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PROGRESS IN DIRECT-SEEDING THE SOUTHERN PINES

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Direct seeding is a proven, accepted method of artificial regeneration for the major southern pine species. More than 600,000 acres have been sown in the last seven years on a broad array of site and cover conditions. As a matter of perspective, this acreage is almost double the total size of existing plantations in all of New England.

Most of the seeding has been with slash, loblolly, longleaf and shortleaf pines, but Virginia and white pine also have been sown. I will review the development and application of direct-seeding techniques with these species and suggest ways for you to profit from our experiences. I hope my summary will help you evolve reliable prescriptions for your own region.

Development Of Direct Seeding

The idea of direct seeding is almost as old as forestry. Throughout the world, seeding usually has been tried before planting. It was tested by European foresters more than 100 years ago. The first known trial in the South dates back to 1902, when a provident farmer sowed an abandoned field with longleaf pine. In the many sporadic trials, however, failures far outnumbered successes. Research, too, was intermittent, and projects were dropped after a few unsuccessful experiments. Bill McQuilkin, now in your area and a speaker at this conference, did some of the best research while working on regeneration problems of the Piedmont in the early 1940's.

With this backdrop of experience, the Alexandria Research Center of the Southern Forest Experiment Station began intensive investigations with longleaf and slash pine in 1947 and with loblolly in 1951. The need for a fast method of reforestation was great—more than 30 million acres of cutover pine land lay barren and idle. Highest priority was given to longleaf, because it is difficult and costly to plant. Initial studies dealt with seedbed requirements, seasons of sowing, treatments for speeding germination, and identification of predators.

Figure 1, showing the annual rate of direct seeding in Louisiana, helps document the important stages in our research. By 1951, enough information had been obtained to justify four pilot-plant trials with longleaf—totaling 600 acres. Moderate success on these areas stimulated interest, and 11,000 acres were sown in the next three years. On all areas men with shotguns patrolled from daylight to dark to keep birds from destroying the seed. The cost was high, because one man could guard no more than 200 acres. Despite diligent patrols, failures still occurred, and it became obvious that a chemical bird repellent for coating the seed was necessary.

Screening of repellents was started in 1953. The big breakthrough came soon thereafter when three chemical products—sublimed anthraquinone, Morkit and quinazarine—showed excellent repellency with caged birds and on small field plots. After a large-scale trial succeeded in 1954, operations expanded substantially and all sowing was done with repellent-treated seed. Later, with the help of the U. S. Fish and Wildlife Service, Arasan and Arasan-75 were found effective and they have also been widely used.

Although the finding of a bird repellent made longleaf seeding practical, something more was needed for the other southern pines. Longleaf is sown in the fall when rodent numbers are small and birds are the major predators. The other species are usually sown in late winter or early spring when rodent populations are at a peak and birds are still numerous. A small quantity of endrin blended with one of the bird repellents was found to give adequate protection against rodents without endangering birdlife. In 1957, pilot-plant trials with loblolly pine on 6,000 acres gave the necessary assurance for commercial operations to begin with all species. The annual acreage sown in Lousiana soared to a high of 75,000 acres within two years.

Last year, Arasan 42-S, a liquid product, was introduced as a bird repellent, and it has completely replaced anthraquinone and other Arasan formulations. It is the best repellent found so far, giving a very durable coating that is free of chemical dust.

Predators And Repellents

Finding effective repellents for coating seeds was the key to successful direct seeding. Knowing how these repellents act against various predators is important in appraising their utility in another region.

In the South, almost all living creatures from ants to opossums eat untreated pine seed. Birds, rodents, and shrews are the major predators; each group is capable of destroying a seeding in a few weeks.

Rodents and shrews, which reach peak numbers in late winter and early spring, seldom exceed 15 animals per acre. While low compared to populations in the West, this number is capable of eating 1,000 to 1,500 untreated seeds daily. Rodents are not killed by the endrin in the repellent coating. They hull three or four seeds to get the endosperm, become sick from a sublethal dose, and reject treated seed thereafter.

Bird populations are high in the South, especially dur-

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ing the seeding season, when large migratory flocks are present. Birds destroy only seed, and they are no longer a problem once seedcoats are shed. Nearly all species, even those normally insectivorous, will take untreated pine seed in unlimited quantities during the colder months. They sometimes eat one or two repellent-coated seeds, but more often they will pick up a seed and then drop it undamaged. A bird rarely takes enough treated seed to be harmed.

