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Site Preparation Methods for Establishing or Re-establishing Pine Stands

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Loblolly pine (*Pinus taeda* L.) and shortleaf pine (*Pinus echinata* L.) are important to Arkansas' forest landowners and forest industry. Management increases the benefits provided by pine stands by shortening rotation lengths, producing better quality products and improving wildlife habitat.

Good forest management always includes a provision for forest regeneration after a harvest. Unfortunately, because of economic constraints or lack of knowledge, many forestland owners in Arkansas make little or no provision for regeneration. Vines, shrubs and small trees begin to re-invade a site soon after timber is harvested. On many sites, these stems represent species which have a lower potential to produce income than loblolly pine has. As a result, many acres of potentially productive Arkansas land are overstocked with brush and less productive trees at the expense of more productive pine.

Both natural regeneration (from seed produced on-site) and artificial regeneration (planting trees) are common methods of regenerating pine forests in Arkansas. Both methods focus on establishing or re-establishing pine on the site. In most cases, some form of **site preparation** will be necessary for pine regeneration to succeed.

What Is Site Preparation?

Site preparation is just what the name says – preparing a site for seedling establishment. Site preparation has from one to four primary objectives: (1) clear logging debris to provide site access, (2) reduce competing vegetation, (3) prepare the soil for seeds or seedlings and (4) shorten the time until the next harvest.

The three most common tools used to accomplish these objectives are **chemical site preparation**, **mechanical site preparation** and **prescribed burning**. Chemical site preparation helps control competing vegetation, while mechanical site preparation is primarily aimed at clearing debris and preparing the soil. Prescribed burning is used to remove debris and reduce competing vegetation. These tools are often used in combination to prepare the site for regeneration and to improve seedling survival and growth during the first few years of the rotation.

The most appropriate tools will depend upon site conditions, site location and landowner preferences. No single site preparation tool or combination is best for all situations. Each has advantages and disadvantages. Landowners should enlist the aid of a professional forester to determine how best to prepare a site. A professional forester will work with a landowner to develop a site preparation prescription which takes into account such factors as soil conservation, surrounding land uses and landowner preferences.

The up-front cost of site preparation drives some landowners to postpone regeneration until some future date when, the landowner hopes, more money will be available. For most small landowners, proceeds from the timber sale provide the most practical source of funds for site preparation and regeneration. The

longer the landowner waits to prepare the site, the more expensive and difficult the site preparation becomes. To compound the problem, as proceeds from the timber sale are spent, less money is available for regeneration. The forest is often never properly regenerated. By postponing site preparation, the landowner keeps a little extra income for now but gives up the opportunity for a larger income in the future.

Chemical Site Preparation

Chemical site prep involves applying proper herbicides at the right time to control competing vegetation. The use of herbicides has become increasingly popular in recent years in both pine and hardwood management.

Chemical site preparation has some advantages and some disadvantages. Herbicides control hardwood trees, hardwood brush and herbaceous vegetation more effectively than any other site preparation treatment. Control can be nearly complete with the right combination of herbicides. Several herbicides are available which kill hardwoods and herbs with little impact on pines **at recommended application rates**. Research has proven that chemical site preparation is cost effective. The greatest disadvantage to chemical site preparation lies in its long-term impact on perennial herb populations.

Advantages of Chemical Site Preparation

- Can be used where burning is not an option
- Can be applied with little soil disturbance
- Can be applied to steeply sloped sites
- Can be applied to small or large tracts
- Can be economically effective
- Can facilitate prescribed burning

Chemical site preparation can serve either of two purposes. First, herbicides can be applied alone or in conjunction with mechanical site preparation or prescribed burning, and before seedlings are planted, to reduce weedy competition during the first year or two of the rotation. In some cases, one herbicide application can be used to both kill existing brush and to control weedy competition after the trees are planted. On highly productive sites with high levels of competing vegetation, more than one application may be necessary. Several herbicides are available which, when properly applied, kill weeds and hardwood brush without killing pine seedlings.

