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Managing Loblolly Pine Stands…from A to Z

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Loblolly pine (*Pinus taeda* L.) is the most important timber-producing tree species in Arkansas and the South as a whole. Loblolly pine naturally occurs primarily in the coastal plain region of the southern United States. In Arkansas, this region comprises the southwest third of the state (Figure 1). Though loblolly pine is native to the coastal plain region, research has shown that planted stands in north Arkansas can be successful as well.

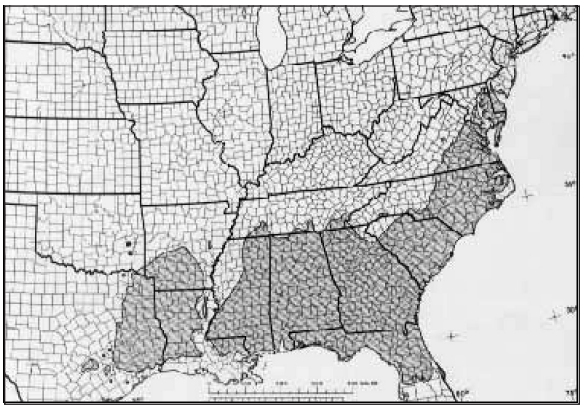

Figure 1. The native range of loblolly pine.
Source: USDA Forest Service (1990)

Loblolly pine is adaptable to a variety of soils; however, it performs best on well-drained soils with adequate moisture, a thick topsoil layer and firm subsoil. The ability of loblolly pine to survive and grow on a variety of soil types, along with consumer demand for its wood, has maintained its popularity as a species to plant for timber production statewide.

Why Manage Loblolly Pine Stands?

In most cases, sawtimber-size loblolly pine trees provide the greatest economic benefit. Unmanaged loblolly pine stands can take up to 50 years to mature into sawtimber-size trees. Managed stands can generate sawtimber-size trees much faster, often within 25 to 40 years depending on the management regime. The difference in rotation length between managed and unmanaged stands can greatly affect the rate of return generated from a stand. Therefore, management of some sort is economically desirable to most landowners. Management provides other benefits as well. Managed stands are less susceptible to adverse weather, insect outbreaks and disease outbreaks. Managed stands also provide better habitat for wildlife than unmanaged stands.

Establishing Loblolly Pine Stands

Loblolly pine stands can be established using two methods: (1) artificially regenerated (planted) stands or (2) naturally regenerated stands. The method to utilize depends on the current conditions of a particular forest site and a landowner's objectives.

Artificial Regeneration of Loblolly Pine

Artificial regeneration of loblolly pine involves establishment from planted seedlings or seed. In most cases, planted stands provide the

most wood in the shortest amount of time, which makes this management method economically attractive. Most forest managers adhere to the concept of "the more intensive the management, the shorter the rotation." Though there is merit to this concept, landowners should weigh the benefits of intensive management against the associated costs. Figure 2 provides a timeline with possible management operations for loblolly pine stands.

Pre-Planting Preparation (Site Preparation)

Some form of site preparation is usually necessary before establishing or reestablishing a stand of loblolly pine. Pines do not tolerate shade and will grow rapidly in full sunlight. Any residual trees left after a logging operation will reduce sunlight and nutrients available to nearby seedlings and can reduce seedling vigor and growth. Therefore, residual trees and newly formed competing vegetation should be controlled before the pines are planted.

Site preparation can involve three primary methods: (1) chemical, (2) mechanical and/or (3) prescribed burning. Chemical site prep involves applying proper herbicides at the right time to control competing vegetation. It is important to match the proper herbicides, application rates and application timing with the proper site conditions (soil, vegetation type and amount). Therefore, professional assistance from a licensed herbicide applicator is always recommended when applying herbicides.

Mechanical site prep involves operations such as ripping, bedding, raking, shearing and others designed to prepare the soil, provide site access and provide some competition control. Many mechanical methods can be costly but may be necessary for successful regeneration.

Prescribed burning can be an excellent tool for providing planting access and controlling competing vegetation. Often, prescribed burning is used in unison with either chemical or mechanical site prep. However, there are often social and/or environmental constraints with the use of prescribed fire. In these situations, an alternative site prep method, usually chemical, should be employed. (See *Site Preparation Methods for Establishing or Reestablishing Pine Stands*, FSA5002).