Insects are the next most destructive group of predators. Many species of ants, crickets, millipedes, cutworms, beetles and caterpillars destroy seed and seedlings. Insects do their greatest damage by feeding on the endosperm when the seedcoat cracks open, on emerging radicles and on cotyledon-stage seedlings. The repellent coating on the seed affords no protection. Usually damage is less than 5%, a loss that can be ignored, but in localized areas special controls may be essential. For example, town ant colonies in Texas and Louisiana must be fumigated before areas can be sown or planted.

Treated seed is avoided by rabbits, raccoons, and opossums. Squirrels, however, eat large quantities of it with no apparent ill effect and can cause serious damage if numerous. They especially like the large seeds of longleaf, and several operations with this species have been wiped out in north-central Alabama where populations are unusually large. Research is under way to find a chemical to repel squirrels.

The biggest unsolved problem is the clipping of newly germinated seedlings near the groundline. Usually, less than 25% of the stand is destroyed in this manner, but occasionally losses are heavy enough to cause failure. Rabbits, shrews, and crickets are the chief suspects. We are now searching for a systemic repellent that will protect young seedlings as well as seed.

There is good reason to believe the repellents developed for the southern pines will be effective in your region. However, it is essential to know all of the predators, the magnitude of their damage, and the effect of repellents on their depredations. We may never learn to control some of the lesser predators, or we may not be able to afford to control them—the best course may be to maintain sowing rates high enough so that we can tolerate the uncontrollable losses.

Broad Recommendations

Many of the seeding recommendations for the southern pines closely parallel requirements for successful natural regeneration.

All of the major species cast their seed in the fall. Longleaf germinates almost immediately, and the young seedlings are capable of withstanding very cold weather. Although sowing can be done in fall or spring, fall is preferred because the trees develop larger root systems before they encounter the usual early summer drouth. Loblolly, shortleaf, white, and Virginia pine germinate in the spring—the young seedlings are easily killed by freezing temperatures. In direct seeding, seeds are stratified for 30 to 60 days to assure quick germination and then sown a week or two before germination naturally occurs. Slash pine is intermediate—it germinates in both fall and spring, and seedlings are moderately resistant to cold. Most sowing is done in February with stratified seed, but fall sowing is quite successful in the most southerly part of the range.

The important point is that sowing should be done immediately before the time germination is desired. Fall sowing for spring germination is risky. Long exposure of the seed weakens the repellents and permits predators to deplete the supply during the winter. In New England, spring sowing seems most logical for all coniferous species.

General rates recommended for broadcast sowing are about 10,000 viable seeds per acre for longleaf, 12,000 for slash, and 16,000 for loblolly, shortleaf, white and Virginia pines. Rates are about 50% less for row and spot sowing. Initial catches, or the proportions of seed germinating under field conditions, range from 25 to 50%, differing by site and climatic conditions. Catches are highest on wet soils in the Southeast and lowest on deep, dry sands and in the West Gulf area. First-year survival follows the same general pattern, ranging from about 50 to 90%. Obviously, experience in an area makes it possible to save money and enhance the chance of success by adjusting seeding rates to individual situations.

The type of seedbed to prepare for each species depends on the drouthiness of the soil, amount of grass on open sites, depth of leaf accumulation where there is a hardwood overstory, and depth of the water table. Ordinarily, grassy sites are the most difficult, because the sod competes vigorously with seedlings in their first year.

Longleaf is sown largely on these adverse grassy sites. Mechanical seedbed preparation is unnecessary, however, for the seedlings quickly develop the long tap root that makes longleaf the most drouth-hardy of the southern pines. The only preparation required is a burn, made 6 to 12 months in advance of sowing, to reduce the accumulation of dead grass so that seeds can reach mineral soil.

With other species, disking of grassy sites is necessary —it assures adequate survival if the weather is dry in the first year, and it increases growth. Mortality is often as much as 80% on unprepared sites; disking will cut this loss in half. And even in good weather, disking will add the equivalent of one year's growth or more to the height of seedlings. Costs can be minimized, on all but excessively wet sites, by disking in strips with light equipment.

High water tables, coming within a foot or two of the surface, are common in the flatwoods region of the Southeast. Such sites have heavy stands of wiregrass, often in

association with gallberry or palmetto. Elevated, disked seedbeds are needed to reduce competition and enlarge the water-free root zone.

With all species, mechanical seedbed preparation is unnecessary if grasses are shaded out by a hardwood overstory. On these sites, the leaf litter usually should be burned in order to expose mineral soil. If burning is not practical, seed spotting—placing five to seven seeds on raked spots—is effective.

On deep, dry sands, the surface dries so rapidly that germination is very low. Here broadcast sowing is impossible. Instead, the bed must be well prepared and the seeds covered with about ½ inch of soil. Furrow seeders, which prepare the seedbed and sow in a single operation, have been designed for this purpose. Seed spotting is also done.

