

ROOT PRUNING IN FOREST NURSERY MANAGEMENT

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Should the nurseryman root prune his stock? Following are some comments and suggestions on this question.

Purposes of root pruning

Basically there are five reasons usually given to justify root pruning. They are:

1. Increase the uniformity of the stock
2. Increase the ease of planting
3. Increase the initial field survival
4. Stimulate lateral root development
5. Allow production of seedlings rather than transplants

Probably the principle reason given for root pruning in the past has been that it represents an attempt to increase the uniformity of the stock. Supposedly the stock is pruned at the proper time and at the proper depth in the soil, the rapidly growing seedlings will be pruned and thereby retarded while the more slowly developing seedlings will not be pruned and will continue to grow unhindered.

Another reason often suggested to justify root pruning is that long tap-rooted seedlings are difficult to plant either by hand or machine, and pruning the roots will overcome this difficulty. For this purpose, however, roots could be clipped during packing and need not be pruned in the bed during the growing season.

A third reason offered in favor of root pruning is that initial survival of outplanted seedlings will be increased. The explanation here is that root pruned stock is more easily lifted and planted than non-pruned stock; and, therefore, is in better condition when outplanted and this, in turn, aids survival.

A less frequently proposed reason for root pruning is that the pruning of tap roots tends to stimulate lateral root production and these additional lateral roots are of some benefit to the seedlings.

In forest nurseries where stock must be grown for more than one year, root pruning coupled with decreased stand density in seedbeds has been suggested as a means of producing plantable seedlings rather than transplants. Thus, saving considerable time, labor, space, and money.

Hazards and costs of root pruning

The hazards involved in root pruning include reduced field survival if pruning is improperly done or done at the wrong time, and an increase in the chances that root disease organisms may invade the seedlings through the cut roots. Root pruning is also an additional expense in the production of nursery stock. If the nurseryman is to adopt root pruning, the advantages of this extra operation must offset both the hazards and expenses inherent in it.

Evaluation of root pruning

Let us turn to the experience of others to see whether we can reach some general conclusions regarding the value of root pruning in forest nursery management.

The first reason suggested for root pruning was to improve uniformity of stock by reducing the top growth of the larger seedlings. The general conclusion can be reached that root pruning does retard growth of seedlings for a while but, usually, one pruning during the season, regardless of when it is done, is not adequate to significantly increase the uniformity of the stock at lifting time. Darby (1) reported excellent results in controlling top growth of seedlings by root pruning first when the majority of the seedlings had reached the desired height for planting and again after each heavy rain until lifting. Others who have reported less success in controlling top growth do not appear to have used root pruning to this extent. Shoulders (9) conducted a very careful study on seedlings of longleaf, slash, and loblolly pines which were pruned once in September, October, November, December, or January, and found that none of the single treatments effectively controlled top growth of any of the three species.

The time of pruning appears to be most significant in determining whether the stock produced will have long tap roots or not. Shoulders (8) reported that seedlings of slash, loblolly, or longleaf pines pruned prior to September grew and hardened one or more new tap roots which extended below the lifting level by the end of the season. Longleaf was the slowest to regenerate tap roots, apparently, because it took the most time of the three species to callus over the initial cut. Stock pruned in November, however, did not produce any new tap roots but did callus over the cuts and on many seedlings, at lifting, white bud-like root primordia were seen.

Foster (2), in 1932, suggested a "new practice" for nurserymen whose stock must be in the nursery for more than 1-year. He advocated root pruning seedlings after the second year and then growing 3-0 seedlings rather than 2-1 transplants. This practice was well received and the number of transplants produced has steadily decreased since then. In more recent times, some nurseries have drill-seeded beds rather than

broadcast-seeding them. After the second year, roots are pruned both horizontally under the beds and also vertically between the rows. The 3-0 stock thus produced has been easy to handle and in excellent condition for outplanting.

Another advantage often claimed for root pruned stock which is outplanted in areas where damage from freezing is possible is that pruning stock is reportedly less susceptible to such damage than non-pruned stock. An adequate study of this does not seem to have been conducted.

