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REFORESTATION RELEASE NO. 4 SEPTEMBER 1958

REFORESTATION TECHNIQUES

By Roy Cole and S. P. Darby

GEORGIA FORESTRY COMMISSION
P. O. BOX 1183
Macon, Georgia

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1. INTRODUCTION

Georgia's forests, aggregating 23,973,300 acres, constitute her most valuable and extensive crop. These forests are growing basic material for new products and in many instances, products of increasing value. Increased value of forest products makes it essential that landowners become better acquainted with good forestry practices. Under stocked timber stands and non-productive sites must be managed so as to obtain maximum production.

The planting of forest trees is not new in Georgia, having its beginning early during the twentieth century. Reforestation by artificial means has mushroomed into a very large business in the last few years, reaching an all-time high during the current decade. Only through the practice of proper forestry techniques can landowners meet today's demand for wood. Our supply of trees is dependent upon the establishment of new forests. The Georgia Forestry Commission has available a staff of well-trained foresters who can give assistance regarding forest management problems. In addition, the State Extension Service, as well as consultant foresters and private industry will render aid. The primary object of this publication is to assist interested landowners in establishing tree crops on areas in need of reforestation.

It is the landowners' responsibility to seek advice from a technically trained forester as to what species of trees to establish, the spacing, and other related information.

2. METHODS OF ESTABLISHING NEW FORESTS

Landowners are concerned primarily with three methods of establishing new forests, (1) natural reproduction, (2) planting of tree seedlings, and (3) direct seeding. When using the natural reproduction method, timber stands are so managed that new crops commence when mature trees are harvested. One such system known as the seed tree method yields satisfactory results in many instances and is a relatively inexpensive method, however, it is dependent on good seed years. In addition, all sites are not adapted to this method of establishing forest crops. On many sites artificial stocking is required. In such cases, landowners resort to planting tree seedlings or direct seeding. Direct seeding, as the name implies, is the planting of seed on the site to be reforested. It has given inconsistent results but is being reviewed by many landowners with renewed interest. This method shows promise, but is still in the experimental stage and should not be attempted without expert supervision.

A landowner must decide whether natural reproduction or other means will be used when establishing new tree crops. In determining which method is to be used, the landowner should take into consideration cost involved with each type operation and weigh it against the product he intends to produce to determine if the investment being made is sound. The question of how to manage timber land to obtain specific results is complex. Like-

wise, the method to be employed in establishing a new tree crop is not simple. As previously stated, a landowner should obtain the services of a technically trained forester to assist in making this decision. The site should be visited by both the landowner and forester to see existing conditions. Only then can an intelligent answer be obtained as to how a new tree crop should be established.

3. RECOMMENDED SPECIES TO PLANT

Successful plantation establishment is largely dependent upon selection of the correct species of tree to plant. When selecting the species best suited for an area the following factors should be considered; site, climate, and desired product. Each landowner must determine the type product or crop to be grown. This will depend on financial return expected, crop rotation, local markets, and many other factors. To assist in making this selection as to climate and site, information presented in Figure 1 will be of assistance. Advice should be obtained from local authoritative sources as to specific species for a given site. As previously stated, the area to be reforested should be visited and local site conditions thoroughly investigated prior to the species selection. Major trees used in Georgia for planting include slash pine, loblolly pine, longleaf pine, eastern white pine, yellow poplar, eastern red cedar, and Arizona cypress.

Longleaf (Pinus palustris Mill) is generally confined to the lower areas of the state and the sandy, well drained type soils. Best development is attained on sandy soils that have a heavier subsoil. Usually it is excluded from the better sites by more aggressive and faster growing species. Longleaf is used primarily for construction lumber, poles, piling, interior finish, naval stores, and pulpwood. It is more resistant to fire, insects, and fusiform rust than other southern pines. This species is most susceptible to damage from hogs and brown spot needle blight. On better soils of the coastal plain, slash and loblolly pine are generally preferred to longleaf. When planted north of its natural range, longleaf suffers heavy damage from ice or snow storms.

Slash pine (Pinus elliottii Engelmann) grows well on heavier type moist soils. It does best on low moist ground, hammocks, in swamps, and in places where the water table is within a few feet of the ground surface. It has been observed that it is least productive on the deep, well drained, pure sands, where scrub oak is mixed with pine. This species is very susceptible to fusiform rust. Slash pine is used extensively for piling, poles, cross-ties, general construction, pulpwood, and naval stores. Its northern range in the state is limited, as is longleaf, by its susceptability to ice damage. As a gum producer, it yields more gum than longleaf and of a better grade because there is less scrap. In most respects it is superior to longleaf on flatwoods soils.

Loblolly pine (Pinus taeda L.) is not restricted to strictly dry sites nor strictly damp sites but will grow from the foothills of North Georgia to the lower extreme of the state. It grows in a variety of sites except the

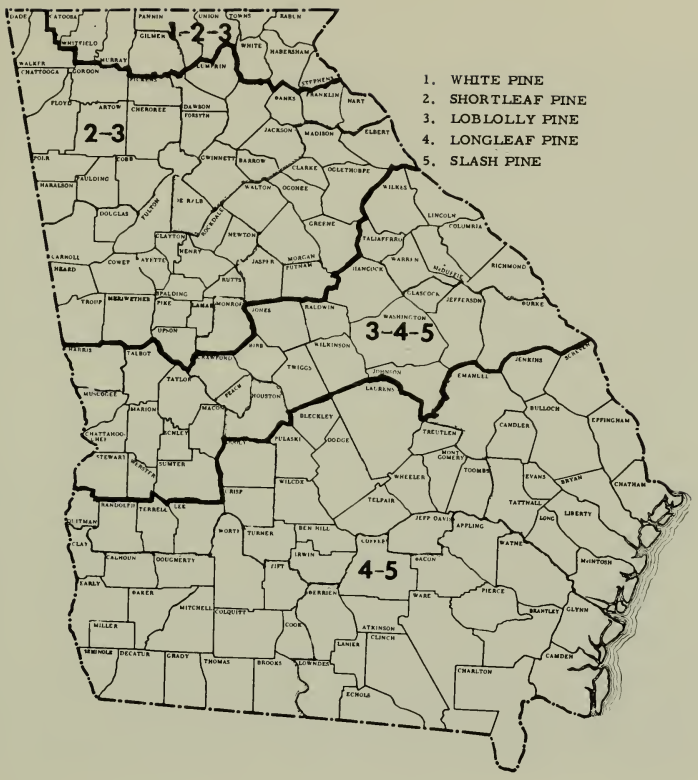


Fig. 1. Recommended species to plant in Georgia.

