PRUNING LOBLOLLLY PINE SEEDLINGS [1]

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Abstract.--Undercutting and top pruning are performed routinely to meet loblolly pine seedling size, uniformity and condition standards. Top pruning improves height distribution but does not improve crop uniformity because it does not release seedlings below desired height before treatment. Undercutting alters root:shoot balance, improves seedling quality and crop uniformity. The overall success of undercutting and pruning operations is determined by the timing and frequency of these operations. At present, pruning is used in excess to correct growth imbalances caused by genetic differences among seedlots and suboptimal sowing, fertilization and irrigation practices.

INTRODUCTION

Pruning practices in southern pine nurseries have undergone gradual revision since Lhe first regional nursery manual was published (Wakeley 1954). Nurserymen prune seedling shoots and roots to improve seedling survival, and to facilitate packing and field planting. Seedbed root pruning practices have been revised and refined with the introduction of precision nursery equipment and a better understanding of the damaging effects of improper pruning. With the advent of mechanized irrigation, shoot pruning has become a routine practice among southern nurseries (Boyer and South 1984).

Some pruning terms are used interchangeably, causing confusion. Top pruning refers to the cutting of succulent shoot tips before bud set in the fall. In southern nurseries, seedlings are top pruned early in the growing season (mid-August) to allow sufficient regrowth and bud set. Care is taken to avoid cutting into woody shoot tissue. Undercutting involves the drawing of a thin, sharp blade under the seedbed, parallel to the bed surface. This effectively severs the tap root and causes minimal soil disturbance. A flat blade or a New Zealand reciprocating undercutter is used by a highly skilled operator to maintain blade depth within acceptable tolerances.

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[1] New Mexico State University Agricultural Experiment Station Scientific Paper No. SP 215

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Undercutting should also include lateral root pruning one to several weeks later to further alter the root system. Wrenching is done by passing a blade tilted at a slight angle to loosen the soil and sever lateral roots. This aerates the soil, stimulates root growth and fibrosity and imposes plant water stress on shoots.

The term root pruning should he restricted to the trimming of long laterals and tap roots after lifting and before planting. Root pruning is detrimental to early growth, as shown by Mullin (1973), and will receive no further comment because this practice should be eliminated from nursery operations. This paper will discuss the impacts of pruning on nursery crop yield and quality. Readers interested in the effects of pruning on plantation establishment should consult papers by Dieurauf (1976) on top pruning and Tanaka et al.(1976) on undercutting.

TOP PRUNING

Top pruning is used in the South to: (1) limit shoot height, (2) improve above—ground crop uniformity, (3) increase root:shoot ratio, (4) facilitate application of fungicides and (5) improve packing, storage and planting. Top pruning improves the height distribution of southern pine seedlings by clipping the tops of excessively tall seedlings, which otherwise would be cull seedlings (Fig. 1).

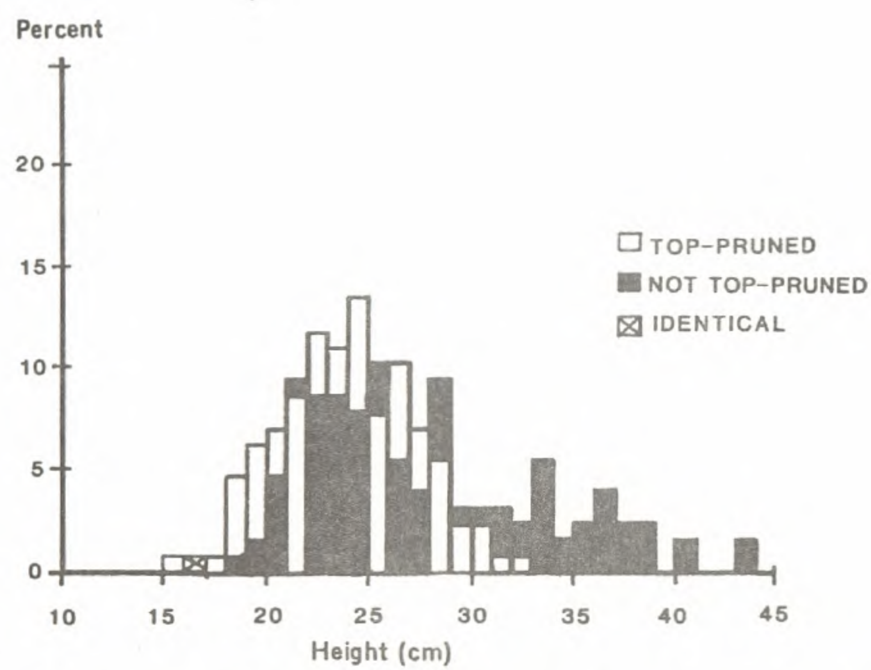

Fig. 1. Distribution of seedlings with and without top pruning (Mexal and Morris, unpublished).

