ROOT TRAINING OF SOUTHERN PINE SEEDLINGS AS PRACTICED AT MBI NURSERY

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Introduction

The advent of lower densities in the seedbeds at the MBI Nursery in recent years allowed root systems to become unwieldy. This led to extensive root pruning either at the Nursery at lifting time or most often in the field by tree planters. Obviously, such pruning reduced the viable root systems so that transplanted seedlings struggled to survive and grow even with good weather conditions. During the last ten years, certain practices have evolved at the MBI Nursery which is helping with these problems.

The practices are not new in concept but rather an adaptation of several practices of past record. The ideas of root pruning, root wrenching, root-shoot development, aeration, moisture control, stressing and mycorrhizal development are all incorporated into the practices. In addition, fertilization, organic content of soil, and cultural practices are supporting the practices.

The keys to successfully training the roots of Southern Pine seedlings is to start early preparing the crop for the practice and to do the stages at the right time. Timing is critical as certain procedures must be followed when deemed proper.

Following are the general procedures and when they are done.

I. Bed Formation Prior to Seeding

To perform the undercutting task properly (at the right depth without having many seedlings fall into drains thus causing undue loss from outside rows); preparation starting at bed-building time helps alleviate this problem. First, a tool is needed. MBI fabricated one using cultivator parts, depth control wheels, tool bar, modified middle-buster plows, row markers and an improvised blade. The rig has worked very well during bed construction. This tool does a good job of laying off beds and pulverizing the soil for bed formation. Further, the blade establishes a shear plane beneath the bed which helps toward controlling the depth of the first undercut in late July or early August. The depth control wheels establishes the depth of the blade set at approximately 6 inches running depth, and the middlebusters create drains without "humps and hollows" when the land is level and well prepared. The smooth drains is helpful toward regulating the depths of undercuts that come later.

The modified middle-busters give additional assistance toward depth control and prevents most seedling "fall down" into the drains due to firming of bed shoulders.

The reason for such strong emphasis on depth control is to regulate the length of the seedling tap-roots to as near

6 inches as possible when sent to the field for transplanting.

The blade is 72 inches in length constructed from the knife of a plywood lathe or scraper blade. The width is 5-6 inches. The blade must be run with **as little tilt** as possible with only enough "draft" for blade to stay in the soil without heaving of the bed excessively. Too much tilt causes undue disturbance of the seedlings often exposing their, roots.

II. Timing First Undercut

At time of full development of secondary foliage (when first fascicle bundles are formed) is the time for first undercut. Seedlings should be 8 to 10 inches in height around the first of August in south Alabama and south Georgia areas. Then is the time to run the blade at 6 inches depth cutting the tap roots of the larger seedlings. To wait much later will create severe problems. If the main tap root grows too woody at the undercutting depth, a fixed blade will not cut clean. Seedling roots will wrap around the blade creating one unholy mess in relatively friable soil as found in the MBI Nursery.

To stimulate compact root growth and development - and to enhance mycorrhizal development - undercutting should begin by the first week in August in south Alabama.

III. Timing Lateral Root Pruning

The first lateral pruning (?) has been done in mid-July in recent years thus establishing the lateral shear plane before under-cutting begins.

A week or ten days following the first undercut, the lateral roots (between the rows) should be pruned again. This gives time for the seedlings to have settled and gotten over the shock of undercutting to some extent. This regime is shocking to the seedlings and also to the nurseryman but it is well worth the trauma.

Heavy irrigation must follow undercutting and root pruning. It is not to kill the seedlings but to make them "tough" via root disturbance and moisture control. Even with irrigation immediately following undercutting, some wilting occurs and the shock will cause discoloration during the fall due to the stress caused by the disturbance of the root systems. The seedlings will set buds and go into a pseudo-dormant state following the first undercut and lateral root pruning operation. The objective is to keep **them in this state throughout the fall allowing root development and stem caliber increase but regulating height growth. Top pruning is not practiced in the MBI nursery. Because this regime renders it unnecessary.**

IV. Timing of Second Undercut and Lateral Root Pruning Operation

The seedling crop must be watched closely following the first undercut and lateral root pruning operation. The time to undercut the second time depends on the response of the seedlings. Close scrutiny of the seedlings is required on a regular basis. When profuse new white roots have formed and pinned into the soil - undercutting should be done as bud elongation will occur within a few days. Usually, 3 to 4 weeks will elapse between the first undercut and time for the second undercut. Hence, when the first undercut is performed in early August - the second undercut is usually required about the first week in September.

