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Hardwood Reforestation in the South: Landowners Can Benefit from Conservation Reserve Program Incentives

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SUMMARY

Hardwood forests are some of the most productive timber and wildlife habitat sites in the United States. Because of their tremendous agricultural potential, most hardwood forests have been cleared, especially in the lower Mississippi River Valley. Many of these soils are now classified as highly erodible or subject to periodic flooding. The Conservation Reserve Program, initiated in 1985 to return delicate soils to less demanding uses, includes the option of putting cleared land back into forests. This publication offers landowners guidelines for planting and direct-seeding procedures that they can use in hardwood reforestation.

Keywords: Artificial regeneration, direct seeding, planting wetlands.

FORESTS TO FARMLANDS; FARMLANDS TO FORESTS

Hardwood forests provide sites for some of the most productive timber and wildlife habitat in the United States. Additional benefits are improved water quality from forests acting as filter zones along streams and restoration of deteriorated sites. Studies have shown that on good hardwood sites, hardwoods grow as fast as pines on good pine sites. Such sites may also support two to five times as many game animals as do upland pine forests. Hard-masted species such as oaks and pecans provide particularly important resources for wildlife. Deer, turkey, rabbits, squirrels, migratory ducks, and wood ducks are taken in great numbers from hardwood forests each year.

Before the arrival of the first European settlers to the North American continent, dense hardwood forests and cypress-tupelo forests covered floodplains of major and minor stream bottoms, mountainous coves, and the swamps along coastal areas. More than 100 species were represented (Freeman and Frome 1968). The tremendous agricultural potential of the areas, especially those along rivers and streams with their rich soils and abundant moisture, was realized almost immediately. The rate of clearing for agriculture was slow at first, especially along streams, due to frequent flooding and poor drainage. Gradually, as flooding was brought under some control and drainage projects were established, increasingly more hardwood forests were cleared.

By the late 1930s, about one-half of the original forests had been cleared. Clearing continued at a rapid pace through the late 1970s, especially in the lower Mississippi River Valley. It is now apparent that many areas that were cleared were better suited as forests than as agricultural land. Many of these areas are subject to periodic flooding and can successfully produce an agricultural crop only in relatively dry years (Allen and Kennedy 1989).

Because much of the forest land cleared for agriculture has been determined to be highly erodible, Congress initiated the Conservation Reserve Program (CRP) as part of the 1985 Food Security Act to provide greater protection to delicate soils. One solution is to put cleared land back into forests. Landowners who participate in the CRP agree to take eligible land out of agro-

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nomic production and put it into one of the reserve programs for a lo-year period. In return, the landowner is compensated for part of the per acre cost of reforestation and an annual per acre per year fee for the 1 O-year period.

In another title of the 1985 Food Security Act, "wetlands" also qualify as areas open to participation. With wetlands having been defined as land subject to periodic inundation, this has made several million acres in the southern and southeastern United States available that are highly suitable for reestablishing hardwood forests.

Local landowners can be directly involved in such a reforestation project. Several basic decisions will put the landowner on the route to better conservation practice, a healthier environment, and a productive timber crop.

PLANNING A REFORESTATION PROJECT

Careful planning is the first and most critical step in a landowner's reforestation project. Landowners must decide on location and preparation needs for the planting or direct-seeding site, tree species, quantity of seedlings or seeds needed to complete the project, and the mode of planting or seeding. Decisions need to be made well in advance of the planting or direct-seeding date—preferably up to a year-to insure availability of planting and seeding stock, labor, and equipment.

Reforestation will probably take place primarily on lands least suited for agriculture. For detailed information on where wetlands lie and on which species were present before clearing, landowners can consult local soil survey maps that can be obtained through the USDA Soil Conservation Service county office.

Proper tree species selection will greatly affect the probability of success of the individual project. Selection must be based on factors such as soil type, frequency and duration of flooding (table 1), flooding depth, site-species adaptability, availability of planting stock, and personal objectives for reforestation. In many planting projects in the Lower Mississippi Valley, emphasis has been placed on hard mast-producing species such as oaks (*Quercus* spp.) and sweet pecans (*Carya illinoensis* (Wangenh.) K. Koch), good for timber and wildlife. Light-seeded species such as sweetgum (*Liquidambar styraciflua* L.), sycamore (*Platanus occidentalis* L.), and the ashes (*Fraxinus* spp.) will probably establish themselves on the site, because their seeds are easily dispersed by wind and water.