Second, for neglected sites overgrown with brush, herbicides can be sprayed to kill undesirable vegetation to provide tree planters with access to the site. After the brush is killed, it must be reduced or removed to complete the treatment. Prescribed burning or mechanical crushing or chopping are the most effective means to reduce and remove the dead brush and weeds. Prescribed burning and mechanical site preparation are discussed in more detail later.

A number of herbicides are registered for forestry use in Arkansas. Some are only effective in the short term and when applied directly to foliage or the stem of the target plant. Other herbicides are "soil active." These herbicides persist in the soil for a few months and, in addition to killing existing vegetation, prevent new vegetation from re-invading a site. For specific recommendations, see University of Arkansas, Division of Agriculture, Cooperative Extension Service Publication MP44, *Recommended Chemicals for Weed and Brush Control* (available online at www.uada.uaex.edu or see your county extension agent).

Foliar Spraying

Foliar application of herbicide involves applying chemical to the leaves of plants in order to eradicate them or at least reduce their vigor and growth. Broadcast applications (spraying over the entire site) can be applied aerially (usually by helicopter, Figure 1) or by ground equipment. Aerial application is often the method of choice for larger tracts, steeply sloped terrain or sites with limited access.

Figure 1. An aerial broadcast application.

Ground equipment is most often used on sites with easy access and usually involves spraying from a tank mounted on a skidder, tractor or ATV (Figures 2 and 3). Often, smaller tracts are better suited for ground application. Broadcast applications must be handled carefully to prevent herbicides from drifting into sensitive sites such as streamside management zones or neighboring agricultural fields.

Broadcasting is not the only type of foliar application. Foliar herbicide applications may be banded, spot sprayed or applied as a directed spray. Banding involves spraying a band, usually 4 to 6 feet wide, centered on a row of planted seedlings. Spot spraying simply involves spraying a circular area around a seedling (generally in a 4-foot radius circle). Directed spraying involves spraying herbicide directly on weeds with care taken to avoid spraying herbicide on the planted seedlings. As indicated, these alternatives to broadcast applications are usually performed as a "post-planting operation."

Figure 2. Skidder-mounted spray rig.

Figure 3. ATV-mounted spray rig.

The timing of foliar applications depends upon the chemical(s) to be used and the goals of the treatment. Some herbicides perform better when applied early in the growing season, and others work better when applied late in the growing season. In most site preparation operations, an early-season application (called "pre-emergent application") is most desirable. Applications made after the growing season begins are referred to as "post-emergent treatments" (see MP44).

CAUTION: IMPROPERLY APPLIED HERBICIDES MAY CAUSE UNDESIRED DAMAGE. ALWAYS READ THE LABEL BEFORE APPLYING AN HERBICIDE. FOLLOW ALL DIRECTIONS, PRECAUTIONS AND RESTRICTIONS ON THE LABEL.

Soil Application

Soil application involves applying herbicides that remain effective in the soil. Soil-applied herbicides can be broadcast, applied to individual stems or applied on a grid system. These herbicides may be in liquid or granular form. Soil applications should usually be made early in the growing season to help ensure that rainfall will be present to activate the chemical in the soil.

Tree Injection

Tree injection involves injecting herbicide into the trunk (cambium) of a tree. Several tools are available for injection. The most common commercial tools are the basal injector and the hatchet-type injector (Figure 4). Most often the application is made by hacking the trunk of a tree with a hatchet and spraying a predetermined volume of chemical into the wound (hence the name "hack-n-squirt"). Though labor intensive, injection can be very useful in many situations. Tree injection can be used in conjunction with prescribed burning to remove larger stems not controlled by burning alone. Injection may be used as a follow-up treatment to a foliar application to remove surviving stems.

Figure 4. A hatchet injector.

Tree injection can be effective almost year round (excluding early spring). However, injection may be most effective when applied during the fall when trees are sending nutrients from the crown down to the roots. Again, herbicides differ, so always read the label before making an application.

