HARDWOOD NURSERY MANAGEMENT - NURSERY OPERATIONS

Jake M. Stone 1/

INTRODUCTION

First, I will briefly review the background leading to construction of the Union Camp Corporation Nursery, second, the operating methods, and third, take a more detailed look at some of the problem areas, or areas of opportunity, depending on your perspective.

Union Camp's Franklin mill uses in excess of 50 percent hardwood fiber. Development of hardwood plantations was one of the alternatives selected to meet potential mill requirements for hardwood. In order to insure, insofar as possible, an adequate supply of hardwood seedlings of acceptable quality, the decision was made in early 1974 to construct and operate a hardwood nursery. Construction started in July of 1974. The first crop was harvested in the winter and spring of 1976. The second crop is on the way. The primary species being grown are: Sycamore (Platanus occidentalis), Sweet Gum (Liquidambar styraciflua), Green Ash (Fraxinus pennsylvanica), and a mixture of the entire leaf red oaks including Willow Oak (Quercus phellos), Laurel Oak (Quercus laurifolia) and Water Oak (Quercus nigra). First year production was approximately 400,000 seedlings. Current production is slightly over one million. Production will increase to two million by 1978. There are three full-time employees in addition to myself.

OPERATIONAL METHODS

Seed from wild trees are collected, cleaned, stored, tested and stratified.

Seeding of sweet gum, sycamore and oak is accomplished with four Planet, Jr. planters attached to a tool bar behind a farm tractor. The planters are mounted off-center so that two trips per bed provide eight rows six inches apart on each four-foot wide bed. Ash seed is broadcast with a So-Rite fertilizer spreader. Usually, four trips per bed are required. Sawdust mulch is applied immediately following planting.

Initial irrigation is at least daily. Later irrigation is on alternate days to supplement rainfall to a minimum of two inches per week.

Top dress fertilization is with 70 lbs./ac. of 33% percent Ammonium Nitrate on a bi-weekly basis beginning in mid-June and continuing into September.

Seedlings are hand lifted following undercutting and shaking. Packing includes washing, root pruning, root application of clay slurry, and bagging. The seedlings are then distributed and/or placed in cold storage.

1/ Supervisor, Nursery and Seed Orchard, Union Camp Corporation, Franklin, Virginia.

PROBLEMS AND OPPORTUNITIES

As with anything else relatively new, there are many problems with operating a hardwood nursery. There are also opportunities to reduce or eliminate these problems and to improve efficiency. First of all, we have found acorns to be extremely difficult to collect in large quantities. It is entirely possible that the capability to collect seed will prove to be the limiting factor in total oak seedling production. We have not found an efficient method of removing the caps from the acorns. Long-term storage of acorns is questionable at best. A large inventory of dead seed is a liability.

Sycamore seed are supposed to be relatively easy to collect, clean and store. Except for late winter access to trees, there are no great problems with collection. Cleaning is time consuming but by repeating the process several times, clean seed are obtainable. Storing one rather large lot of sycamore seed from one year to the next resulted in germination dropping from approximately 45 percent to 11 percent. This represents a major seed loss. These seed were planted and from them developed a fairly uniform stand in the seed beds.

Probably the best way to solve many of the collection problems is to establish a seed orchard. We are developing one but are likely ten years away from collecting seed from it. The next best solution may be the establishment of seed production areas. However, it must be remembered that hardwoods often occur in mixed stands.

Another possible source of seed is from existing plantations if they are old enough to produce seed. An eight-year-old sycamore demonstration area is producing seed.

There are opportunities for improvements in planting as well as in seed collection. The Planet, Jr. planters simply will not handle the largest of the water oak acorns. When the acorns get above 0.7 inch in diameter, they hang in the throat of the planter after leaving the seed hopper. Above that size, they have to be hand planted. The Stanhay Jumbo Planter is theoretically capable of accurately planting larger acorns. At our current level of production, the cost of the planters is prohibitive.

Broadcast sowing of ash with a So-Rite spreader is a make-shift operation at best. Hopefully, a machine can be devised that will row plant the ash and get it done in one trip, but we are a long way from that now. Ash seed are also highly subject to being wind blown. Bed density is below desirable levels this season because of high winds during and after seeding. A partial solution to this has been to roll the beds following mulching and to put a wind shield around the seeder so that the ash seeds drop straight down on the bed.

Sycamore seed were sown at near the calculated rate. However, following germination and early mortality, density is half to two-thirds of what it should be. There were many seedlings that germinated and were lost immediately,

either to damping off or to some other causes. Identification and control of these causes is essential, or a much higher seeding rate will have to be used in the planting in order to obtain satisfactory stocking. Allowances for high mortality will likely result in erratic stocking.

Sweet gum seed have been relatively easy to sow accurately. Germination and survival have been higher than anticipated. This year, however, we have experienced nearly 100 percent mortality in small patches. I do not know the direct cause, but it is associated with sand splash. Following germination of the sweet gum, high winds removed all of the mulch from the seed bed in some patches. Because the seed had already germinated, additional mulch was not applied. In the wind blown areas, sand splashed and collected on the stems of the sweet gum seedlings. Eventually, almost total mortality has occurred. Mortality is characterized by blacking of the tips of the colyledons. This is progressive and eventually the seedling appears to die from the top back down to the ground. Wakely (1954) refers to similar problems with pine seedlings in the early stages of growth and associated with sand splash. He attributes it to a form of damping off.