highest, wettest, and driest. It is a large size tree and on good sites grows fast. Loblolly is used in general construction work, for railroad ties, poles, piling, and pulpwood. Loblolly has no commercial value for naval stores. In some localities, loblolly is extremely susceptible to southern fusiform rust.

Eastern white pine (Pinus strobus L.) is found on many different sites including dry rocky ridges. Best growth however is made on moist sandy loam soils or those with a mixture of clay. It is used for general construction, interior finish, cabinets, and as an ornamental shade tree. In Georgia, white pine is grown commercially only in the mountain section.

Yellow poplar (Liriodendron tulipifera L.) prefers deep, rich, moist soil, along streams, bottom lands, and moist slopes. This species is used for construction, furniture, veneering, shingles, and woodenware.

Eastern red cedar (Juniperus virginiana L.) and Arizona cypress (Cupressus arizonica Greene) are used primarily for Christmas trees. Red cedar is adapted to a variety of soils such as abandoned fields and limestone soils.

When using eastern red cedar and Arizona cypress for Christmas trees, the best planting site would be a gently rolling, well drained area with a moderate amount of ground cover, a good workable soil and no brush. Sharply rolling to hilly land is also suited but more difficult to manage. Soil fertility is not a limiting factor. Normally, trees can be marketed in three to six years.

In conclusion, it should be pointed out that species selection is determined largely by the product desired, site, and climate. A safe rule to follow is to plant the species that originally occupied the site or to plant the species showing the best performance on nearby similar sites.

4. SITE PREPARATION

Once the planting site and species has been chosen the next point to consider is what to do about preparing the soil. The kind and amount of ground preparation will vary with the individual site. The main purpose in site preparation is to assure good survival. Two important factors that greatly influence seedling survival and hence plantation establishment are: (a) type soil and (b) amount and kind of natural vegetation present. Natural vegetation can be harmful to newly planted trees in two ways. First, a heavy mat of low herbaceous plants such as grass and weeds, can rob the young trees of soil moisture and nutrients. This is especially true if dry periods occur during the first year. Secondly, the taller woody plants deprive them of light. If this over topping vegetation is tall enough and dense enough, it can shade the young trees out entirely. The following three kinds of planting sites are likely to be encountered:

(a) *Old fields*

Some planting sites need no preparation. These include old fields covered sparsely with grass or herbaceous plants, and recently cultivated fields with stubble from the last crop remaining. A field completely bare of any vegetation makes for easy planting, but such land is subjected to erosion during the spring, summer, and fall and to frost heaving during the early spring. Therefore, it is better to have a light low cover of some kind, whether it be new grass or old stubble. When this condition exists no site preparation is needed. It is unwise to plant on freshly harrowed land. Cultivated land should be allowed to settle thoroughly before planting.

(b) *Heavy sod*

Sites covered with a heavy sod need some preparation before being planted. If planting is to be done by hand there are two alternatives, (a) scalping or (b) furrowing. If the site to be planted is a large area, furrowing with a plow at intervals equal to the intended spacing is a wise practice to follow (Fig. 2). Trees should be planted in the furrow. On hilly land the furrow should be plowed parallel to the contour, the slices being thrown down hill. This prevents excessive erosion and forms little irrigation channels that help water the trees. Plow depth

should be shallow, just deep enough to remove the vegetation and the main mass of roots. Deep furrowing has proved very beneficial to survival on dry, sandy sites where longleaf is planted. Deep planting may also be beneficial for slash on dry, sandy sites. Furrowing should be

Fig. 2. Site preparation on heavy sodded area, showing furrows and newly planted seedlings.

done several months before planting so that a firm soil will exist at planting time. Furrowing not only destroys natural vegetation and assists in the control of runoff, but it also breaks up compacted soils, thus improving drainage. If the site to be planted is subject to dry periods, it would be better to plow the furrows a little deeper in order to conserve moisture.

(c) *Brushy land*

If the site is covered with brush or small trees, it should be cleared before planting. It is almost useless to try to remove woody plants by cutting because nearly all of them sprout a great deal, thus creating an endless maintenance job of cutting sprout growth.

One of the simplest ways to control undesirable trees and shrubs is to kill them by the use of chemicals. The common chemicals used to kill woody plants are called "brush killers" and may be applied before or immediately after planting. They may be applied to the foliage as a

spray or to the base of the tree in crystalline form or as a solution (Fig. 3 and 4). Usually foliage spraying on large areas is done by aerial means. Several commercial agencies and the Georgia Forestry Commission are equipped to do this work. The Commission, however, limits spraying to relatively small tracts. A trained forester should be consulted before using poisons since erratic results are frequently experienced.

Fig. 3. Elimination of undesirable hardwood tree by spraying. The lower 18 inches of weed trees are sprayed with oil mixes of growth regulating brush killers. An efficient garden sprayer is equipped with a pressure gauge.

4-A. Ammate Crystals are put in "cups" made at the base of the tree.

4-B. Chemical is poured into the frill made with an axe. The frill must be continuous around the tree.