Basal Bark Application

Basal bark application involves spraying chemical directly onto the bark of a tree and allowing the chemical to penetrate into the cambium of the tree. This application usually is made to the lower 1 to 2 feet of the trunk using a backpack sprayer and wetting the stem on all sides. Basal bark applications are most effective on smaller stems (less than 6 inches DBH). As with injection, basal bark applications can be labor intensive and may be best suited for smaller tracts.

Mechanical Site Preparation

Mechanical site preparation involves a wide range of activities designed to flatten and break up vegetation and/or loosen the soil. It is frequently used in conjunction with chemical site preparation. A site might be sprayed with herbicide to kill residual vegetation after a harvest, then mechanically prepared to break down or remove the dead vegetation. On the other hand, a site might be mechanically prepared, then sprayed with herbicide to prevent weedy vegetation from competing with newly planted pines. Site preparation must be planned very carefully because poorly planned site preparation not only wastes money but can severely damage wet or highly erodible soils.

Six types of mechanical site preparation are commonly used in Arkansas. They are chopping, ripping, shearing, root raking, disking and bedding. A description of each of these follows.

Chopping

Chopping is accomplished using steel drums fitted with large blades. Drums can be from 8 feet up to 12 feet long and 5 feet or more in diameter. The chopper drums are fitted with 10- to 14-inch blades which span the full length of the drum (Figure 5). Single or paired drums are pulled across the site with a rubber-tired tractor or, more commonly, a crawler tractor. As the drums are pulled across the site they crush vegetation and chop woody vegetation into small pieces. Smaller stumps are split apart, or broomed; and roots are severed. A drum can be

Figure 5. Roller chopping for site preparation.

filled with water to increase its weight and increase the chopping action. Erosion can be minimized by pulling drums up and down slopes instead of across slopes. The debris from chopping can be left in place to serve as a mulch or burned to further clear a site for planting.

Ripping

Ripping goes by several other names including subsoiling and subsoil plowing. Soils are ripped to improve survival and growth of seedlings during the first few years after planting by improving seedling root development. Ripping involves pulling a shank or set of shanks through the soil at depths ranging from 12 to 40 inches. Ripping is most commonly done at depths of 12 to 18 inches. Frequently shanks have a pair of wings at the bottom to more effectively fracture compacted soil layers. Shallow rippers can be pulled by wheeled tractors, but deep rippers usually are pulled by crawler tractors. Ripping costs vary with ripping depth and type of equipment used. Ripping depth should be determined by the depth to the compacted soil layer. Ripper wings should be set at or immediately below the depth of the compacted soil layer to increase fracturing of the compacted zone.

Ripping targets soils that have been compacted or are naturally dense and accomplishes two things which improve seedling survival. First, it facilitates planting seedlings deeply so roots have better access to soil moisture. Second, it improves the survival and growth of seedlings by loosening the soil so seedlings can develop larger and stronger root systems during the first three or four years after planting. Loosening the soil decreases resistance to root penetration, improves soil aeration and increases soil drainage. Rips collect surface runoff and improve soil drainage in soils that are compacted or are naturally dense. In soils that are dense or compacted, these changes improve seedling survival, height growth and diameter growth. However, a landowner must be careful to not rip some types of soils or rip soils under certain conditions. Ripping coarse-textured, i.e., sandy, soils can lead to excessive soil drainage which will subject tree seedlings to drought stress. Wet soils respond poorly to ripping and can even be compacted by the shank and wings.

Shearing

Shearing uses a specialized V-shaped bulldozer blade with sharpened teeth along the bottom edge. The serrated edge is used to cut or shear stumps and trees at or near the ground line. Most shear blades also have a spike at the bottom of the front edge (Figure 6). This spike, frequently called a “stinger,” can be used to split large-diameter stumps

Figure 6. Shear with stinger.

or trees before they are sheared. An experienced machine operator can shear trees and stumps at the ground line with minimal soil disturbance. Shearing frequently is a precursor to raking and piling. Shearing is not well suited to steep sites where dozers cannot operate safely.

