

HOW TO DIRECT-SEED THE SOUTHERN PINES

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Direct seeding has gained wide acceptance in the South since the development, about 5 years ago, of repellents to protect seed from birds, rodents, and insects. An estimated 400,000 acres have been sown by a great number of individuals and companies. Low costs, small capital outlay for equipment, speed and ease of seeding, coupled with a high degree of reliability, account for the recent upsurge in the popularity of this new regeneration technique.

In its simplest form, direct-seeding consists of sowing seed right on the site where the trees are to grow. With the southern pines, the seed must be coated with repellents and distributed on suitable seedbeds in adequate amounts at the optimum season. Detailed recommendations for longleaf, loblolly, and slash pines have been published. Although our knowledge and experience is greatest with these 3 species, enough is now known about shortleaf, Virginia and white pines to formulate interim recommendations for pilot-plant trials.

Techniques for the different species are much alike, differing sometimes only in rate of sowing or length of stratification. Therefore, this article is organized around the major steps in planning and executing an operation. If not excepted, the prescriptions can be regarded as applying to all species.

Site Suitability

For consistent success, a landowner must learn which sites are best adapted to seeding and which can be regenerated more readily by other methods. Seeding with all of the southern pines has been successful under a wide variety of cover conditions—none have yet been found to limit applicability of the method. Nevertheless, there are three situations that should be avoided. First are steep eroded sites where seeds are easily washed away. Second are sites subject to spring flooding; submergence of the seed reduces its viability and the effectiveness of repellents. Third are all areas with a past history of repeated planting failures.

Some upland sandy soils dry out and crust over so rapidly that top-sown seeds often cannot germinate. On these sites seed must be covered about $\frac{1}{2}$ inch.

Site Preparation

The need for seedbed preparation varies by cover, species, and soil. If the deep sands of west Florida are excluded, sites can be grouped into 2 broad categories: open land with a heavy grass sod, and areas dominated by low-grade hardwoods that shade out much of the grass.

On grassy sites, burning 6 to 12 months in advance of sowing is adequate for longleaf, because seedlings develop extensive root systems quickly and compete well with the native sod. For the other species, disking or some other form of mechanical seedbed preparation is needed to assure high survival in the event the first summer is dry. With some species, disking—and to a lesser extent furrowing—may be justified by improved growth, even if not needed for protection against drought.

To reduce costs, disking is ordinarily done in strips about 7 feet wide and 8 feet apart. One pass with an offset disk is generally sufficient. Summer disking is preferred because the best kill of grass is obtained when the sod is turned during hot, dry weather. Moreover, the soil has 4 to 6 months to settle, so that seed losses from silting are minimized. On heavy sod, burning before disking facilitates pulverization of the soil.

Seeding in furrows made with a fireplow has not proved satisfactory, especially on heavy soils. The furrows permit seed to be washed away on sloping ground or killed by flooding on poorly drained sites, and they often invite erosion. They are best suited for well-drained soils where the topography is almost flat. Furrow-seeding, an entirely different technique, will be discussed later.

Tracts dominated by hardwoods are the most costly to plant but ordinarily the easiest and cheapest to direct-seed. The only site preparation needed is to burn off the leaf litter if it is deep enough to prevent seeds from reaching mineral soil. For maximum survival and growth of pines, the overstory must be deadened during the first summer—as for planted trees.

In the mountains, burning is often harmful to watersheds or hazardous in other ways. Spot-seeding on small areas raked free of leaves appears well suited for these situations. Spots should be large enough to minimize leaves blowing back over young seedlings. In some areas hardwood leaves accumulate to depths of several inches but seldom become dry enough for a complete burn. Here disking may be effective if the soils are free of rocks and slopes are not too steep.

Sandy soils pose special problems. In west Florida, for example, practically all the wiregrass and scrub oaks must be eliminated before pines are seeded or planted. This is done by burning the ground litter in early May, chopping the area 6 to 8 weeks later with a heavy tandem chopper, and rechopping in late summer.

Seed Procurement

Procurement of seed should be arranged well in advance. Seed should be from a local source if possible. There is no objection to seed that has been stored even for 5 years or more, provided that germination tests show it to have retained high viability. Lots whose germinability has declined 15 to 20 percent should not be used, because vigor of the living seeds is likely to be impaired.