Land can be cleared with a bulldozer but this is expensive and may disturb the soil excessively. Fire should be used very carefully in any land-clearing operation. It is hazardous to use and there is always a chance that a "controlled" fire will escape beyond its intended limits and destroy valuable crops or property on adjacent lands. Moreover, fire consumes organic matter on or near the surface of the ground, thus robbing the soil of fertility. Finally, fire only temporarily eliminates unwanted vegetation, unless several controlled burns are carried out. The roots of perennial plants are very rarely damaged by fire. Hence, the next year after burning these plants will sprout more prolifically than ever.

5. SPACING OF SEEDLINGS

The spacing of trees in the plantation is dependent upon the landowner's need, that is, the desired products, the site and other factors. The choice of a spacing at which to plant a given species is almost as important as the choice of species for a particular site. The idea spacing is that which gives the most trees per acre and yet yields ample space for each tree to grow and develop into the desired product. To plant trees too far apart is not making full use of the area available, and if planted too close they become stagnated at an early age. In either case, land involved is not producing its maximum and consequently money is lost. Very close spacing of species other than longleaf is likely to result in stagnation soon after the crowns close. For this reason, a close spacing might be permissible for longleaf when it would not be so for slash and loblolly pine. The southern pines' rapid growth insures that even when spaced rather widely, they will close their crowns at an early age and thus prune themselves naturally. Wide spacing has the following advantages; (a) it reduces the cost of establishing a plantation. The cost of planting stock and labor is reduced in direct proportion to the number of trees planted per acre. (b) It reduces the need of early thinning to prevent stagnation and frequently makes it possible to postpone the first thinning until the trees to be removed are large enough for some merchantable product. (c) Wider spacings will facilitate loading and the use of trucks when making thinnings. (d) It results in rapid crown development and diameter growth. This is very important in trees to be used for naval stores. Close spacing has these advantages, (a) it raises the quality of the product by causing earlier self-pruning, smaller knots, and better recovery from attacks by insects and diseases and (b) it decreases the probability that replacements or replanting will be necessary.

Table 1 shows the number of trees per acre for various spacings. For good pulpwood growth, spacing of 6′ x 10′, 6′ x 12′, 7′ x 10′, 7′ x 12′, and 8′ x 8′, which give 500 to 700 trees per acre, are considered advisable. Spacings for naval stores operations may vary from 7′ x 12′ to 15′ x 15′.

When growing Christmas trees, the rows should be far enough apart to permit cultivation with a tractor the first growing season. The spacing in the row should not be less than three feet. The maximum spacing should be based on the expected size of the tree when it is ready for harvest.

TABLE 1. NUMBER OF TREES FOR VARIOUS SPACING

Spacing in feet	Trees per acre	Spacing in feet	Trees per acre
4 x 6	1815	7 x 8	778
6 x 6	1210	7 x 10	622
6 x 8	908	7 x 12	519
6 x 10	726	8 x 8	681
6 x 12	605	8 x 10	545
6 x 14	519	8 x 12	454

Prescription planting is a relatively new concept of plantation establishment. Basically it consists of going into each area to be planted and making an appraisal of the conditions affecting water relations, especially the depth to a water holding layer, the soil type, topography, cover, and species characteristics. Adjacent natural stands are surveyed and an objective of 500 - 700 trees per acre at pulpwood size is set as the desired goal. Data obtained is used in establishing a certain number of seedlings to plant per acre depending on the various factors outlined. For example, one site may require 1450 seedlings per acre, while another may require only 700. This technique insures the most economical use of seedlings on all sites.

6. PLANTING TIME

The planting of forests with transplants must of course coincide with lifting operations at the nursery where seedlings are obtained. In Georgia, seedlings are not lifted until about two weeks after the first heavy frost has occurred, which usually is the early part of November. A good heavy frost is necessary before lifting to harden the seedling properly and prepare it for the initial shock of transplanting. Normally, lifting will occur in North Georgia nurseries a few days earlier than in nurseries located in South Georgia. Forest tree seedlings may be planted safely through early March, however nursery shipments are normally completed by February 15th of each year.

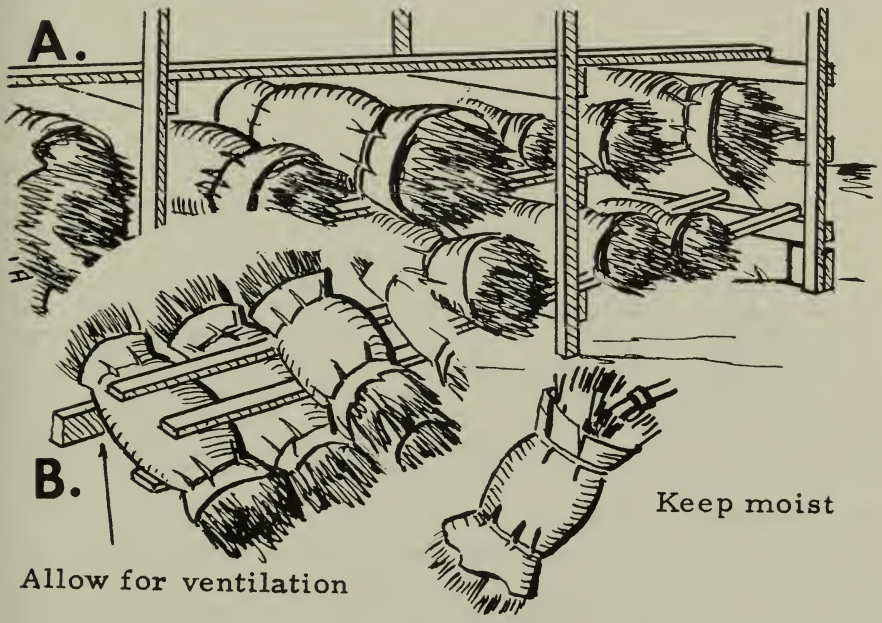
7. PURCHASING SEEDLINGS

The majority of nursery stock grown in Georgia is 1 - 0 stock. Seedlings are graded for defects and diseases before leaving the nursery and only good trees of high quality are distributed. For detailed information on ordering seedlings, your local county forest Ranger should be contacted. In addition, Reforestation Release No. 1, should be consulted. In counties where there is no Ranger, ordering may be done through the Soil Conservation Service or County Agents.