In a study by Mexal and Morris (unpublished), there were more cull seedlings at the lower end of the height distribution curve and fewer at the upper end of the curve with top pruning. Top pruning eliminated tall seedlings and failed to release small seedlings. Results from another study explains why top pruning fails to release seedlings. Seedlings were tagged immediately after top pruning and separated into categories of: (1) pruned, (2) unpruned but plantable, (3) unpruned and cull (Fig. 2).

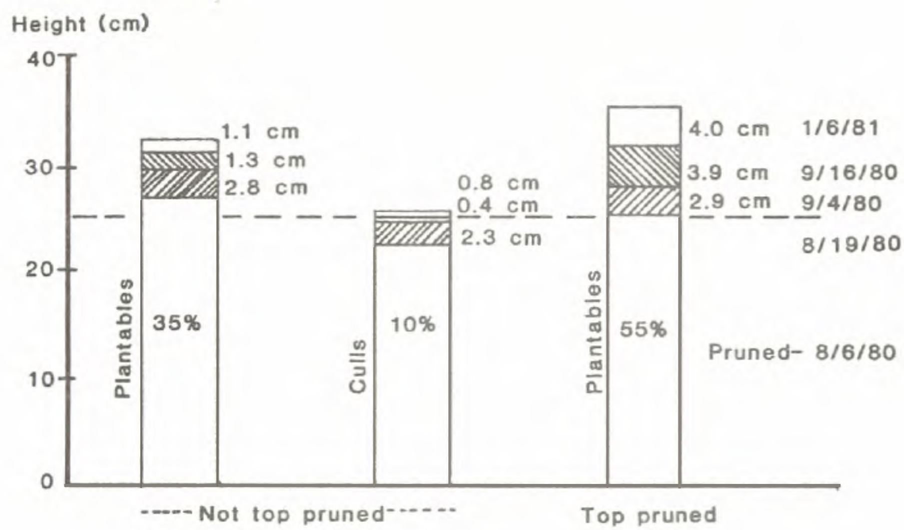

Fig. 2. Regrowth of loblolly pine following top pruning. Seedlings were classified and tagged at time of pruning.

Pruned plantable seedlings grew an additional 11 cm after pruning. Unpruned seedlings graded as plantable in August grew 5 cm. Seedlings graded as culls in August grew only 4 cm and had caliper diameters less than 3 cm by mid—January. Seedlings that were culls because of late germination or crowding had limited opportunity for release because both pruned and unpruned plantable seedlings rapidly filled available bed space.

Although routine top pruning may remove a relatively small portion of the shoot, it removes a disproportionately large segment of the photosynthetic biomass found in secondary needles in the upper shoot. This relationship is diagrammed in Fig. 3, showing that the removal of 20 percent of the shoot reduced secondary needles 45 percent. A significant reduction in foliage biomass of exceedlingly large seedlings may improve survival (Dieurauf 1976). However, a similar reduction in the biomass of average size seedlings on sites of average quality actually will decrease height growth from a reduced photosynthetic ability. Dittmer (1973) showed this with Cynodon dactylon (L.) Pers. He stated: "clipping of the shoots inhibits root production." Grass maintained at a predetermined height by clipping suffered reduced biomass not only in tops but but also in roots (Fig. 4). Loblolly pine (Pinus taeda) seedlings should respond similarly.

Routine top pruning may increase the incidence of brown spot needle blight (Scirrhia acicola (Dearn.)) in southern pine nurseries. Pruned infected foliage left in beds bears inocula. As colter blades pass through contaminated areas, spores are spread throughout the nursery. Kais (1978) recommended several procedures to avoid pathogen contamination after top pruning.

UNDERCUTTING

Each tree species has a characteristic root:shoot ratio, which remains constant in stable environments and decreases progressively with plant age and size (Kramer and Kozlowski 1979). Undercutting alters shoot—root balance while improving seedling uniformity (Table 1). Top pruning reduces the coefficient of height variation by eliminating exceptionally tall seedlings. However, undercutting reduces variability of shoot and root fresh weights.

