ALABAMA'S REFORESTATION OF ABANDONED MINE LANDS

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Abstract

As administering agency for Alabama's Abandoned Mine Land Reclamation Program, the Department of Industrial Relations has been in the tree planting business for over 25 years. Its nationally recognized reforestation program has evolved from hand-planting orphan (ungraded) abandoned mines to state-of-the-art techniques involving soil testing, ripping (to loosen heavily compacted spoils), spraying (to reduce competition), mechanical planting, and use of genetically improved seedlings. Over 8 million seedlings have been planted to date.

Reforestation is a long-term commitment. Once you've made that commitment, our photo-tour will show you how to get the job done, from choosing the right nursery, through proper care and handling of seedlings, boosting survival rates, overcoming problems with excessive soil compaction and competition from herbaceous vegetation, to long-term management. We'll also recommend setting up partnerships with local soil and water conservation districts to make sure the job gets done right.

Reforestation of abandoned mine lands not only provides long-term soil stabilization, but provides cover and habitat for many wildlife species, while increasing land productivity and enhancing property values.

Introduction

Since 1977, Alabama's Abandoned Mine Land Program has been committed to reclaiming and revegetating previously mined lands, with 87 percent being reforested. Loblolly ines account for 85 percent, with the remaining trees consisting of autumn olive, sawtooth oak, bicolor lespedeza, cherrybark oak, sycamore, yellow poplar, and other wildlife shrubs.

Over the past 100 years, large draglines ripped through the earth and rock to create huge spoil piles of overburden, left to erode and be inhabited with grass, weeds, non-commercial shrubs, and some pines and hardwoods. Most sites consist of rough, ungraded spoils, water impoundments, dangerous highwalls, coal refuse "gob" piles, and industrial and residential waste piles. Spoil piles are compacted by heavy equipment, heavy noxious weeds invade the site, and large rocks are spread throughout the piles. Naturally, all unwanted vegetation must be cleared, impoundments drained, and waste buried or removed to a solid waste landfill. Compaction must be reduced, especially in rows where trees will be planted.

Over the past years, Alabama has developed a recipe for reforestation success:

- $ Proper site preparation
- $ Adding needed soil amendments
- $ Proper soil composition and moisture
- $ Rip and spray to reduce compaction to control competing vegetation
- $ Purchase quality seedlings from superior nurseries and take proper care of seedlings
- $ Use proper planting techniques and practice quality controls
- $ Plant seedlings with good soil moisture and cold weather

These ingredients must be discussed in some detail to explain how critical each and every one is to final tree survival and growth.

Site Preparation

All impoundments are drained using approved dewatering procedures, unwanted vegetation is cleared and burned, trash and waste buried on-site, or transported to an approved landfill, then grading of spoils begins. All highwalls are backfilled with on-site spoil material, including impoundments, then sloped to a 3:1 or flatter slope. Slopes are stabilized by adding terraces at necessary intervals, which are protected by erosion control fabric or limestone riprap.

Soil Amendments

A comprehensive soil analysis is performed by certified soils laboratories to determine the type of amendments needed and quantities necessary for proper plant growth. In Alabama, large amounts of lime and high nitrogen fertilizer are required on most sites. These chemicals are spread, disked into the graded soils, and heavy layers of hay mulch are spread and crimped to create a prime seedbed. A mixture of native grasses and legumes is spread to germinate and stabilize the site until trees can be planted during the following winter. Some areas are hydro-seeded with a mixture of wood pulp fiber, fertilizer, and grass seed.

Soil Composition and Moisture

Careful attention is devoted to the upper layer of soil in which roots of grasses, legumes and seedlings must develop and survive, adding to the organic material and re-establishing topsoil.

Hay mulch is added not only to hold seed and soil in place, but provides the initial head start on organic buildup in the soil. Proper amounts of mulch hold moisture in the soil and reduce sun and wind dehydration and erosion.

A mixture of Pensacola Bahia grass, hulled common Bermuda, hulled sericea lespedeza, browntop millet, and crimson clover are planted in spring and summer. A heavier mixture is planted in fall and winter, consisting of the same seed, plus unhulled common Bermuda grass, unhulled sericea lespedeza, Kentucky 31 fescue, common annual ryegrass, and inoculated crimson and ladino clover. The mix of grasses work together to establish a thick root mass in the upper six inches of soil, while the legumes fix nitrogen in the soil, further promoting root growth

and aiding soil micro-organisms in colonizing and building up organic matter over time. Site conditions vary across Alabama, so the mixture of grasses, legumes and soil amendments is also tailored to each site, based on the comprehensive soil analysis.

Rip and Spray

As we have already discussed, soil compaction, competing vegetation and rocky soils are three limiting factors to successful revegetation and reforestation of graded mine spoils. We developed a subsoiler with a spray attachment to spray a four (4) foot swath along the ripped row where trees will be planted during the winter. Each row is ripped to a 14-inch depth, and a 55-gallon herbicide mixture of 2.5 gallons of Roundup Pro, 10 ounces of Oust, and water is sprayed two (2) feet on each side of the row. Ripping is done in October each year and opens a channel for planting bare root seedlings, moving rocks out of the row. Herbicide controls competing vegetation to an acceptable level, allowing seedlings room to grow and develop a good root system during that critical first year. Rows are ripped on 10-foot spacings where possible, even in areas that must be hand-planted, to allow trees to be planted on a 6-foot x 10-foot spacing to achieve 726 trees per acre. In Alabama, this step is critical to control weeds and grasses for good seedling survival. The soil amendments and mulch almost always produce a lush carpet of grasses to stabilize each site until trees can be planted and grow to produce a forest to permanently hold the site in place.