8. CARE OF PLANTING STOCK

(a) *During delivery*

After lifting, seedlings are delivered to the landowner as rapidly as possible. Often trees are lifted, graded, baled (Fig. 5), and delivered to the landowner



A. Permanent Storage Racks.
B. Temporary Storage Racks.

in one day. After being loaded on the delivery trucks, they should be carried to the planting site as rapidly as possible to prevent "heating". Heating is caused by the process of respiration occurring in the bales in which carbon dioxide and heat are released. An accumulation of either, in tightly packed bales, can do much damage to seedlings, especially in hot weather. Adequate ventilation during transit will assist in eliminating this hazard.

(b) *Prior to planting*

As soon as bales are received they should be placed in a cool place and out of the direct rays of the sun. They should be stacked with the ends at a slight angle to insure that excess water may drain properly. A spacer of some form, usually a 2 x 4 or 4 x 4 should be used between each layer as shown in Figure 5, especially if it is necessary to stack over two layers high. This is done to prevent heating.

The bales should be watered every two or three days. A small perforated metal pipe having one end plugged, with the other attached to a garden hose and quick acting cut-off valve, makes an excellent watering tool. It can be inserted into the end of the bale and the trees thus watered (Fig. 6). The object is to keep the moss wet which in turn keeps the roots from drying out. Seedlings should not be left in bales for over three weeks. If seedlings are to be held over three weeks prior to

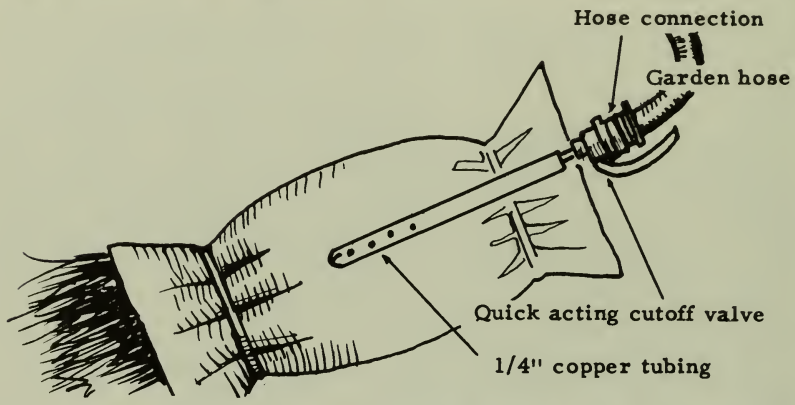


Fig. 6. Syringe type tool for use in watering planting stock. Constructed from copper tubing and connected to standard garden hose.

planting, it is wise to have them "heeled in" (Fig. 7). This means extra work where a large number of seedlings are involved. The site selected should have friable, easily worked soil and never located where flooding may occur. To heel in seedlings, dig a "V" shaped trench, deep enough to put the roots in a slanting position. Remove the seedlings from the bales and spread them along the wall of the trench so that they are not stacked more than three or four deep. Replace the dirt and pack it firmly against the roots. If the soil is not moist, water the roots before covering them.

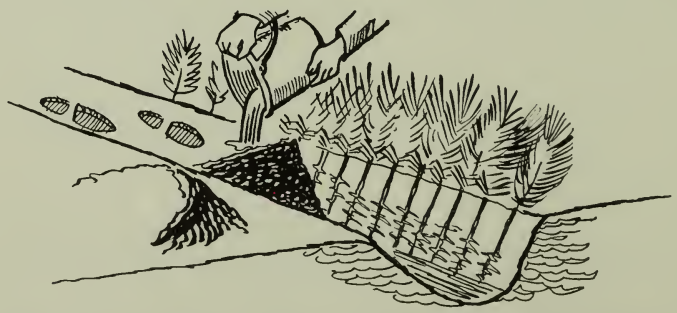


Fig. 7. Heel-in ground. Prepare trench in loose moist soil. Spread seedlings evenly. Pack firmly and water.

Dig the trench as wide as necessary and place each succeeding layer of seedlings against the first, making sure to cover the roots of each layer with soil before starting the next. You, as a landowner, should keep constant check on the seedlings and their condition. The best assurance against loss is to plant the seedlings as soon after arrival as possible.

Seedlings may be kept for short periods of time in cold storage or under refrigeration. Temperature should be between 33° and 36° F. Freezing of seedlings should be prevented if possible. Should they freeze in the bale, they should be allowed to thaw out naturally as frozen trees should not be handled or moved.

(c) *Care during planting*

The care given trees after they are removed from storage until they are planted is very important. Two things are involved, that is, transporting the stock from the place of storage to the planting site, and handling the stock during the planting operation. In transporting stock to the planting site, regardless of distance, the bundles of trees or loose trees as the case may be, must be kept moist. Too often, careless handlers throw seedlings into an open truck and haul them miles to a planting site. During the trip, trees may be exposed to drying winds. Loose trees should be thoroughly watered and covered in the truck with a tarpaulin or other protective cover when being moved. Planting stock involved should be unloaded in a shaded spot near the planting site. It is essential to keep the stock thoroughly moist throughout the entire planting operation. One method that has been used to keep the roots from drying out is to dip them in a solution of mud. The mud drys on the roots and thus a protective layer is formed which prevents drying out. Do not leave seedling roots submerged in water for over an hour. If a bucket is used, sprinkle an inch or two of dirt in the bottom and then half fill with water. If a planting tray is used, pack the roots in wet sphagnum moss or similar material and cover with well moistened burlap. It is important, of course, to keep seedlings moist if a mechanical planter is used. Such planters are designed with metal trays into which seedlings can be placed. Care should be taken to avoid water-logging these trays. The importance of keeping the roots moist and protected at all times cannot be over emphasized. Failure to do this can result in greatly increased mortality of seedlings during the first year. Experience has shown that exposing seedlings to sun and wind for as short a period of time as ten minutes is likely to reduce survival by ten per cent. Leaving seedlings exposed to the weather for as long as two hours will result in two-thirds or more of them dying the first year. Those that do survive may yield slow growth for several years.