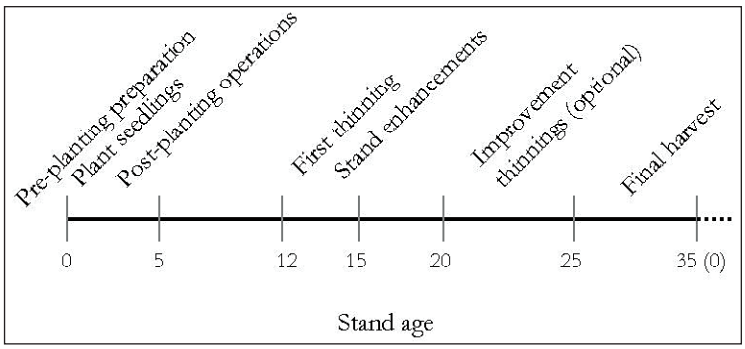

Figure 2. Planted loblolly pine stand management timeline.

Planting Loblolly Pine Seedlings

The most common method of artificially establishing or reestablishing loblolly pine is by planting seedlings. Seedlings raised in a nursery can be ready for planting in one year (called 1-0 seedlings). When being handled, these seedlings are vulnerable to exposure from wind and sun. Therefore, special care of seedlings is essential to both survival and growth.

Why plant loblolly pine?

- ✓ Performs well on marginally productive sites.
- ✓ Can control planting spacing.
- ✓ Shorter establishment time.
- ✓ Takes advantage of genetic improvement.
- ✓ Easier and less costly than planting hardwoods.

Most seedlings are planted between December 1 and March 15. Usually, 400 to 700 seedlings per acre are desirable to meet most management objectives. This number can be established using several different planting spacings (Table 1). For more information, see *Storing, Handling and Planting Pine Seedlings*, FSA5007.

Table 1. Pine Seedling Spacings.

Spacing in Feet	Seedlings Per Acre
8 x 8	680
8 x 9	600
8 x 10	545
10 x 10	435
9 x 12	400

Post-Planting Operations

Post-planting operations take place after the seedlings are planted and within the first three years of the rotation. These operations are focused on reducing competition and improving seedling survival and growth. There are two primary methods used in post-planting operations: (1) chemical competition control and (2) fertilization treatments. If proper site preparation has been employed, chemical competition control can be avoided after planting. If significant competition from woody stems and herbaceous weeds is present, an herbicide application designed to release the pines is necessary. A licensed herbicide applicator should always be used when attempting to apply herbicides to forest sites.

Fertilization treatments can be an important aspect of stand establishment. These treatments could be applied pre- or post-planting. Fertilization at stand establishment usually involves applying phosphorus-based (P) fertilizers such as DAP, TSP or chicken litter. The goal of a fertilization treatment at this early stage is increasing seedling vigor and survival. Many forest managers believe that fertilization at stand initiation

should only be employed on low phosphorus soils. Landowners should get a soil test from the area to be planted and then determine whether or not fertilization is needed. A rule of thumb for the amount of P needed to maintain high vigor seedlings is 50 pounds of elemental P per acre.

Direct Seeding

Another less commonly used method for artificially establishing pine stands is direct seeding. Seeds can be either aerially broadcast or ground broadcast and can be sown in rows or spots. Direct seeding often has a greater chance of failure than planting seedlings but is a management option. For nonindustrial private forest landowners with small acreages, direct seeding may be a good method for spot seeding on a predetermined spacing.

Natural Regeneration of Loblolly Pine

Naturally regenerating a loblolly pine stand involves utilizing the seed fall from the existing trees within a stand. Natural regeneration is most often accomplished utilizing a seed tree harvest. Seed tree regeneration is employed by harvesting the majority of mature trees on a site and leaving 10 to 12 seed trees per acre to provide seed to generate new seedlings. A common belief is that this method is easier and cheaper than planting seedlings. However, there are necessary operations and costs associated with natural regeneration as well.

Site Preparation

Site preparation for natural regeneration differs from that for artificial regeneration but is aimed at accomplishing the same goals: (1) reducing competition and (2) preparing the soil for the new seedlings. One way that the two methods differ is that site preparation for natural regeneration should begin two to three years before the seed tree harvest. The primary goal of these preharvest operations is to reduce hardwood competition. There are two methods used to accomplish this task: (1) prescribed burning and (2) herbicide applications. Often a combination of the two methods can be effective at reducing competition. Prescribed burning can be an effective method for removing hardwood competition smaller than 1 inch in DBH, and herbicide applications (injection) can help remove larger stems. For more information, refer to FSA5002.