Root Raking

Root raking uses a specialized bulldozer blade with widely spaced teeth along the bottom edge (Figure 7). These teeth are used to push logging debris into piles while letting soil pass through the blade. Inexperienced equipment operators can seriously damage a site by pushing excessive topsoil into the piles along with the logging debris. Root raking disturbs the soil extensively, so root rakes must be used carefully to keep soil erosion to a minimum. Logging debris usually is piled into long rows for burning. The piles should be oriented along the contour to slow surface water runoff and to reduce erosion. Root raking produces a clean site which makes for an easier planting job, especially if the site is to be machine planted.

Figure 7. Root rake.

Disking

Site preparation disking in a forestry context is very similar to disking in a row crop context, except that the disk is much more rugged (Figure 8). Disking works best on sites covered with brush or light slash. Results are poor on sites with heavy slash. Strip disking usually is adequate and has a couple of advantages over disking an entire site. Strip disking costs less than disking an entire site and provides less opportunity for soil erosion.

Disking has been shown to slightly increase the survival and growth rates of young pines, although the improvements may not be long-term. It loosens the surface soil layers which improves water infiltration and reduces soil resistance to root penetration. Competition from weeds has a tremendous impact on pine seedling survival and growth. One of the ways

Figure 8. Forestry disk.

disking improves seedling growth is by breaking up the roots of weeds, thus reducing the competition for soil moisture and nutrients. Disking should not be used as a substitute for ripping.

Bedding

Bedding is the process of mounding soil before trees are planted. The result is a site that looks like a row crop field with larger-than-life beds and furrows. Several different types of equipment can be used to create beds. Bedding has advantages similar to disking and ripping. On some sites bedding reduces soil bulk density which reduces the soil resistance to root penetration and increases water infiltration. Bedding also concentrates the A soil horizon within the planting row which increases nutrients available to the tree seedlings. Bedding is most useful on sites with high water tables. It improves pine growth on these sites by giving a tree room to develop a root system above the water table. More recently, bedding has been used on upland sites because of the benefits it provides to seedling growth during the first two

Figure 9. Bedding implement.

years; however, many studies indicate that these gains are lost before the first thinning.

Prescribed Burning

Prescribed burning is used for a number of purposes in forestry. In the context of site preparation, prescribed burning is used to eliminate logging debris and brush and to kill unwanted stems before a site is replanted. The greatest advantage to prescribed burning is its low cost. It is cheaper than any other form of site preparation, especially on large tracts where the landowner can use economy of scale to his greatest advantage. The greatest expense in prescribed burning is fire lane construction. This expense is only necessary for the initial burn. Fire lanes can (and should) be maintained and used for subsequent site preparation fires and for fuel-reduction burns during the life of the stand.

Smoke management is critical with prescribed burning. Burning produces smoke which must be dispersed as quickly as possible. Sending clouds of dense smoke across a highway or into a densely populated area is dangerous and presents all manner of legal liabilities. Prescribed burning may be unwise in some areas due to the proximity of highways, schools, nursing homes and other similar facilities. Some site preparation practices can be used by landowners working alone. Prescribed burning should **never** be attempted by an individual. Prescribed fires frequently breach fire lines. An individual working alone has very little chance of keeping a fire contained. Once a fire escapes, it becomes a dangerous wildfire, and the landowner can be held liable for damage done by the wildfire. Prescribed burning is a great tool for site preparation; however, landowners should hire contractors who have the training and equipment to manage a fire.

Conclusions

Good site preparation before forest regeneration is one of the best investments a landowner can make in his forests. Available options range from low-impact and low-cost treatments which provide modest returns to high-impact and high-cost treatments which provide greater returns. The key to taking advantage of these site preparation options and the returns on investment is planning. Plans for site preparation should be made before the harvest begins. Landowners should hire and work with a consulting forester to plan timber harvests, site preparation and reforestation.

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