9. PLANTING

(a) *Machine*

The majority of forest tree seedlings planted in Georgia are planted with mechanical transplanters. This method is faster and cheaper than hand planting. Two men operating a mechanical planter can set from 8,000

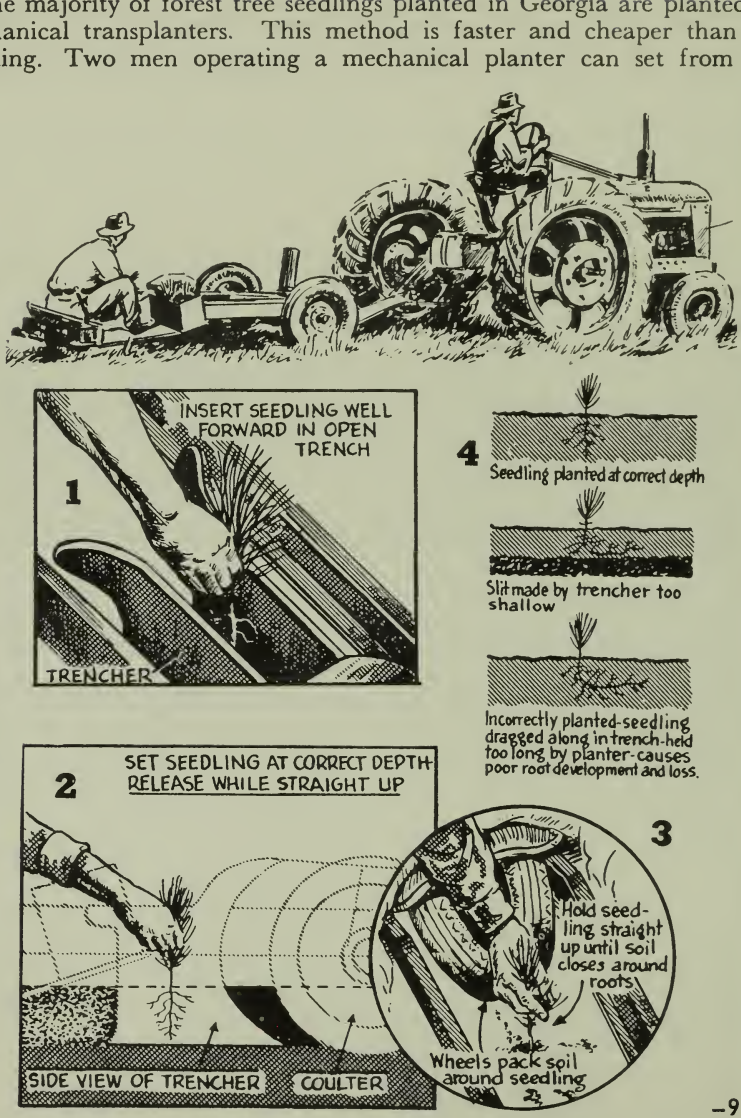


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Fig. 8. Mechanical Tree Planting. Mechanical Tree Planters are usually available from several sources. 1. Many counties have planters which can be rented from the county ranger at a nominal cost. 2. Private industries and individuals have machines which may be rented. 3. Consulting forester and others will do contract planting.

to 20,000 seedlings in an eight to nine-hour day. There are several models of transplanters but all work on the same principle (Fig. 8).

A rolling coulter cuts the surface layer and a double plow follows the same cut, throwing the sod and soil to both sides. The seedlings are set in the slit made by the double plow and the planter wheels roll on either side packing the soil. For all practical use, a transplanter can be obtained that is drawn by an ordinary farm tractor. One man rides the transplanter and sets the seedlings and the other man operates the tractor. The individual riding the transplanter should take care to place the seedling in the slit at exactly the right depth. They should be placed about one inch deeper than the ground line where they were grown in the nursery. An exception may be made to this rule when planting longleaf and small slash stock on deep sandy soils, where the seedlings should be set to within 1" of the bud. The planter operator should also be instructed to release the seedling at exactly the correct time. If released too quickly, the seedling will have a tendency to fall backward and thus give the appearance of lying down. If the tree being planted is held too long, it will lean forward. Roots must be placed straight down in the slit. Most important of all the tap root should extend straight down to avoid a "U" shaped root.

Each time a transplanter is moved from one field to another, it should be checked and if necessary adjusted to insure a perfect job of planting. On rougher sites and extremely brushy land, a crawler type tractor may be needed with a trailing type transplanter.

(b) *Hand planting*

Most hand planting is done by using a dibble or planting bar (Fig. 9). Hand planting is used on sites where it is not economical to use a tractor and transplanter, on small tracts, steep hillsides, land with high stumps, spot planting on wooded areas, and areas requiring replanting where survival of previously established stands has been inadequate. When hand planting, one seedling is removed from the tray or bucket at a time. However, others may be pulled out accidentally. If a tray is being used, the uncovered trees may go unnoticed until they are planted, during which time they may dry out. If a bucket is used, the ones pulled out accidentally will usually fall back into it. When using a dibble it should be pushed into the ground with the foot to create a slit in which the seedling is placed. The seedling should be pushed to the bottom of the slit and then pulled up to the correct level. Spread the roots in the slit or hole as much as possible and be especially sure that the roots aren't doubled back in a "U" shape. Next, the dibble should be pushed back into the ground about two inches from the seedling and worked back and forth to push the soil around the roots and stem, taking care to work out all air pockets. The bottom portion of the slit should be closed first. Care should be taken to keep dry leaves, grass, and other litter out of the hole. Following this, the foot may be used to firmly pack the soil.