A landowner can obtain seed either by purchasing it from dealers or by collecting his own cones and having them processed in a regular kiln. A big advantage of collecting his own cones is that he can obtain seed from local trees of good form. An extractory will charge from 50 cents to a dollar per bushel of cones for extracting the seed. Or, if his reforestation job is a large one, the landowner may wish to construct a small cone kiln of his own. One of the references at the end of this article contains plans for such a kiln. Makeshift facilities for extraction are usually inadvisable, because seed is easily damaged.

When purchasing seed, minimum standards for viability, soundness, purity, and moisture content should be specified. Carefully handled seed of all southern pines, whether fresh or stored, should have at least 70 percent germinability on a sound-seed basis. Lots should contain no more than 10 percent empties by number and 2 percent impurities by weight. A moisture content of 10 percent or less should be specified to assure a fair number of seeds per pound and to avoid the need for drying the seed if it is to be stored.

When it is desired to have the dealer stratify the seed and treat it with repellents, the charge for these treatments should be negotiated separately. It is uneconomical to pay the same price per pound for stratified and repellent-coated seed as for untreated, because the treatments add substantially to the original weight.

Seed Treatment

Quick, prompt germination improves the odds for success by reducing the period of exposure to predators and adverse weather. Seeds of all southern pines except longleaf are somewhat dormant and require cold, moist stratification to speed germination. Stratification is in alternating layers of wet peat moss or other suitable material at about 36°F. Longleaf seed germinates very fast with no pretreatment.

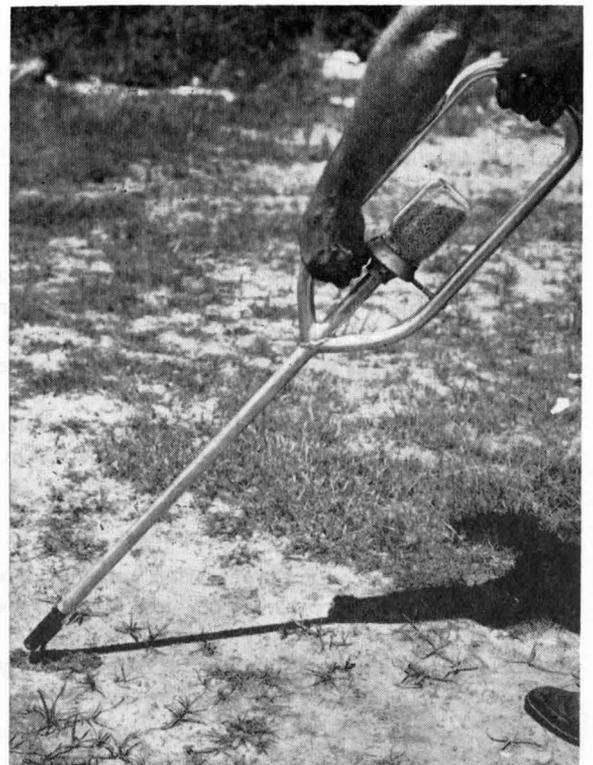
The stratification period varies by species and individual lots. The only sure way to determine it is to test the germination of samples stratified for different lengths of time. When such tests are impractical, blanket recommendations are to stratify loblolly for 60 days, slash for 30, shortleaf for 45 to 60, sand for 15 to 30, Virginia for 30, and white pine for 30 days.

There is an easy way for tree farmers to stratify small lots in a home refrigerator. Seeds are soaked in water for several hours and then placed in a polyethylene bag which is tied shut and refrigerated at about 38°F. for the length of time recommended above for each species. Enough water should be added periodically to rewet surfaces of seeds when they dry out.

Repellent coatings are added after stratification. The same repellents and stickers have performed well with all southern pine species. Arasan-75 and anthraquinone are used almost exclusively for protection against birds—at concentrations of 10 pounds of Arasan-75 and 15 pounds of anthraquinone per hundred pounds of seed. Arasan-75 gives a more durable coating, but is highly irritating to the eyes, throat, and mucous membranes. Hence anthraquinone is preferred for hand-sowing operations.