The two major reforestation methods are direct-seeding and planting seedlings, both of which can be done by hand or machine. The largest continuing seeding and planting program is that of the Louisiana Department of Wildlife and Fisheries. This group has direct-seeded and planted over 4,000 acres during a 5-year period in old fields in the Quachita Wildlife Management Area near Monroe, Louisiana. Direct-seeding is usually less expensive than planting seedlings, but costs depend on factors such as species, seed price, labor, and availability of seedlings. Planting seedlings may result in faster establishment of a forest and greater growth rates through the first several years.

Site preparation may be necessary to create suitable growing conditions for seeds or planted seedlings and to facilitate the use of mechanical planters or seeders. If the area has been in cultivation for a long time, site preparation by disking would break up any plow pan or otherwise compacted soil and aid in weed control during the growing season following planting. Disking with a heavy disk at least twice late in the summer prior to planting is recommended. Disking should be to at least a 6-inch depth and preferably 8 to 15 inches deep.

If some burning is necessary near the reforested area, a firelane should be created around the site. This should be done annually in early fall and in most cases is easily accomplished by disking.

Table 1 .-*Species tolerance in relation to flooding time and duration*

Continuous flooding		Periodic flooding		
January-June	January-May	January-May	January-Aprli	January-March
Cypress	Green ash	Sweetgum	Sawtooth oak	Shumard oak
Overcup oak	Nuttall oak	Water oak	Sycamore	Cherrybark oak
Water hickory	Persimmon	Willow oak	Cottonwood	Swamp chestnut oak
		Nuttall oak	Sweet pecan	Nuttall oak
		Green ash	Nuttall oak	Green ash
			Green ash	

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DIRECT-SEEDING

Oak seeding research was begun at the Stoneville, Mississippi, Southern Hardwoods Laboratory in the early 1960's. Direct-seeding is becoming a widely used method of reforestation, particularly in the Lower Mississippi River Valley. Since 1981, some 5,000 to 10,000 acres of publicly and privately owned land have been direct-seeded with acorns.

Many early tests were with Nuttall oak, (Quercus nut-&//ii Palmer). Slow growth of this species through the first 5 years may be discouraging because competing sprouts and seedlings of several tree species outgrow the oaks. However, 10 to 15 years later, enough oaks should be in a competitive crown position to assure their presence in the future sawtimber stands (Johnson and Krinard 1987). Although Nuttall has been the most popular red oak to direct-seed and has had the highest success rate, at least six other red oak species, four white oak species, and sweet pecan also have been successfully direct-seeded. Species selection should be based upon site quality and landowner preference.

Guidelines given for direct-seeding Nuttall will apply to other hard mast species that can be seeded. Some lower germination rates can be expected with other oaks and pecan. Because white oaks are fall germinating species and are hard to store, acorns should be direct-seeded as soon as possible after collection.

Collecting and Storing Seeds

Acorn collecting is probably the biggest job one will encounter in a direct-seeding program. Collection is normally done in the South between October 1 and January 1. Acorns that have not been collected from under trees can be eaten by birds and rodents within a few days to a few weeks after seed fall. The time when acorns drop varies by species and individuals within a species, so one needs to keep checking trees to know when seeds fall.

Early seeding eliminates long-term storage that requires cold space and monitoring of acorns. Fresh collected acorns, if seeded before cold storage, seem to be less attractive to rodents. It is theorized that nonstored acorns, unlike acorns that have been in cold storage, do not exude odors that attract rodents to the direct-seeded site.

Many oaks will produce an excellent seed crop only one or two years out of every five. Thus, for storable red oak acorns (Bonner 1973), extra collection may be required during good seed years. Acorn storage may be expensive, but is more reliable and productive than collecting acorns during poor crop years. It allows for an annual seeding program, even in years of total acorn crop failure.

Practical time limits for storing large quantities of red oak acorns may be less than the 5 years indicated from research (Bonner 1973). In Louisiana, about 5,300 pounds of Nuttall oak acorns were collected during the fall-winter of 1984-85. Acorns were stored in a walk-in cooler at 35 ° to 40 °F and used during the 1985, 1986, and 1987 planting seasons (about 30 months of storage). However, without proper storage, acorns can lose viability after 1 year of storage. In the Louisiana study, acorns were stored in polyethylene bags with about 20 to 25 pounds of seed per bag. This made handling easier and kept seeds from heating within the bag (Johnson and Krinard 1987). Bags were placed in cold storage on shelves to allow for air circulation. If weevils were present in the acorns, they would emerge, eat through the bag, and fall to the floor from the wire shelves, keeping damage to the polyethylene bags to a minimum.