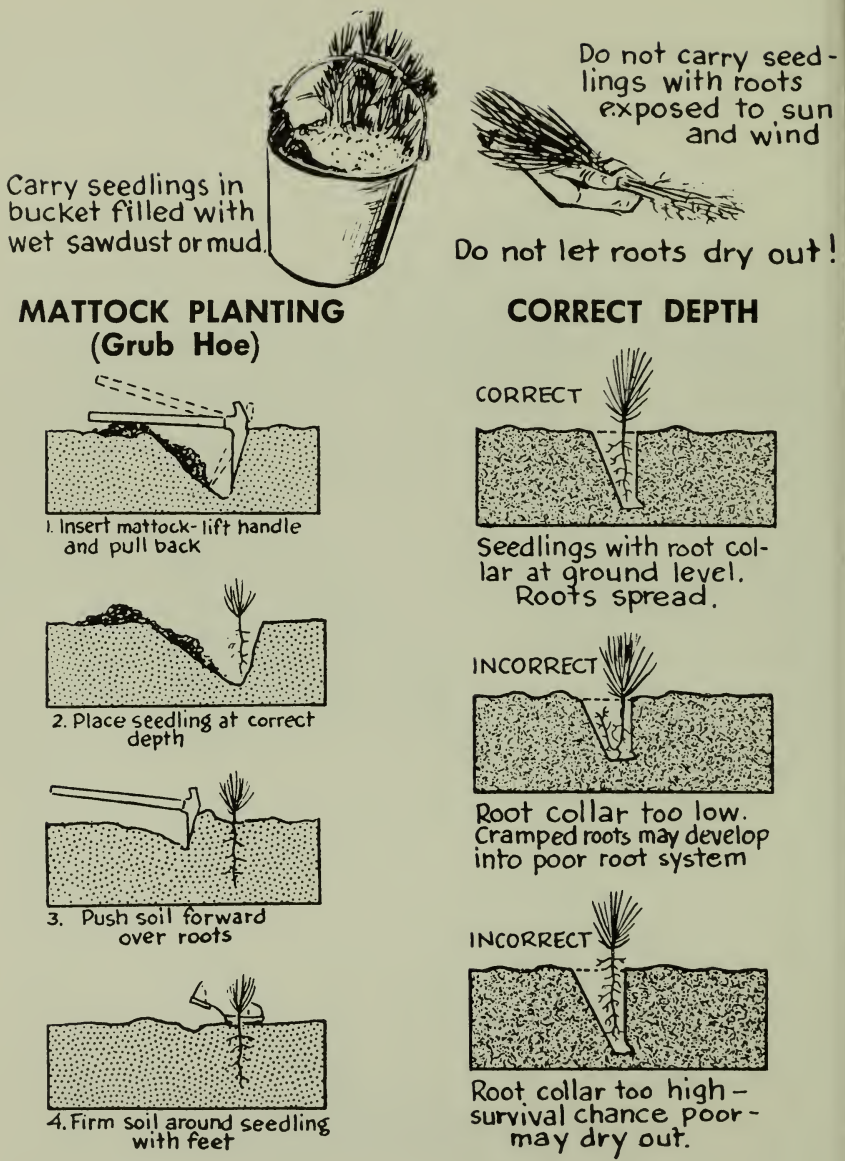
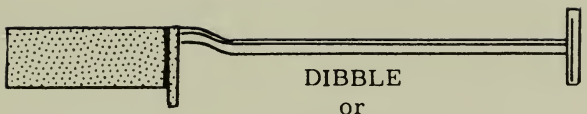
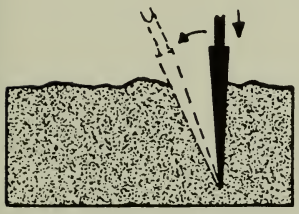


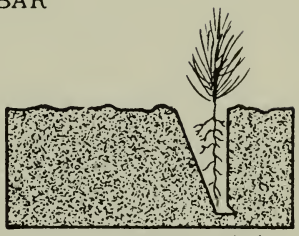
Fig. 9. Hand Planting. Forest tree seedlings are planted best by a two-man crew. Trees should be carried in a bucket and the roots kept moist at all times. Hand planting is most commonly done with a dibble or mattock.



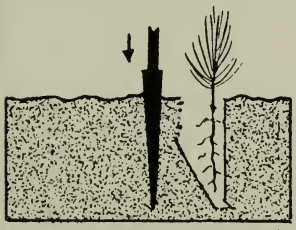
DIBBLE
or
PLANTING BAR



1. Insert dibble straight down as shown. Pull backward to open hole.

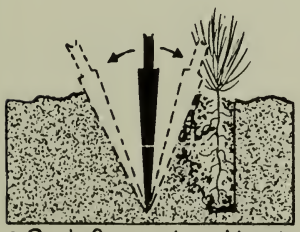


2. Remove dibble and place seedling at correct depth.

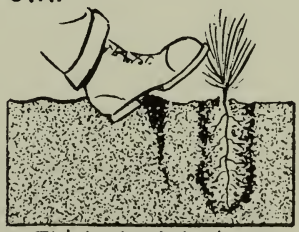


3. Insert dibble straight down behind last hole.

4. To hold seedling pull dibble backward closing bottom of slit.



5. Push forward and backward packing soil firmly against root



6. Fill in last hole by firming with heel.

A good test to determine if the ground around the seedling is packed tight enough is to grasp two or three needles and pull upward with the hand. If the needles pull off before the seedling comes up, the soil around the tree is packed properly. One man using a dibble can average 700 to 800 seedlings in an eight-hour day.