The stimulation of lateral root formation now appears to be very significant in increasing field survival. The value of lateral roots and tap roots to slash and longleaf pine seedlings was demonstrated by Wakeley (11) when he showed that tap roots could be trimmed at lifting to only 3 inches in length without causing a decrease in survival below 90 percent, even on poor sites. The loss of even half of the lateral roots, however, decreased the overall survival of longleaf to 60 percent and slash pine to 30 percent. Of importance here is the fact that the removal of half of the laterals still left sufficient laterals on the root systems so that the seedlings would usually pass unnoticed on the grading table. Langdon (2) also showed strong evidence that the lateral roots are the key to high field survival. He advocated an occasional comparison of shovel-lifted stock with machine-lifted stock and if the machine-lifted stock had detectably fewer laterals than the shovel-lifted stock, corrective measures should be taken.

In the case of ponderosa pine seedlings two studies are of interest. Fowells (2) was unable to stimulate lateral root production by the use of the growth substances indoleacetic acid and vitamin B1. Stone, et al, (10) studied the root regenerative potential (RRP) of root pruned seedlings grown in four nurseries. They defined RRP as the number of new roots produced in one month on root pruned stock which was transplanted to a standard environment in a greenhouse. Through the use of this method they were able to show that stock from one of the four nurseries was inferior to that from the others. In both of these investigations the emphasis was on the importance of lateral roots to survival.

The literature is full of casual remarks that root pruning stimulated lateral root formation but very little quantitative data has been reported. Possibly through the use of the RRP concept of Stone, et al this information could now be obtained. The high correlation between lateral root abundance and high field survival, however, is unmistakable.

It was shown by Johansen (1) and Shipman (2) that increasing the density of longleaf seedlings in the nursery bed was detrimental to field survival but proper root pruning improved survival at all bed densities studied (up to 40 seedlings per square foot).

Finally, if root pruning is to be an aid in field survival of seedlings, it must be of most value on the poorest sites. This has been illustrated by Mpasiotes (6) who planted root pruned and non-pruned stock of *Pinus halepensis* on three sites of increasing severity in the hot, dry part of Greece. He expressed his results in terms of the number of non-pruned seedlings which would have to be planted to have the same density of seedlings at the end of 1-year as an initial 100 pruned seedlings. As the severity of the planting sites increased, the number of non-pruned stock required increased from 154 to 219.

Conclusions

It is of interest to note that root pruning has seldom caused mortality either in the seedbed or field. Shoulders (2) has reported a temporary droop or wilt of some seedlings immediately after pruning but one irrigation cycle corrected this. Also, although the potential for root invasion by pathogens exists, it has apparently been a very rare occurrence. Thus, it appears that the risks involved in root pruning are strictly minimal.

Turning to the proposed advantages of root pruning, it can be said, in general, that root pruning does increase field survival and the value increases in direct relation to the severity of the planting site. Some control of seedling height can be achieved through proper timing of root pruning, and an abundance of the important lateral roots can be obtained at the same time. Also, if roots are pruned at the proper time, the stock will be both easy to lift and plant since long tap roots will be at a minimum. Finally, in those nurseries raising stock which is more than 1-year old, proper root pruning will allow the nurseryman to produce seedlings rather than transplants and the stock so produced may be partially protected from frost damage.

In all of these considerations it seems that the expenses in time, equipment, and power are nominal in view of the potential benefits. With proper equipment, root pruning is simple and easy. Tractors used should be powerful enough to maintain constant speed and should be equipped to accurately maintain the depth of the blade in the soil. The blade should be rigid, thin, and sharp and absolutely horizontal at the cutting depth so that it will cut the roots cleanly and cause a minimum of disturbance of the soil.

Returning now to the original question as to whether to root prune or not, it appears that the answer will almost certainly be in the affirmative. The information at hand indicates that the advantages far outweigh the costs and risks involved. When all factors are taken into consideration, the production of pine planting stock should include, as a minimum, one root pruning at a depth of approximately 7 inches, 2 to 3 months before lifting for 1-0 stock or at the end of the second growing season for 3-0 stock. Beyond this minimum, the nurseryman should devise that pruning schedule best suited to his soil, climate, and species being produced.

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