Stauffer's Endrin 50W, applied at the rate of 2 pounds per 100 pounds of seed, is standard for protection against insects and rodents. It should be thoroughly blended with

At right, one of several hand tools developed for spot seeding, a useful technique for areas under 200 acres. Below, disk seeders, developed to prepare and sow two rows simultaneously with the same tractor power required for single row seeders



the bird repellent before application to insure that all seeds are coated uniformly.

A light aluminum overcoating hastens drying of the repellent coating and lubricates seeds so they flow freely through hoppers. About 1 cupful per hundred pounds of seed is ample.

Either Dow Latex 512-R or Flintkote's asphalt emulsion C-13-HPC is a suitable sticker. Latex is diluted with clean, soft water in the ratio of 1:9 and asphalt 1:3. Latex is easier and cleaner to mix and apply, but requires careful handling and storage.

With equipment made from 2 steel drums (see photo) two men can treat 1,000 pounds of seed daily. The drum on the right has the top removed; it is used to apply the sticker. The fine-meshed, heavy wire basket is about 20 inches deep. It holds the seed when it is dipped into the sticker. The other drum is used to apply the chemical. It has a close-fitting but removable cover and is mounted on an axle so that it tumbles end-over-end when the crank is turned. A single set of baffles is welded inside the drum to help mix the seed and repellents.

The sticker is mixed with water in the dipping drum. It should be stirred at regular intervals during the treating operation. Unused sticker should be discarded and a fresh batch prepared at the start of each day's work.

The treating procedure is as follows: Put 35 to 50 pounds of dewinged seed (amount varies by species) into the basket, and lower it into the sticker. Stir the seed with a paddle. In about 2 minutes, lift the basket and allow the surplus sticker to drain off for about 30 seconds. Draining for more than 30 seconds is hazardous because the sticker quickly sets, resulting in a poor bond of repellents to the seed. Next, pour seed into the mixing drum, add a weighed amount of repellent, and stir it into the seed with a paddle. Then close the cover tightly and rotate the drum for about 2 minutes. To coat with aluminum, add powder to the drum and tumble for another minute. Finally, remove the coated seed and spread it out to dry in a layer 2 or 3 inches thick on paper or canvas.

Small lots can be repellent-coated with the aid of a lard can, a small basket made of window screen, and heavy-weight paper bags. One-pound batches are best. Seed is placed in the basket and dipped into the sticker in the lard can. It is stirred for about 2 minutes, lifted out, allowed to drain for 30 seconds, and poured into a paper bag. A weighed quantity of blended repellents is then put into the bag, which is closed tightly and shaken vigorously for about 60 seconds. If it is desired to overcoat with aluminum, one or two teaspoons of the powder can be added and the bag shaken again for about 30 seconds. Finally, the seed is spread out to dry.

The seed can be sown as soon as it is dry enough to handle—the less delay the better. If inclement weather delays sowing, the seed can be held safely for 2 weeks in a well-ventilated, unheated building or a refrigerated room.

Season of Sowing

Longleaf should usually be sown in fall as soon as there is ample soil moisture and maximum daily temperatures drop below 80°F. Usually the best time is early November to mid-December. If there is danger of frost heaving, as evinced by damage to natural seedlings, sowing should

be delayed until March.

As a general rule, the optimum time for sowing all other species is in spring about 2 weeks prior to the start of germination of natural seed, or about the average date of the last killing frost. Therefore the season will range from mid-February in the Lower Coastal Plain to April in the upper South. When sowing cannot be completed at the optimum time, it is preferable to be too early rather than too late. The danger in late sowing is that an early spring drought may reduce germination or kill seedlings before their roots are well developed.

In the southerly range of slash pine, winters are extremely moderate and natural seed germinates throughout late fall and winter. Here sowing can be done anytime from November to February 1, whenever soil moisture is ample for rapid germination.

Rate of Seeding

The rate of sowing depends largely on the method of distributing seed. For broadcasting, the rate for all species should be 10,000 to 15,000 viable seeds per acre. About half this quantity is needed for furrow seeding, and disk seeding requires about 7,000 to 12,000 seeds per acre. The following table gives suggested rates for the different species in pounds per acre; it assumes that germination is at least 75 percent.