Collecting.-As a general rule, acorns of white oak cannot be stored more than 3 to 4 months because they normally germinate in the fall. Rink and Williams (1984) suggest that acorns of *Quercus alba* L. be stored in 1.75-mil polyethylene bags instead of the 4-mil bags suggested for red oak acorns because of lower germination after storage in 4-mil bags. Suspected causes of lower germination were higher concentrations of ethanol and CO_2.

Labeling.-Labeling bags to show species, collection date, and percent soundness is important during storage.

Seeding Operations

Water (Q. *nigra* L.), cherrybark (Q. *falcata* var. *pagodifolia* Ell.), Shumard (Q. *shumardii* Buckl.), and Nuttall oak acorns can be removed from cold storage and sown even in the summer with good results. Seeds that germinate in cold storage will produce seedlings when field-sown even if their radicles are broken off (Bonner 1982). Acorns of site-suitable species can be sown in flood areas soon after the water recedes-usually in April, May, or June-and should germinate and produce healthy seedlings. The least desirable months for planting in the South and Southeast, however, are July through October when the soil is normally hot and dry.

Old fields have been hand- and machine-sown with and without site preparation, but seeding is easier and generally better done on intensively prepared sites. Mechanical seeders cannot operate effectively in areas following a harvest cut because of too much debris and too many stumps.

Machines used for seeding are actually modified one- and two-row soybean seeders. Some will drop acorns automatically; others are ridden by operators who drop acorns at specified distances. Seeders that drop seeds automatically should be checked at the end of each row

to make sure the hopper does not jam, leaving long distances unseeded. Seeds sown 1 to 6 inches deep will germinate and produce seedlings. Deeper depths slow germination and emergence of the young shoot; therefore, about 2 inches is the recommended depth. Reported direct-seeding rates range from 30 to 40 acres per day, with a three person crew using machines, to 6 to 8 acres per person with hand seeding. Normal spacings are rows 10 to 12 feet apart and 3 to 5 feet within rows, or 1,000 to 1,500 acorns per acre. Research at the Southern Hardwoods Laboratory has shown a high rate of success when direct-seeding is done in complete openings greater than 100 feet on a side. Direct-seeding in openings less than this size have generally resulted in failures due to rodent damage (Johnson and Krinard 1987).

Germination as high as 80 percent has been reported in some research trials (Johnson and Krinard 1987). However, about 35-percent germination seems to be a fairly reliable planning figure for commercial sowings. Thus 1,000 to 1,500 acorns per acre should result in 300 to 500 one-year-old trees, which would be a sufficient number for most objectives.

On the basis of limited data (Johnson and Krinard 1987), it appears that seedlings can be established 1 year after direct-seeding at a lower cost than planting seedlings. It appears that direct-seeding can be done for about 60 to 70 percent of the cost of planting seedlings. However, there are so many influencing factors that reliable cost comparisons would involve a thorough economic analysis.

Some situations may not be conducive to direct-seeding. Direct-seeding failures may occur under adverse field environments (such as free water coupled with high temperatures, a deadly environment for newly germinated acorns), extended periods of drought during growing season, residual chemicals in old fields, animals (especially raccoons), and defective acorns or improper storage techniques.

Post Direct-Seeding Operations

Most land managers have not attempted to control weeds around direct-seeded oaks in old fields (Johnson and Krinard 1987). In some research trials, bushhogging between rows of seedlings appeared to improve seedling survival and growth. If one is willing to accept a little lower survival and growth, competition control may not be necessary in natural stand openings until free-to-grow oaks are 15- to 20-feet tall (Johnson 1981). Under normal conditions, a site with an 80- to 90-foot site index should produce 15- to 20-foot tall trees in 10 to 15 years. At that time, if necessary, individual oaks can be released by deadening or by cutting competing trees.

PLANTING SEEDLINGS

Planting tree seedlings is a well-established method of reforestation. When done correctly, the chances for successful establishment of a forest plantation are very high (Allen and Kennedy 1989, Kennedy and others 1986, Kennedy 1984). If the planting is done incorrectly or carelessly, however, the project could be an expensive failure. Keys to successful initial establishment of seedlings, in addition to selection of the appropriate species for the site, are obtaining good quality seedlings, ensuring good preplanting care of seedlings, and using proper planting procedures.

The primary sources of tree seedlings are State forestry organizations and private nurseries. The seedlings available from most nurseries will be bare-rooted-separated from the soil they were grown in at the nursery. Bare-rooted seedlings are less expensive than container-grown seedlings, lighter, easier to transport, and easier to plant.

