seedbeds and multiple cell containers, plants that get a slow start are typically overtopped and end-up as culls. Top pruning during the growing season is an ideal way to temporarily slow the faster growing plants and allow slower ones to catch-up (Figure 2). The result would be higher seed-use efficiency and more shippable plants. Dierhauf (1976) was the first to note that top pruning "released" small seedlings, but subsequent trials had mixed results.

To Decrease Shoot-to-Root Ratio. Many foresters and restorationists request plants with short, stubby shoots and a large, fibrous root system for their harsher sites. Top pruning is a cost-effective way to produce these target stock types, and is one of the main reasons why southern nursery managers use this practice.

To Increase Stem Diameter. It would seem logical that top pruning would increase stem diameter because more

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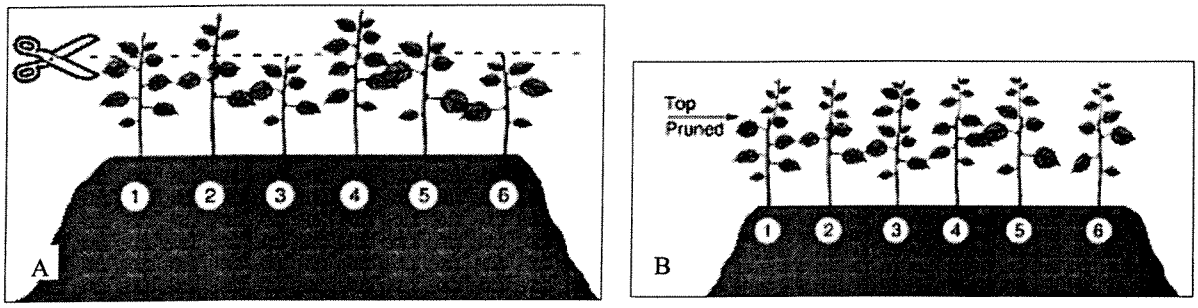

Figure 2 - One of the reasons to top prune nursery stock is that it produces plants of a more uniform size. At the time of top pruning, only the taller plants (1,2,4, & 5) will be clipped (A). The shorter plants (3 & 6) will be released from competition for light and hopefully catch-up with their neighbors (B).

photosynthate would be available. However, several studies have shown the opposite effect.

To Facilitate Seedling Handling During Transplanting and Outplanting. Nurseries producing transplant stock typically top prune their seedlings to make them easier to handle during the transplanting process. Top-pruned plants are also more hardy and resistant to moisture stress and growth checking after transplanting. With some species, top pruning is used to reduce shoot height and make plants easier to harvest, handle, store, and ship. In a general review, South (1996) found that top-pruning hardwood seedlings to a target height is a standard nursery practice.

Implementing Top Pruning

Types of Equipment. Bareroot nurseries use a variety of tractor-drawn implements to top prune their stock. In the southeastern survey, most nurseries used rotary mowers (Figure 3A) that can be easily adjusted for height. Sickle-bar mowers feature a reciprocating sickle mounted within a sidebar. Flail mowers have swinging pyramid-shaped flail blades which rotate from a horizontal cylinder. Sources for top pruning equipment can be found in the Bareroot Nursery Equipment Catalong (Lowman and others 1992).

Ornamental growers have been top pruning their container stock for years, either manually or with homemade equipment such as lawnmowers (Figure 3B). Hedge trimmers have also been used but must be cleaned regularly when pruning pines and other conifers because of their sticky resin.

Timing. With most crops, one top pruning in early summer when shoots are still succulent is recommended. In the southeastern states, loblolly and other southern pines are often top pruned several times throughout the summer to keep seedlings within target specifications.

During Crop Cycle—In my experience, timing is the primary reason for poor top pruning results, but this varies with nursery climate and plant species. Woody plants in tropical or semitropical climates show continuous bursts of shoot growth whenever

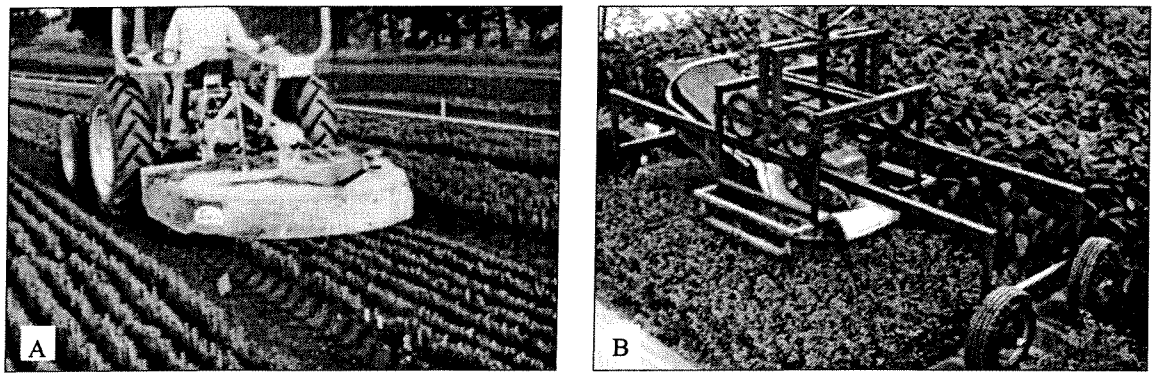

Figure 3 - Top pruning with rotary mowers is a routine practice in many bareroot conifer nurseries (A). Ornamental container growers have modified lawnmowers to top prune their stock (B).

environmental conditions, especially moisture, are favorable. This is the main reason why controlling shoot growth is so difficult in nurseries in these climates.