The extent of root wrenching by the undercutter blade and elongation of laterals will determine when the second lateral root pruning is done. Usually, about the second or third week in September this is done in the MBI Nursery. Recently, a lateral pruning in late October has helped the performance of the lifter during harvest. Apparently, the coulters on the Whitfield lateral pruner as used by MBI causes a shear surface which deters lateral root development so that only three lateral prunings are required. Probably, the coulter slit once established creates a shear plane that continues to separate at that point during subsequent undercuttings. Hence, the separating action along the slits seems to help inhibit cross-over lateral root growth.

V. Timing of Third Undercut

The same routine toward scrutinizing the seedling crop

should be continued during September. When the seedlings indicate inclination toward new height growth due to a surge of new root development, the time for the third undercut is due. About the first week in October is usually the time for the third undercutting.

Weather conditions influence the rate of re-establishment by the root systems. If the weather is wet, more frequent undercuttings will likely be needed to retard height growth.

VI. Other Undercuts

Under normal conditions three undercuts will suffice for controlling the height and size of seedlings in the MBI Nursery. However, if a wet or late fall occurs then additional undercuts may be needed even as late as late October or early November.

Undercutting about two weeks prior to lifting is being considered in order to stimulate root initiation prior to seedling lifting. Indications are that survival and growth of out-planted seedlings are stimulated by so doing. Hopefully, other nurseries will help check on this! CAUTION! This will make lifting with machines with stationary blade very difficult because the blade on the machine will not slice under seedlings resulting in "pile-up" or pushing forward of the "bed mass", i.e. soil and seedlings. The soil is so loose until the bed mass will not stay in place. Of course, this problem can be solved

with a little modification of the machine such as using a vibrating blade plus other minor adjustments. Other soil types that are more firm in texture may not create the problem of piling-up as experienced in the MBI Nursery.

VII. Water Management

Following each undercut, 1.0 to 1.5 inches of water is required over about two days in order to set the crop. This will saturate the soil strata thus keeping the seedlings alive and stimulate root initiation. The seedlings have been "plowed-up" and in effect they are being transplanted in place. As root growth and development requires moisture, aeration (oxygen) and fertility, then all three should be provided in adequate amounts to achieve the desired configuration. Root development is encouraged by the process. The objective is to train and develop a root system that will support the plant when transplanted, yet of a configuration that can be accommodated in the transplanting process.

No attempt will be made at this time to get involved in the fertilization regime except for one statement. Adequate fertility and organic matter is maintained in order to enhance root development. Following the heavy applications of water, the moisture level in the seedbeds is monitored closely. When the moisture recedes to about 5 inches, heavy irrigation is applied so that the total root zone is saturated. Again, the moisture is allowed to recede and the

process is repeated, weather permitting.

Good moisture is provided before undercutting and/or lateral root pruning by irrigation if necessary. Performance of the operations work much better when the moisture is good and buffers the shock to the seedlings somewhat.

By allowing the moisture to recede to 5 inches during the fall, some stress does occur. Seedlings usually appear light green in color and the foliage will turn brown toward the lower part of the crown.

As a result of continually pulverizing the soil in the seedbeds during the fall, mycorrhizae forms heavily on the root systems but the fruiting bodies associated with P. tinctorius are scarce until late fall. The continual soil disturbance probably interferes with fruiting body formation.

SUMMARY STATEMENTS

The undercuttings, lateral root prunings and moisture management results in compact root systems that can be transplanted without additional root pruning. In fact, MBI prohibits root pruning in the field by contractors.

The color of the seedlings reflect the treatments by late fall and early winter bringing on the question - "Whats wrong "them" seedlings?" - My answer starts like this - Glad you asked that question - and go from there -

Survival and growth of MBI stock during the extreme

drought of 1986 have been acceptable in most areas. Hence, the treatments are helping with the practical aspects of proper planting -- which is enhancing establishment of plantations. Seedlings are grown at a density of about 20/ft.^{2} in the MBI nursery in recent years. Hence, root training is essential.