Table 1. Effect of pruning treatment on crop variation and cull percentage (Mexal, unpublished)

Treatment	Coefficient of Variation			Culls (%)		
	Height	Shoot Wt.	Root Wt.	> 35 cm	< 3mm	Sum
Control	17	38	36	23	17	40 A*
Top Pruned	11	28	32	33	15	48 A
Undercut	17	27	16	7	19	25 B

* Letters indicate significant difference at 0.5 level.

From a crop production view point, seedling weight is the primary factor directing the course of nursery management decisions. Therefore, the more uniform crop created by undercutting facilitates crop management, but top pruning does not improve production efficiency. In this same study, only undercutting significantly reduced the number of culls resulting from excessive shoot growth. Independent of other

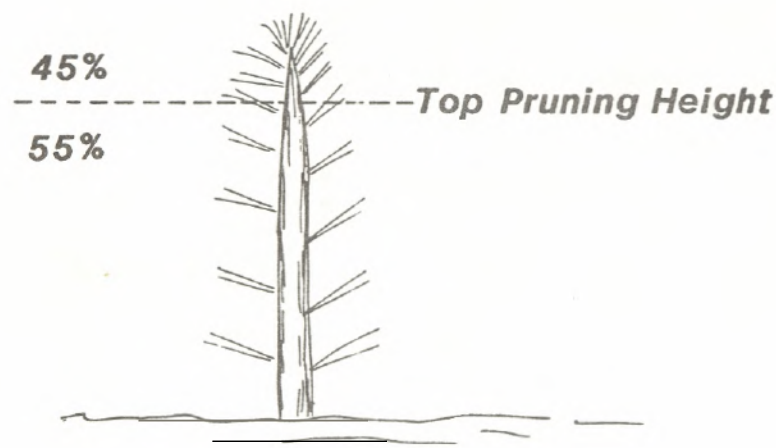

Fig. 3. Diagrammetic effects of top pruning on removal of secondary needles.

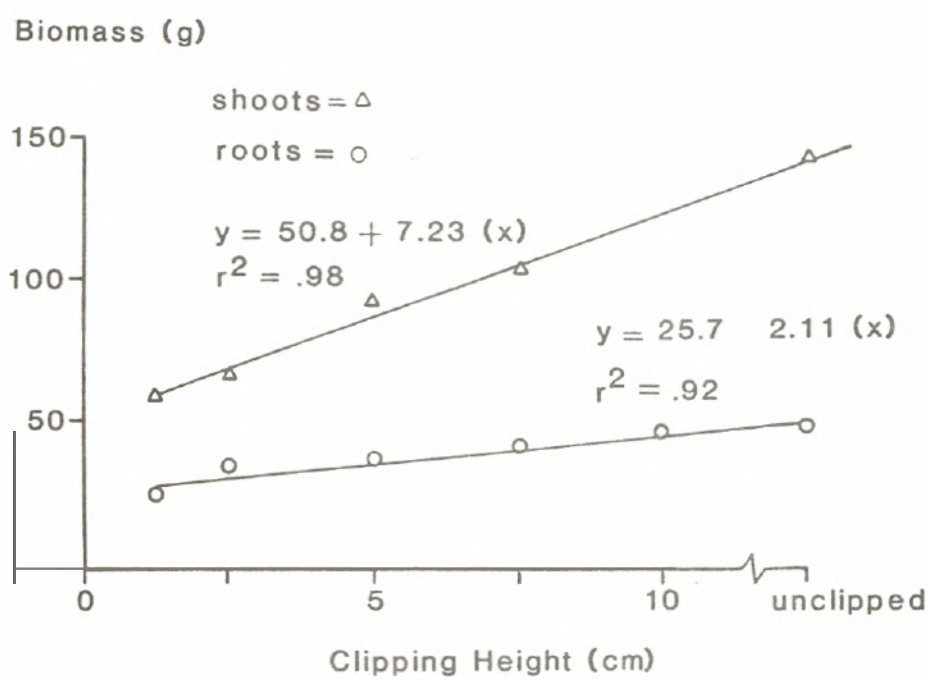

Fig. 4. Effect of clipping bermuda grass to specific heights on total biomass production (Dittmer 1973).

cultural treatments, top pruning may not be sufficient to check height growth. In fact, the number of culls in top pruned treatments did not differ from those harvested from control research plots. Undercutting, however, significantly reduced the total number of culls as well as the number of seedlings culled for excessive size. The number of seedlings culled because caliper was less than 3 mm was not influenced by any cultural practices.