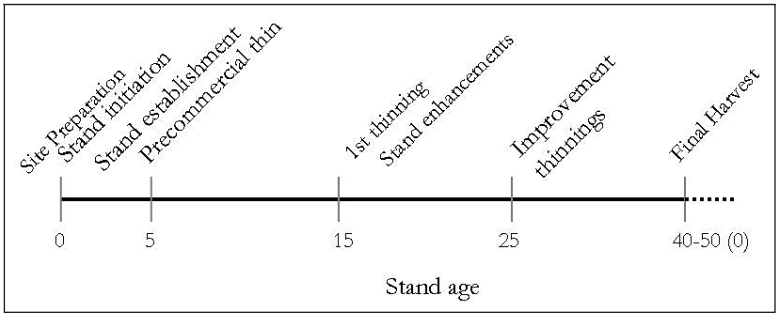

Figure 3. Natural stand management timeline.

Stand Initiation (Seed Tree Harvest)

Always leave the best trees for seed trees. These are the tallest, straightest, largest crowned and highest vigor trees. Often, it is necessary to conduct a prescribed burn following a seed tree harvest to remove slash and expose the mineral soil to the falling seed (which improves germination). The goal is to establish 1,500 to 2,000 seedlings per acre and then remove the seed trees to avoid overstocking from repeated seed falls. This number can generally be accomplished within three years. After an adequate number of seedlings per acre have been established and the seed trees removed, it may be beneficial to conduct a precommercial thinning between years 3 and 10 to establish rows and reduce the number of seedlings per acre to a more manageable number.

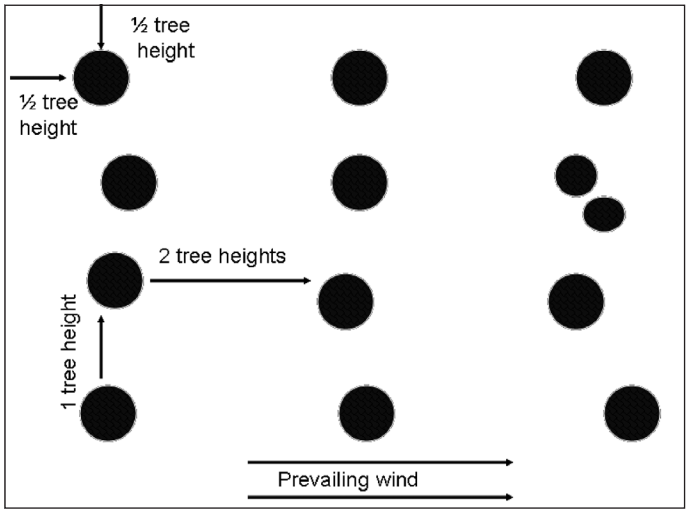

Figure 4. Example of a seed tree distribution.

Intermediate Stand Management

There are several operations that can be employed between the time a stand is established (~ year 5) and the end of the rotation, which comprise intermediate stand management. These operations are focused on enhancing growth and vigor and are often referred to as timber stand improvement operations (TSI). There are three primary operations involved with intermediate stand management: (1) stand density control, (2) fertilization treatments and (3) competition control.

Stand Density Control

Stand density control refers to controlling the number of trees within a stand in an effort to increase individual tree growth. By reducing the number of trees, growth is focused on fewer stems, which increases individual tree growth

rates. Density control is most often accomplished through commercial thinnings. The first thinning will generally take place between years 12 and 15 with additional thinnings at 5- to 8-year intervals thereafter. As stated earlier, the desired goal is reducing the stand rotation length.

Another important objective of thinning operations is improving tree quality. By removing the low-vigor or ill-formed trees in the early thinning operations, stand growth can be focused on higher vigor and straighter stems. Thinning operations can differ greatly between natural stands and artificial stands; therefore, landowners should get an understanding of the type of thinning operation needed for a particular stand. For more information on thinning, refer to *Improve Your Pine Stand by Thinning*, FSA5001.

Mid-Rotation Fertilization

Another stand enhancement operation involves applying fertilizer to mid-rotation loblolly pine stands. When applied, fertilization is performed after the first thinning in order to focus the nutrients on the "crop trees" (trees left after thinning). This fertilization treatment should be a nitrogen (N) based treatment. This is generally accomplished by applying urea (chicken litter may also be a viable option). The rule of thumb for the amount of elemental N desired in most loblolly stands is 200 pounds per acre.