In contrast to pine seedlings, which are usually planted while still quite small, hardwood seedlings should be good-sized and sturdy. They should have a top length of at least 18 inches, and the diameter at root-collar should be at least 3/8 inch. Roots should be well developed and pruned to a length of about 8 inches to make planting easier.

Bare-rooted seedlings require careful handling; the roots are very tender and vulnerable. Seedlings generally come from the nursery wrapped in bundles of 50 to 200. If the seedlings are not to be planted immediately, they should be stored (still bundled) in a cool, dark place-ideally in a cold storage unit. A barn, shed, or dense shade will do for a few days, as long as the roots are not allowed to freeze or dry out.

Only as many seedlings as can be planted in 1 day should be taken to the field. They should either be taken out of the nursery-supplied bundles and planted immediately or be transferred in small groups to a bucket or planting bag containing moist sphagnum or peat moss. One should never carry a group of seedlings in the hand while planting, for their roots will be exposed to the air and the sun and will dry out very quickly.

The best time to plant bare-rooted seedlings is while they are dormant and when the soil is moist-generally, from January through March in the South. Planting can be done into May if the seedlings are kept in cold storage until planting.

Spacings of 10 by 10 feet or 12 by 12 feet are recommended for timber production. However, if the goal is to reforest primarily for wildlife, spacings of 12 by 12, 15 by 15, or even 20 by 20 feet will meet the objectives.

Seedlings can be hand planted using a dibble bar, tile spade, or sharpshooter shovel. It is important that the

roots be placed in the hole so they can spread out somewhat naturally-they should not be twisted, balled up, or bent. Moist soil should be packed firmly around the roots.

Planting a tree by hand is a simple task, but nevertheless is often done incorrectly. If a crew of inexperienced tree planters is used, it is essential to demonstrate clearly the proper way to plant. The crew should be supervised more carefully as the day wears on and they begin to get careless due to fatigue.

Perhaps the most frequent planting mistake is planting the seedling either too deep or, more commonly, not deep enough. Seedlings should be planted with the root collar just below the soil surface. Making holes too shallow for proper placement of roots causes "J-rooting," which can result in malformed root systems. A third mistake is leaving an air pocket around the roots after closing the holes, which may allow the roots to dry out.

One experienced person can plant 600 to 800 seedlings per day if planting conditions are relatively good. This can vary substantially, however, for a variety of reasons, including degree of site preparation, temperature, and the size of seedlings being planted.

Machine planting is usually much faster than hand planting on soils other than heavy clays, when other site conditions are favorable. An experienced crew of 2 to 3 can plant 4,000 to 10,000 seedlings per day with a planting machine. Often survival will be better than that achieved by hand planting.

Early Plantation Development

The landowner should closely monitor development of the new plantation. Any serious problems are likely to show up in the first couple of years after regeneration. Outright failures and only partially successful plantations occur occasionally. They most often result from extended post-planting dry periods; flooding coupled with high temperatures, poor planting or seeding practices, residual herbicides, or herbicide drift from nearby aerial applications; poor quality seed or seedlings; or animal depredation.

Early weed control (by disking, mowing and/or use of herbicides) will speed growth of seedlings during the first few years and perhaps slightly increase survival, but the benefits may not justify the costs. Bushhogging to cut weeds and grasses is the only weed control allowed under CRP, but the landowner cannot be reimbursed for these costs under CRP. Too much weed control might actually reduce the short-term value of the site for some types of wildlife that use the weeds as food or cover.

There is no really cost-effective method to protect newly established seeds or seedlings from animal predation. Domestic animals, birds, deer, rabbits, squirrels, raccoons, beavers, nutria, and mice may all destroy seeds or seedlings. Fencing to control domestic animals and good site preparation to reduce ground cover can reduce the number of rodents. The only planting situation in which protection of individual seedlings is justified is where there is a high population of nutria. In such a case, chicken-wire predator guards are essential, especially for cypress (*Taxodium distichum* (L.) Rich.) plantings. Some loss and damage caused by animals should be expected and tolerated.

BENEFITS: TANGIBLE AND INTANGIBLE

Accepted methods for hardwood reforestation by direct-seeding or planting are available for the landowner. In addition to more wildlife, timber, soil conservation, and better water quality, one can expect numerous other benefits, such as personal satisfaction and aesthetics, from reforesting part of their land. Some benefits are economically related-cost sharing on establishment costs and annual rent fees. Other benefits may be less tangible but nevertheless still important to the individual and to the health of our environment.

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