Except on sandy soils with good internal drainage, plowed furrows have not proved satisfactory. Their main drawbacks are that seed is washed away on sloping ground or killed by flooding on flat, poorly drained sites. Furthermore, furrows often start erosion unless they are carefully prepared on the contours.

General recommendations are to kill overtopping hardwoods in the first summer after a stand of pines is established. But when hardwood stems number in the thousands per acre, it is usually cheaper to control en masse before pines are started rather than to attempt individual-stem treatments afterwards. Disking, chopping, bulldozing, chaining, and cutting with KG blades are successful. Ordinarily, the method and timing of hardwood control is the same for direct seeding as for other modes of regeneration.

Under southern conditions, seedbed preparation normally is inexpensive. Slower juvenile growth of your conifers may dictate somewhat more intensive treatments than we use, but general requirements should be fairly comparable. In evaluating seedbed needs in your region, you should consider growth as well as survival. Often an extra investment of a few dollars per acre will both speed and increase returns substantially.

Seed can be sown by hand, by hand-operated "Cyclone" seeders, by airplane, by helicopter, and by tractor-drawn machines. I will not attempt to describe all of these methods, for they are adequately summarized in the literature. The main point is that there is a variety of proven machines already available for you to consider in all kinds of situations. There seems to be a trend towards row seeding, especially in the Southeast, where wide spacing is desired for naval stores production. Row seeding will probably gain impetus as seed becomes available from production areas and orchards.

Operational Seeding

Initially, direct seeding on an operational scale was concentrated in Louisiana, where most of the research was done. Success stimulated work in other States, and in the last four years most of the major southern landowners have seeded on a large scale. In 1958, 80% of the seeding in the South was centered in Louisiana; four years later only 25% was done in Louisiana (fig. 2). Since 1958, the annual rate for the South has increased by about 250%.

A few landowners have completely replaced planting with direct seeding. Others are seeding only where site, cover, or topography makes planting virtually impossible. Most, however, are using both methods to achieve flexibility and economy of operations.

Seeding has not been confined to the easiest and most favorable sites. Operations have been carried out in many difficult situations, including mountain areas with steep, rocky terrain; wet ponds and overflow areas; cutover sites with a mass of worthless brush; and gullied land. Furthermore, landowners have been alert to adapt this new method to situations where other methods of restocking were impractical or impossible. For example, seeding has been successful on areas that were clearcut after disastrous wildfires and severe storms, and where logging debris prevented planting.

There is a growing trend to substitute direct seeding for natural seeding on harvest-cut areas, especially in poor seed years. When a landowner waits five years for a good seed crop, he loses valuable growth, hardwood brush invades the site, and seedbeds scarified by logging deteriorate. Moreover, clearcutting permits hotter, more effective fires for seedbed preparation and cull hardwood control than are possible where seed trees must be protected.

While most direct seeding has been done by industrial landowners, owners of small tracts are becoming interested. They can buy seed fully treated, and thus avoid most of the technical pitfalls. Spotting and broadcasting with hand-operated seeders are the most popular methods, and both are faster and easier than planting. The State of Virginia has approved ACP payments for direct seeding of loblolly, shortleaf, Virginia, and white pine; Mississippi has done the same for longleaf pine in four counties. Extension of incentive payments will undoubtedly stimulate application by more small landowners.

Here are the main advantages of direct seeding, as determined in commercial operations:

Many difficult sites have been restocked that were impossible to plant economically.

Seeding longleaf is practical whereas planting is costly and success is erratic.

Costs are about half those for planting on comparable sites.

Capital outlay for machines is negligible, except for row seeding.

Large acreages can be sown quickly, freeing supervisory personnel for other duties.

Labor requirements are very small.

The major disadvantage, at least as voiced by some landowners, is that seeding gives less precise control of stocking than planting. While this is true, it is important to recognize that seeding permits better regulation of stand density than natural seeding.

How successful has seeding been in the South since repellents were developed? I would estimate that at least 90% success has been achieved where recommendations were followed. More can hardly be said of planting, and I firmly believe that risks are about equal for both methods. Probably the biggest single cause of failure in properly executed operations has been dry weather during the germination period. Drouth in the critical first summer ranks second. Failures from drouth can be minimized by preparing prescribed seedbeds and by sowing at recommended rates.

Most failures have occurred because landowners have departed from recommendations. Inadequate seedbed preparation, reduced sowing rates, and sowing beyond the optimum period have been the chief causes of trouble. Often the deviations from prescriptions are deliberate, and in full knowledge of the risk. For example, one large landowner customarily sows 1/3 pound of slash seed per acre on freshly burned grassy sites, whereas recommendations are to disk and sow one pound of seed. His cost is about $1.75 per acre, which is so low that he can make three or four attempts and still spend less than it would cost him to plant once. Such departures from standards that were established for consistent success are unobjectionable if the landowner realizes they increase his odds for failure. So many variations in seeding methods have developed that I'm sure you can understand why I restricted my estimate of seeding successes to operations conforming to research recommendations.