The objective of this treatment is to increase the stand growth rate and, therefore, shorten the rotation length. Fertilization is often more economically viable after the first thinning because the cost is not carried the entire length of the rotation, as with establishment P-based fertilization treatments. Again, fertilization will be most helpful on nutrient-deficient sites (marginal production sites).

Mid-Rotation Competition Control

Controlling competition from the hardwood mid-story can be an important aspect of intermediate stand management. Reducing the hardwood mid-story is especially important when an N-based fertilization treatment is applied. The presence of a significant hardwood mid-story has the potential to reduce the positive impacts of fertilizing loblolly pine. Under these conditions, the fertilizer is not being utilized solely by the pines, so the full benefit of the fertilizer is not realized.

Prescribed fire and/or herbicide applications are the primary methods for controlling hardwood mid-story. Periodic prescribed burns (~ every 3 years) can reduce the presence and size of hardwood mid- and understory trees in loblolly pine stands. Burning has the most impact on smaller stems (<1 inch), which is why multiple burns are often recommended.

In stands where burning is not an option, chemical control of the hardwood mid-story may be the best control method. This application is most often performed aerially, but in open stands it could be applied from the ground. An additional benefit of mid-rotation competition control could be a reduction in site preparation intensity after the final harvest occurs.

Final Harvest of a Loblolly Pine Stand

Depending on the type of management and management intensity employed, a final harvest should take place between ages 25 and 50. If a stand is to be harvested and replanted, a **clearcut harvest** should be employed. Clearcutting, as the name implies, involves removing all of the canopy trees in one harvesting operation. This method best fits artificial regeneration for two reasons: (1) the harvest provides access for replanting and (2) full sunlight will be available to planted pine seedlings.

If natural regeneration is employed, a **seed tree harvest** method is generally best (previously discussed). This method best fits natural regeneration because loblolly pine can produce great quantities of lightweight seed. Therefore, few seed trees are needed to produce an adequate supply of seed for reestablishment. This small number of trees still allows an ample amount of sunlight to reach newly developing seedlings.

Some landowners do not desire to remove the entire stand in one harvest. Often these landowners will employ some form of a **selection thinning**. This harvest method is most common in uneven aged (or all aged) management and allows for several age classes to exist in a stand at the same time. A selection thinning is also a commonly used method if a second or third thinning is employed between first thinning and final harvest.

A selection thinning allows for the removal of stems based on certain criteria such as tree form or vigor. However, careless thinning can result in "high grading." Thinning by **diameter limit** often focuses on removing the largest and best trees and leaving the smaller, less vigorous trees, resulting in a "high graded" stand. Forest landowners should be very careful when employing a diameter limit harvest.

Stand Protection

The biggest damage risks to loblolly pine stands generally come from **storm**, **fire**, **diseases** and **insects**. Storm damage potentially provides the most serious risk to loblolly pine stands. This is primarily because it is difficult to protect a stand from storm damage. Probably the best defense against storm damage is to manage stands for proper stocking levels of high-vigor, healthy trees. Properly stocked stands with high-vigor trees should handle storms better than understocked stands and/or stands with low-vigor trees. If your timber is damaged by a storm, don't be too hasty to conduct a salvage harvest. Even severely damaged stands may be more economically viable than salvaging and replanting.

Wildfire is one of the most damaging occurrences in the forest. Young pine stands are particularly susceptible to wildfire damage. Stands can be protected by establishing fire breaks around them. Fire breaks are often 10 to 20 feet wide and can be managed to provide cover and food for wildlife. Once trees are large enough, a prescribed burning program (along with other management operations) can reduce the risk of fire damage.

The two most important diseases of loblolly pine are fusiform rust and annosus root rot. Fusiform rust causes spindle-shaped swellings or cankers on the stem and branches. As the tree grows, the cankers may become sunken, causing the stem to weaken. Weakened stems become vulnerable to wind and may snap off in high wind conditions.

For best control, harvest diseased trees during normal thinning operations. If a canker covers less than 50 percent of the circumference of a stem, it can be left until the next thinning (if needed). In heavy infestation cases (more than 50 percent of the stand), clearcutting and replanting probably will be necessary. Heavy infestation of fusiform rust is rare in Arkansas.