Undercutting improves overall crop quality by increasing root fibrosity. A more fibrous root system improves field survival and growth (Tanaka et al. 1976). Undercut seedlings have more roots available to regenerate new transplant roots, have a greater nutrient pool and a greater root surface area to absorb water. Venator (1983) noted that undercutting did not appear to increase primary laterals, but markedly increased secondary and tertiary laterals. The result was no significant net change in seedling root weight.

Crop response to undercutting is affected by the timing and frequency of undercutting treatments. Factors interacting with the time of treatment include: stage of seedling development, cultural treatments and precipitation. To be successful, undercutting must be applied early enough to check height growth. Venator and Mexal (1980) showed no response to undercutting, presumably because there was no impact on seedling height. Timing also influences the site of origin of new roots (Wilcox 1955).

Irrigation water is sometimes withheld to impose water stress on a crop growing too rapidly (Duryea 1984). Undercutting is an alternative treatment when precipitation exceeds crop water demands. Undercutting performed August through October does not replace wrenching to facilitate lifting; seedlings must be wrenched before lifting to avoid root stripping.

Frequent undercutting reduces seedling root and shoot growth, regardless of growing density (Fig. 5). The greatest impact of undercutting was a reduction in shoot growth (Mexal 1982). Moderate undercutting usually does not affect the growth rate of remaining roots. (Geisler and Ferree 1984).

CONCLUSIONS

Early top pruning checks height growth of larger seedlings. However, pruning is effective only for three weeks after treatment and it may be necessary to reduce watering to slow top growth. All pruning practices elevate production costs assigned to manpower, equipment and energy. Generally, pruning corrects management shortcomings rather than the conditions directly causing undesirable crop growth patterns. To improve crop uniformity, management should be directed away from nursery pruning toward better crop management in the early stages of crop growth. These include: (1) longer stratification to promote rapid and uniform germination, (2) selection of optimal sowing date, (3) clonal sowing to reduce growth differences due to heritable traits, and (4) proper irrigation and fertilization. Growth retarding chemicals also deserve greater attention.

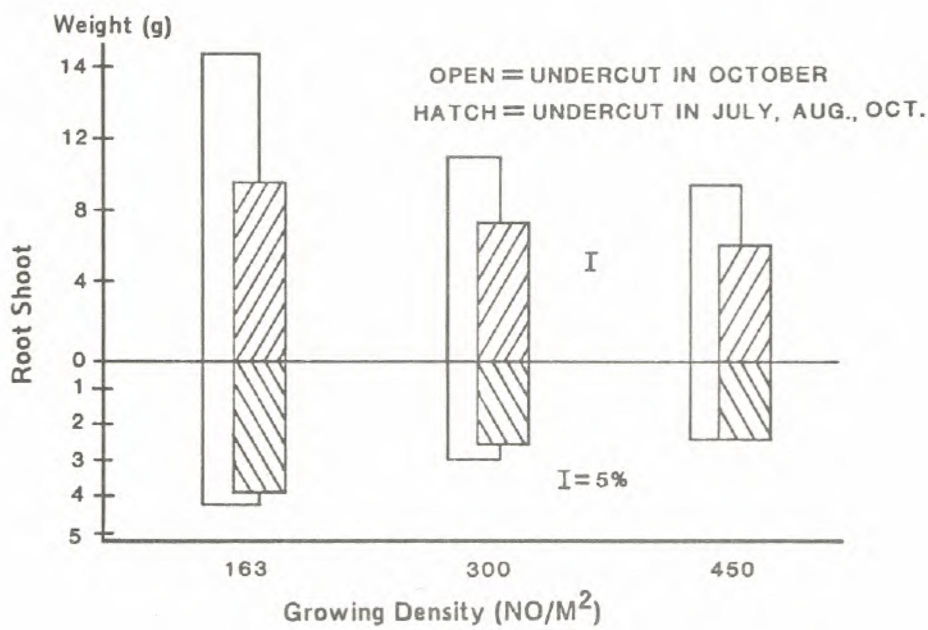

Fig. 5. Interactions among loblolly pine seedling biomass, growing density and frequency of undercutting (Mexal 1982).

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