Research Still Needed

Although direct seeding of the southern pines is fully operational, considerable more research is needed to refine techniques and to further reduce costs. Remaining problems fall into four general categories.

First, and most important, a systemic repellent must be found to prevent post-germination clipping of seedlings. Losses from this cause average about 25%. If they can be checked, substantial reductions in sowing rates can be effected. Second, present broad recommendations must be perfected and adapted to individual site and cover conditions. Our goal is to bring into practice prescription sowing that will result in better control of stocking and lower costs through reduced sowing rates. Next, insect predators must be studied in greater detail, especially on sandy sites where direct seeding is least reliable. Finally, a number of row-seeding machines must be more fully evaluated before they can be modified for use on a broad array of soil and cover conditions. Perfecting these machines will permit greater economies in seed and seedbed preparation, in addition to improved regulation of stocking.

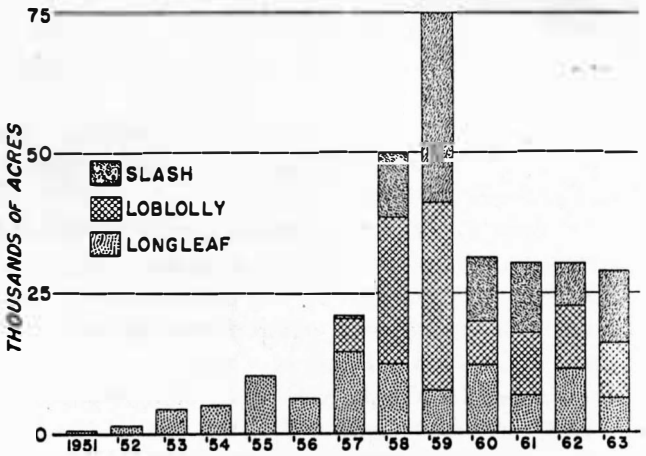

Figure 1.—Area direct-seeded in Louisiana, by species.

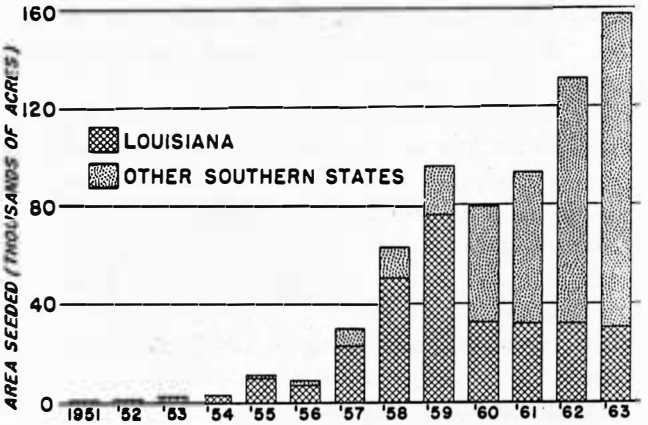

Figure 2.—Growth of direct seeding in the South.

Recommendations

I'm certain that practical direct-seeding techniques can be devised for all species that reseed naturally. So in conclusion I'd like to draw on my 16 years' experience to offer suggestions as to how you might make direct seeding a reality in the Northeast:

For initial trials, confine work to your most tolerant species and to your best sites. Work on more difficult sites only after you have gained experience. Never sow sites on which planting has repeatedly failed.

Sow only seed of known high quality.

Use repellents developed in the South. Increase the endrin dosage in the coating if mammals are not repelled by the standard mixture.

Sow as close as possible to the time natural seed germinates. Sow a little early rather than a little late.

Stratify seed to obtain rapid germination.

One of the best safeguards against failure from

drouth is high initial stocking. Sow enough seed to obtain a stand even if a dry period is encountered.

Prepare a seedbed on which seed can reach mineral soil.

Make frequent checks during the germination period and the first year or two so that you can determine why failures occur.

Do not judge success or failure without careful, systematic inventories. Young seedlings are so difficult to see that a true evaluation cannot be made just by walking over an area.

Don't judge the merits of direct seeding by the outcome in a single year. Unusually favorable or adverse conditions can bias a hasty evaluation.

Be careful in evaluating hearsay evidence about the reliability of direct seeding. If failures are reported, determine if sowing was done properly. Potential savings from seeding are so great that no one can afford not to investigate this method thoroughly.

Recommended Reading

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