Trees and shrubs with indeterminate growth habit have a wide pruning window and can be pruned almost anytime during active shoot growth. Determinate woody species should be top pruned when the terminal shoot is expanding and before it becomes woody. In pines, this is often called the "pinfeather" stage because the new emerging needling look like the pinfeathers on a duck (Figure 4).

Proper timing is critical for developing wound callus tissue and forming new buds. Pruning wounds made during the early-summer flush heal better than those made at other times of the year. Pruning too late in the season can cause plants to flush again which can lead to fall frost injury. So, the best time to top prune cannot be scheduled by the calendar but instead must be determined by phenological development which will be different from nursery to nursery and year to year.

At Harvest—Hardwoods and other broadleaved nursery stock are sometimes top pruned with paper cutters as part of the lift-and-pack process. Because they are dormant and without foliage, this does not appear harmful but greatly facilitates handling, storage, and shipping. This practice should not be attempted with conifer stock which must be stored because the injured foliage would certainly attract gray mold (*Botrytis cinerea)* and other foliar pathogens.

Concerns About Top Pruning. As already mentioned, some growers have reservations about top pruning their crops and the possibility of producing seedlings with forked stems or increasing disease are the major concerns.

Stem Forking—The possibility of creating multiple shoots is the most common reason that growers are afraid to try top pruning. In one of the few comprehensive research studies, top pruning increased the number of Douglas-fir bareroot seedlings with multiple leaders from 10 to 38% at time of harvest but that percentage dropped two years after outplanting (Duryea and Omi 1987). With loblolly pine, outplanting trials found no forked seedlings after 3 years (Dierhauf 1976).

Of course, the objectives of the seedling user would determine whether initially forked plants would be a problem. Foresters are concerned about producing trees with straight boles but forking would not be important for nursery stock used for restoration or other non-

Figure 4 - Trees and shrubs with indeterminate growth should be top pruned before the expanding terminal shoot becomes woody; in pines, this is called the "pinfeather" stage.

commercial objectives. In the final analysis, experience has shown most young plants exhibit strong apical dominance so forking does not persist for long.

Disease—This is one of the oldest fears about top pruning. Toumey (1916) was concerned that the wounds from top pruning would allow access for fungal pathogens. This is certainly a possiblity and so growers should keep their pruning equipment sharp and mowers should be steam-cleaned regularly. Brown-spot needle blight, caused by *Scirrhia acicola*, is the only documented disease to be spread by top pruning but experience has shown that spreading fungal disease has not been a problem in bareroot nurseries. In container nurseries, the greatest risk is from *Botrytis* because this fungus is omnipresent and quickly colonizes wounded tissue. Therefore, the presence of foliar disease should be surveyed before top pruning and pruned shoots should be promptly raked immediately afterwards.

Effects on Outplanting Performance

Most published research has been with southern pines, and several studies have shown that top pruning usually improves survival of loblolly pine by around 6% (South 1998). Longleaf pine is a particularly challenging species and needle clipping just before outplanting increased field survival of seedlings from four separate nurseries. For Douglas-fir, outplanting survival and growth of pruned seedlings was not better than the controls (Duryea and Omi 1987). With

hardwood tree crops, many trials show no significant effect on survival after outplanting but South (1996) found that this differed with harshness of the outplanting sites. On hotter and drier sites, top pruned seedlings performed better probably due to their better balance between shoots and roots.

Top pruning has been shown to improve the survival and growth of oak and other broadleafed seedlings. With blue oak (*Quercus douglasii*), McCreasy and Tecklin (1993) report that top-pruned container seedlings had greater height and stem growth after two growing seasons. They recommend top pruning for all nursery stock that has grown overly tall with an out-of-balance shoot:root ratio. With bareroot water oaks (*Quercus nigra*), top-pruned seedlings were not only growing faster after outplanting but also appeared to be more vigorous (Adams 1985).

Conclusions and Recommendations

Although the published research contains contradictory and confusing results, top pruning is a valuable cultural procedure that helps nursery managers control shoot height and achieve crop-size uniformity. Timing is critical and seedlings should be pruned when actively growing in early summer to ensure the proper development of terminal buds. In the southeastern states, loblolly and other southern pines are often top pruned several times throughout the summer. Pruned shoots should be removed immediately after pruning to reduce chances of disease. Although pruning is an effective alternative for excessively tall stock, nursery managers should always make small tests before implementing this practice operationally.

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