For the purpose of increasing efficiency, we plan to take a look at planting five rows per bed. This can be accomplished with one trip per bed, and should allow sufficient space between rows for lateral root pruning in the seed bed at harvest time. It may also allow sufficient space between rows for cultivation during the growing season, probably with a rotary hoe type cultivator.

Hand weeding is almost a continuous operation from mid-May to early fall. The weeds that are most troublesome are carpet weed, morning glory, nut grass, and various other grasses. An unreplicated test of the weed control chemical Amex has been installed. It appears to be doing a fair job controlling the weeds. Unfortunately, seedling growth has been retarded significantly. Mineral spirits are also used for weed control in sweet gum starting at a rate of 12 gallons per acre. This is partially effective, and certainly reduces the load of hand weeding. I see no immediate solution to the requirements for hand weeding.

Testing of herbicides is a slow and often frustrating process, but ultimately herbicides probably hold the most hope for elimination or reduction of hand weeding. As many herbicides as there are in production, there must be one or more that will be at least partially effective.

Harvesting and packing presents some real opportunities for cost reduction. Though none of the steps individually seems to be particularly difficult, unit production is relatively low. This is mainly attributable to the large size of the hardwood seedlings. The average hardwood seedling is probably eight to ten times the volume of the average pine seedling. The influence of size is clearly demonstrated throughout the harvesting, packing and storage processes. Certainly, mechanical lifting equipment needs to be evaluated. However, our experience has been that with approximately equal labor, the rate of hand lifting is much higher than the capability to package and store seedlings. Therefore, this is an area that deserves the greatest immediate attention.

My concept of a fairly efficient packing arrangement would be a conveyor system that will provide washing, root pruning, and clay slurry treatment with no hands touching the seedling except to put them on the conveyor, and then take them off the conveyor for packaging. It is reasonable to think that this can be done, but we have not tested it yet. Apparently, the most difficult aspect would be a feed mechanism into the root pruner. Better yet, would be development of satisfactory root pruning in the field prior to lifting, but I rather doubt that this will be accomplished in the immediate future. This is primarily because of the long lateral roots that extend parallel to the row direction in the bed.

There are some other questions that need to be answered in the packaging and storage process. One, what is the best packing medium? Two, what is the best package? Is it a bag, a bale, a box or a carton of some type? Three, how do we store them so that we utilize our cold storage space efficiently, and still not damage the seedlings?

In 1975, the South Carolina Coastal Nursery grew and packaged hardwood seedlings for us. A hydromulch slurry was used for root moisture retention. These seedlings kept as well or better than those treated with the clay slurry mix. Which is the better of the two for moisture retention? I really do not know.

Another of the problems connected with seedling storage is that after about six weeks in storage, sweet gum seedlings begin to mold. This mold occurs near the top of the seedling outside the bag. It appears that the mold is a contributor if not a direct cause of mortality following field planting of the seedlings. Lowering the humidity in cold storage may prevent some of the mold. On the other hand, maintaining high humidity in cold storage is essential to avoid drying of the seedlings. Fungicides may prevent or eliminate the mold. Ferbam, Captan and Benlate have been tried. The mold was not eliminated. Development may have been arrested to some extent.

There is one other area that may present a major operational problem for several years, that is, what do you do when you get a crop failure at your own nursery? Contrary to pine production, there are few nurseries producing hardwood seedlings in quantity. Consequently, when you have a failure at your own nursery, there are few places to turn, if any, to secure additional seedlings. This is a condition that exists and cannot be controlled on an individual basis. Anyone in the business of producing or using hardwood seedlings will have to assume a risk of periodically not having seedlings available.

What can be done about costs? Labor is the largest item of operating expense. It follows then that labor unit productivity must be increased or the labor requirement decreased to appreciably reduce costs. Increasing seed bed density or reducing the cull factor would provide the most dramatic reduction of expenses. This is not to suggest that quality should be sacrificed, but rather that density levels should be pushed to the highest limit that will maintain desired quality specifications.

SUMMARY

The fundamentals of operating a hardwood nursery are not unique. Seed are collected, cleaned, stored, tested, stratified and planted. The seedlings are nurtured, harvested, packaged, stored and/or distributed.

Some aspects are critically different from pine nursery operations:

1. Seed characteristics are more highly variable between species.

2. Soil and water management is different.

3. The seedlings are more susceptible to injury from herbicides.

4. Lower bed density and larger seedling size has an enormous influence on operating methods and costs.

Most problems and opportunities are the result of current ignorance. That is, hardwood nursery technology is 15 or more years behind pine nursery technology. Since we can benefit from the experience gained in the pine nurseries, I see no reason why this gap should be maintained indefinitely. There are opportunities in all phases of hardwood seedling production to improve efficiency.

Where are we now? We are somewhat inefficient, troubled by a lack of information and many risks are present, but within these limitations, substantial quantities of seedlings can still be produced.

LITERATURE CITED

Wakely, Philip C. 1954. Planting the Southern Pines. Agriculture Monograph No. 18, Forest Service, USDA.