Species	Broadcast sowing	Row seeding	Row seeding
		in furrows	on disked strips
Pounds per acre			
Longleaf	3.00	1.50	2.00
Slash	1.00	.50	.75
Loblolly	1.00	.50	.75
Shortleaf	.40	.20	.30
Sand	.25	.13	.20
Virginia	.30	.15	.20
White	.60	.30	.40

Methods of Sowing

Sowing can be done by hand or with seeding guns, hand-operated "cyclone" seeders, airplanes, helicopters, or tractor-drawn machines.

Distribution by hand is efficient on small areas of disked strips or plowed furrows. One man can cover 15 to 20 acres per day, and seed is conserved because it is cast only on the prepared portions.

The "cyclone" hand-operated seeder is useful for broadcast sowing on tracts up to 200 acres in size. One man can sow about 20 acres a day. Its greatest utility is on areas that are irregular in shape or where it is desired to bypass scattered patches of established pines.

Spotting is also useful for areas under 200 acres. A spot about 1 foot square is raked or kicked free of leaves or grass, and 5 or 6 seeds are dropped onto it and very lightly pressed into mineral soil. With 1,000 spots per acre, one man can sow 2 to 4 acres daily. Special tools have been developed for this purpose, but a fire rake and apron for carrying seed are probably adequate for most operations.

Fixed-wing airplanes and small helicopters have been used extensively in the past 5 years. Both give excellent distribution and precise sowing rates. They are best adapted for large operations. A light plane can cover up to 1,500 acres per day and a helicopter 3,000 acres.

Tractor-drawn machines have also come into wide use in recent years. There are now at least 10 models, and more may be expected. All have one feature in common: they prepare a seedbed and sow in rows at a single pass. They can be broadly grouped as furrow seeders and disk seeders.

Furrow seeders have either middle-buster plow pulled behind a tractor or a V-plow mounted at the front of a tractor. Most of the pulled models have an arrangement to bury the seed or press it into firm contact with the soil. They are best suited for sandy soils where seeds broadcast on the surface fail to germinate adequately. Front-end models also work best on sandy soils, and they can operate in moderately heavy brush. With either type, about 20 acres can be covered daily.

Disk seeders were developed to sow 2 rows simultaneously with the same tractor power required for single-row furrow seeders. They can sow about 30 acres per day. They have 2 separate offset disk units, each about 1½ feet wide and 4 to 5 feet apart. Seeds are dropped directly on the disked soil and pressed down by a packing wheel. Sowing rates must be higher than with furrow seeders, because considerable seed is lost from silting.

Though tractor-drawn implements have some advantages over those for broadcast sowing, most have sharp limitations. Therefore, all types should be carefully investigated to determine if a particular machine is adapted to soil and cover conditions on the area to be regenerated.

Appraisals and Release

In initial trials, it is quite important to inspect seeded areas systematically during the germination period. It is the only way to identify unusual predators, and to pinpoint the cause of failure when stocking is low. After several successful trials, these observations can usually be discontinued.

Observation stations are the best means of checking on the progress of a seeding. A station may consist of 50 extra seeds sown within 18 inches of an identification stake, plus 2 seed spots screened to keep out predators. The number of stations depends on the size of the area, but 5 to 50 usually are enough. They should be checked weekly until most seeds have germinated. Progress of germination, number of seeds and seed hulls found, and type of damage

should be noted at each inspection.

Appraisal of overall success requires careful, systematic inventories in June or July of the first year and at the end of the first growing season. The summer inventory is essential on areas with a cover of hardwoods. These hardwoods must be deadened early in the first year, provided the inventory reveals that there are enough seedlings to justify the work.

First-year release is superior to delayed release because it results in greater pine growth and higher survival in a dry year. Any conventional method of deadening hardwoods can be used, except for foliar sprays that kill succulent yearling seedlings.

Recommended Reading

This article gives only the rudiments of direct-seeding. It is strongly recommended that landowners contemplating an operation study the subject more fully before starting work. Here are some publications that cover the subject in greater detail. All except the 4th are available on request to the Southern Forest Experiment Station, New Federal Office Building, Loyola Ave. at Girard St., New Orleans 12, La.

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