10. DIRECT SEEDING

Direct seeding is the practice of planting seed of a desired species directly on the site to be reforested. A great deal of experimental work has been done on direct seeding. Results obtained have been erratic and for this reason large scale operations are not recommended. Direct seeding may be done with a hand seeder, regular seed planter, by airplane, or broadcasting by hand. Seed must be placed in contact with mineral soil. Covering is not necessary as long as contact with the mineral soil exists.

When contemplating direct seeding, several things should be considered. Birds and rodents may take a heavy toll of exposed seed. Rains can bury the seed too deep for germination. The stand density or the exact number of trees per acre, and spacing, cannot be predetermined. Costs average from $6.00 per acre for loblolly to $9.10 per acre for longleaf, which in many cases compares favorably with planting. The biggest single cost is seed. Another item that must be considered is seed treatment cost for protection against birds and rodents. This amounts to about $0.20 per pound. Basic principles for direct seeding are about the same for all southern pines. Best results have been obtained using longleaf seed. Sowing should be done in the fall as soon as moisture is adequate for prompt germination. This is usually from late October to early December. As for seedbed preparation, it is a must if there is very much ground cover. This is necessary to bring the seed into contact with mineral soil. Burning in the spring of the year before seeding will also accomplish this. A light grass rough improves germination by holding soil moisture. On dry sandy sites, it may be wise to disk in the late summer.

The seeding rate for longleaf is 10,000 viable seed per acre. This amounts to three pounds of cleaned seed. Loblolly should be seeded at the rate of 28,000 to 38,000 viable seed per acre which amounts to 1½ to 2 pounds of cleaned seed. Slash pine should be sown at a rate of 13,000 viable seed per acre or 1 to 1½ pounds of cleaned seed.

11. SEED TREATMENT FOR BIRD AND RODENT CONTROL

For seed treatment against birds, sublimed Anthraquinone or Winthrop repellent as it is known commercially, gives best results. Arasan may also be used but is injurious to seed unless applied properly. Arasan is also very irritating to the eyes, nose, and throat. Caution should be taken when using this chemical. The recommended dosage for Arasan is fifteen pounds to 100 pounds of seed, while Anthraquinone is applied at the rate of 25 pounds per 100 pounds of seed.

When applying a repellent to the seed it is necessary to use some type adhesive for a sticker. Flintkote asphalt emulsion, C 13-HPC, or Dow Latex, 512-R, may be used. Seed should be weighed into lots of 20-25 pounds and placed into large burlap bags. They should then be dipped in the sticker and worked around until all seed are thoroughly covered. Following this, they should be poured onto a screen wire frame and excess sticker allowed to drain from the seed. Next they should be poured into a drum or any other container suitable for stirring and the repellent mixed thoroughly with the seed before the sticker has dried. The seed should then again be placed on a screen and allowed to dry.

For treatment against rodents, Endrin should be used at the rate of ½ pound per 100 pounds of seed. It should be blended thoroughly with other repellents before application to the seed. Endrin is extremely toxic whether inhaled, swallowed, or allowed to remain on the skin. Extreme care should be used in handling this material. Research has shown that it also may slow germination.

Experimental work thus far with seed treatments and repellents indicates a lower germination per cent when they are used, especially if Arasan is allowed to contact the seed directly. This can be avoided by obtaining a thorough coating of the sticker which acts as a protective coating to the seed.

12. PLANTATION CARE

Newly established tree crops should be cared for very carefully. All the effort that has been put into a planting will be in vain unless a few simple rules are observed. Consult someone who is familiar with disease and insect problems which you don't know how to handle or control.

Some damage has been done to new plantations by rabbits. As cold weather kills all green foliage and grass, rabbits run out of green vegetation to eat and frequently turn to newly established pine plantations. For protection from rabbits and deer, chemical repellents may be used. It may be sprayed on or the seedlings dipped prior to planting. Caution should be exercised to keep cattle out of newly established plantations since they trample seedlings.

In closing, the fire situation should be considered. Controlled fires can serve a very useful purpose in keeping certain diseases to a minimum when used properly and under the guidance of trained personnel. The State of Georgia has the best possible fire control facilities available, but the largest responsibility rests with you as a landowner to keep wild fires out of your plantation. One moment of carelessness can wipe out an entire plantation, along with your financial investment. This hazard can be eliminated by observing good fire prevention practices. Establishing and maintaining fire breaks should be taken into consideration when establishing a plantation.

13. SUMMARY

Although an attempt has been made to include as much basic information as possible about reforestation, no publication along this line could be all inclusive. Many landowners will encounter problems that are peculiar to his specific lands. Answers to these in many instances must be obtained locally. Detailed information regarding a specific problem may be obtained from the Georgia Forestry Commission through your District Forester, whose address is shown on the back cover page of this publication. In addition, a list of useful reference material is included in the appendix for your convenience in event further details are desired. The writers are indebted to the authors of the publications listed in the appendix to which we have freely referred.