The risk of annosus root rot is greatest on sandy sites and old field sites. This disease infects freshly cut stumps and spreads to nearby trees through the root systems. Infection rates are generally highest during cool weather. On high-hazard sites, it may be best to conduct harvesting operations during the summer months. Control can also be employed by spreading borax (a fungicide) on freshly cut stumps.

There are several forest insects that attack loblolly pine. *Pales* and pitch-eating weevils reproduce in cut stumps and logging debris, and they can attack pine seedlings planted after a harvest. Waiting one year between harvesting and planting may be desirable if weevils are considered a potential problem.

Young pine stands can be affected by the Nantucket pine tip moth. Tip moths can retard the growth of young pines by killing the growing tips of the shoots. Insecticides are available to control tip moth. These may be economically viable for severe infestations.

The most severe insect pests in loblolly pine stands are the bark beetles (*Ips* engraver beetles, southern pine beetles and black turpentine beetles). The *Ips* engraver and black turpentine beetles rarely cause widespread damage. However, the southern pine beetle can multiply rapidly and cause severe losses of timber. This pest is best controlled by quickly logging and removing infested trees.

Stressed trees are most susceptible to damaging agents. The best way to protect trees from damaging agents is to manage pine stands for high-vigor trees. This can be accomplished through thinning operations, maintaining adequate nutrients and other management methods.

Growth and Yield

Loblolly pines are planted and managed for their fast growth qualities. The amount of wood produced by a loblolly pine stand will greatly differ depending upon the forest site quality, the number of seedlings planted, the intensity of the management regime employed and rotation length. Well-managed stands on good sites are capable of producing 400 to 500 board feet per acre annually for many years. Table 2 illustrates yield estimates based on differing levels of site quality and number of seedlings per acre planted.

Table 2. Estimated Yield Per Acre for Loblolly Pine Plantations.[1]

Site Quality[2]	Trees/A Planted	Age 15 - 1st Thinning[5]				Age 25 - 2nd Thinning[6]				Final Harvest (~ Age 35)			
		PW[3]		ST[4]		PW		ST		PW		ST	
		Cords	Tons	MBF	Tons	Cords	Tons	MBF	Tons	Cords	Tons	MBF	Tons
Low	400	2	6	0	0	2	6	0	0	3	9	2	25
Low	700	3	9	0	0	8	23	0	0	4	10	2	25
Medium	400	4	12	0	0	2	6	0	0	10	26	4	44
Medium	700	6	17	0	0	9	24	0.1	1.5	16	44	3	36
High	400	7	18	0	0	6	16	0	0	11	29	5	55
High	700	9	24	0	0	15	40	0.2	2	18	49	3	36

[1] Yield estimates were produced with GYIF – cutover loblolly pine growth and yield model developed by Tom Matney at the College of Forest Resources at Mississippi State University. Software available at http://www.cfr.msstate.edu/forestry/index.asp.
[2] Site quality is based on the height of the trees at age 25: low = 50 feet, medium = 60 feet and high = 70 feet.
[3] PW = pulpwood given in cords and tons.
[4] ST = sawtimber given in Doyle board feet (1,000 D bd ft = 1 MBF) and tons.
[5] 1st thinning was a 3rd row thin removing 33% of stand.
[6] Residual basal area is ~ 65 ft^2 per acre.

Take-Home Points

- ✓ Loblolly pine grows well on a variety of forest sites.
- ✓ The primary goal for managing pine stands is to shorten the rotation length.
- ✓ In many cases, planted stands provide the most wood in the shortest period of time.
  - – Rotations are usually between 25 and 35 years.
- ✓ Naturally regenerated stands may involve lower establishment costs than planted stands.
  - – Begin planning and preparing several years prior to harvest.
- ✓ The goal of thinning operations should be to remove poorly formed, low-vigor trees and leave high-quality, high-vigor residual trees.
- ✓ Fertilization will provide the most benefit on nutrient-deficient sites.
- ✓ Controlling competing vegetation may provide the most benefit (regarding tree growth) of any management operation.
- ✓ The method of final harvest should fit in with the management method being employed.
  - – For example, natural regeneration = seed tree harvest.

Additional Resources

University of Arkansas Division of Agriculture – Cooperative Extension Service
Web site: http://www.arnatural.org/forestry.htm

Arkansas Forest Resource Center
Web site: http://www.afrc.uamont.edu/Default.htm

Arkansas Forestry Commission
Web site: http://www.forestry.state.ar.us/

USDA Forest Service – Southern Research Station
Web site: http://www.srs.fs.usda.gov/

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