SELECTED READING

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2. Prescription Planting for Forest Trees, by Phil Archibald, December 15, 1957, reprinted from Southern Lumberman.
3. Prescription Planting, by John B. Hatcher, February 1957, reprinted from Forest Farmer.
4. Planting Small Slash Pine Seedlings, by R. D. Shipman, and John B. Hatcher, February 1957, reprinted from Forest Farmer.
5. Growing Loblolly Pine, by Thomas Lotti, February 1956, Farmers' Bulletin No. 2097, for sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
6. Growing Loblolly and Shortleaf Pine in the Mid-South, by Charles X. Grano, December 1956, Farmers' Bulletin No. 2102, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
7. Natural Regeneration of Loblolly Pine in the Southeastern Coastal Plain, by Robert D. McCulley, August 1953, Southeastern Forest Experiment Station, Asheville, North Carolina.
8. Loblolly Pine Seed Trees: Selection Fruitfulness, and Mortality, by Kenneth B. Pomeroy, September 1949, Station Paper No. 5, Southeastern Forest Experiment Station, Asheville, North Carolina.
9. Loblolly Pine Seed Tree Mortality, by Kenneth B. Trousdell, December 1955, Station Paper No. 61[2], Southeastern Forest Experiment Station, Asheville, North Carolina.
10. Seed and Seedbed Requirements to Regenerate Loblolly Pine, by Kenneth B. Trousdell, November 1950, Station Paper No. 8, Southeastern Forest Experiment Station, Asheville, North Carolina.
11. Peak Population of Seed-Eating Rodents, by Kenneth B. Trousdell, October 1954, Number 68, Southeastern Forest Experiment Station, Asheville, North Carolina.
12. Growth, Mortality, and Regeneration After Cutting in Loblolly Pine Pulpwood Stands, by T. A. McClay, September 1953, Station Paper No. 28, Southeastern Forest Experiment Station, Asheville, North Carolina.
13. Growth and Prospective Development of Hardwoods and Loblolly Pine Seedlings on Clearcut Areas, by Karl F. Wenger, July 1955, Station Paper No. 55, Southeastern Forest Experiment Station, Asheville, North Carolina.
14. Influence of Loblolly Pine Overwood on Advance Reproduction, by E. V. Brender and John C. Barber, January 1956, Station Paper No. 62, Southeastern Forest Experiment Station, Asheville, North Carolina.
15. The Behavior and Control of Understory Hardwoods in Loblolly Pine Stands, by L. E. Chaiken, April 1949, Technical Note No. 72, Southeastern Forest Experiment Station, Asheville, North Carolina.
16. Controlling Undesirable Hardwoods, by Laurence C. Walker, 1956, Report No. 3, Georgia Forest Research Council, Athens, Georgia.

17. **How to Grow Longleaf Pine,** by H. H. Muntz, January 1954, Farmers' Bulletin No. 2061, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

18. **Furrow Old Fields to Plant Longleaf in the Sandhills,** by R. D. Shipman, October 1956, Number 98, Southeastern Forest Experiment Station, Asheville, North Carolina.

19. **Survival and Growth of Planted Slash and Longleaf Pines,** by G. I. Garin, and K. W. Livingston, Circular No. 97, May 1950, Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn, Alabama.

20. **Management of Natural Slash Pine Stands in the Flatwoods of South Georgia and North Florida,** by R. D. McCulley, June 1950, Circular No. 845, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

21. **Growth of Slash Pine Plantations on the George Walton Experimental Forest,** by Frank A. Bennett, April 1956, Station Paper No. 66, Southeastern Forest Experiment Station, Asheville, North Carolina.

22. **Shortleaf Pine,** by Wilbur R. Mattoon, October 1940, Farmers' Bulletin No. 1671, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

23. **Recent Developments in Planting and Direct Seeding in the Southern Pine Region,** M. B. Applequist, April 8-9, 1954, School of Forestry, Louisiana State University, Baton Rouge, Louisiana.

24. **Direct-Seeding the Southern Pines,** by William F. Mann, Jr., November 1957, Volume 13-No. 2, Forestry Newsletter Southeastern Section, Society of American Foresters.

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26. **Preliminary Test of Direct Longleaf Seeding,** Robert D. Shipman, February 1955, Naval Stores Review.

27. **Christmas Tree Production,** G. I. Garin, and J. C. Moore, December 1951, Circular No. 92, Agricultural Experiment Station of the Alabama Polytechnic Institute, Auburn, Alabama.

28. **Arizona Cypress A Christmas Tree for the South,** by G. I. Garin, December 1952, reprinted from The Forest Farmer.

29. **Planting and Growing Cottonwood on Bottomlands,** by Louis C. Maisenhelder, October 1951, Bulletin 485, Mississippi State College Agricultural Experiment Station.

30. **Silvical Characteristics of Black Walnut,** by Kenneth A. Brinkman, December 1957, Miscellaneous Release 22, Central States Forest Experiment Station, U. S. Dept. of Agriculture, Forest Service, 111 Old Federal Building, Columbus 15, Ohio.

31. **Silvical Characteristics of Yellow Poplar,** by James F. Renshaw and Warren T. Doolittle, January 1958, Station Paper No. 89, Southeastern Forest Experiment Station, Asheville, North Carolina.

32. **Progress in Development of Efficient Turpentining Methods,** by Albert G. Snow, Jr., January 1954, Station Paper No. 32, Southeastern Forest Experiment Station, Asheville, North Carolina.

33. **Forest Diseases and Insects of Georgia's Trees,** by L. W. R. Jackson, School of Forestry, University of Georgia, G. E. Thompson, Department of Plant Pathology, University of Georgia, H. O. Lund, Department of Entomology, University of Georgia, 1957. Georgia Forestry Commission, P. O. Box 1183, Macon, Georgia.

NOTES

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ASSISTANCE

From The Georgia Forestry Commission

Assistance in establishing your tree plantation can be obtained from your county ranger or district forester. Inquiries should be directed to your county ranger or to the nearest district forester.

			Phone:
DISTRICT 1	Statesboro	Rte. No. 2	Poplar 4-2311
DISTRICT 2	Camilla	Box 26	2741
DISTRICT 3	Americus	P. O. Box 169	2217
DISTRICT 4	Newnan	Box 333	720
DISTRICT 5	McRae	P. O. Box 96	7611
DISTRICT 6	Milledgeville	Box 505	8766
DISTRICT 7	Rome	Rte. No. 1	6004
DISTRICT 8	Waycross	P. O. Box 1160	Atlas 3-5464
DISTRICT 9	Gainesville	P. O. Box 416	Lenox 4-5454
DISTRICT 10	Washington	Rte. No. 3	Osborne 8-2015