Seedling Quality and Care

Now that the site is prepared, stabilized with grasses, and ripped and sprayed, the next step is to procure quality tree seedlings that have an excellent chance of survival. Of course, trees must be ordered six months to one year prior to actual planting to allow tree nurseries to grow what their customers need. Almost all tree nurseries in the Southeast are members of a pine plantation cooperative, which continually produces superior seedlings from genetically improved seed orchards across the region. Seedlings are grown in soil mediums consisting of sand clay loam, decomposed sawdust, and pisolithus tinctorius bacteria. The bacteria attaches to the feeder roots of seedlings in a symbiotic relationship, which greatly increases the plant's ability to uptake moisture and nutrients. Genetic improvement results in trees that are fusiform rust and root rot resistant, and increased growth rates, resulting in good form and right-angled limbs that prune with the least amount of bole exposure.

Seedlings at superior tree nurseries are undercut in August of each year to force root systems to branch out. This produces a really fibrous root system to support seedling growth during that critical first year along in the environment. Most nurseries also grade seedlings to discard trees with Cronartium cankers (fusiform rust), forked trees, and weak seedlings.

Trees are planted in January through March of each year, so trees are picked up at tree seedling nurseries, transported in covered trucks, vans or trailers to prevent dehydration from wind and sun exposure. Then, trees are stored on racks in a humid cold storage building designed to keep temperatures 40-45 degrees Farenheit. This keeps seedlings dormant and moist until transported to the site and planted. As trees are brought to the site, they are kept in shade and covered to protect from sun and wind exposure, preserving moisture. On warm days, trees are simply kept

moist in the shade.

All this care is necessary to nurture seedlings until they are planted, for each tree should be green, dormant, and healthy. They are, after all, baby trees and must be pampered somewhat. As we often say around planting sites, the best way to boost survival rates of trees planted is to 'plant live trees." This may sound ridiculous but seedlings may be green and look fine and be completely dead.

Most pine trees planted are loblolly pine, but some sites are planted with longleaf pines at the owner's request. All trees planted are bare root, and include hardwood trees and wildlife shrubs.

Planting Techniques

In the beginning, contractors were hired to plant trees on reclaimed AML sites, which afforded little control over seedling quality, care, planting techniques, and quality control over planting. So, in 1987 we decided to take control of our reforestation program, and plant good seedlings, properly, on all reclaimed sites. The Walker County Soil and Water Conservation District Board began planting seedlings under a long-standing cooperative agreement with the Department. Survival rates improved dramatically, then, in 1991, we purchased a Reynolds F-050 split-axle tree planter. The planter foot and colter were modified and strengthened for harsh soil and rock conditions. Frequent care and maintenance have kept the planter functioning properly, and we anticipate many years of operation on mine spoils. A dual-wheeled farm tractor is used to pull the planter along previously ripped rows. Workers riding in the planter place trees on 6-foot spacings, and another worker follows to straighten trees and plant skips in rows. Steep slopes are hand-planted with dibble bars, using proper planting techniques. A professional registered forester oversees all tree planting, and performs quality-control checks on planted trees to guarantee proper planting, packing, spacing, and seedling care.

Soil Moisture and Weather

Cold weather and good soil moisture are critical to seedling survival and growth. Sites are monitored to check for proper planting conditions, then trees are planted during optimum conditions from daybreak to dark. Tree planting season is the number one priority when conditions are right, but planting will be suspended if soils become dry or the weather gets too hot. Seedlings are returned to cold storage where they remain until adequate moisture and cold weather conditions return. Conditions vary widely across Alabama, so crews can usually move to another location to continue planting, then move back to a previous site as necessary. If soil amendments, mulch and grasses have been added to graded mine spoils, then organic matter will buildup to hold soil moisture and provide much-needed nutrients for bare-root seedlings. Moisture, organic material and nutrients are concentrated in ripped trenches that have closed during the months prior to planting.

Seedling survival surveys are performed during the fall following planting to determine survival rates, health, growth, and if replanting is necessary on any areas. Such surveys are essential in monitoring any reforestation program and help identify problems, such as poor planting techniques, weak seedlings, poor soil conditions, acid soils, and too much competing vegetation.

If all of the above ingredients are added to your reforestation recipe, then you will have a successful program with good to excellent survival rates. Even during drought conditions, seedlings will survive and establish deep root systems to catapult them upward during the next spring growth season.

We have also surveyed older pine plantations for survival rates, growth and stand density. Site index is good to excellent after reforestation and shows all indication that the new site index will be as good or better than pre-mined site index. For example, many 11-year-old trees are 30-40 foot high and 6-8 inches in diameter at breast height. Projections to age 50 would not be reliable at this point, but all indications are excellent to show improvements over the original site index.

A recent study by Dr. E. Sam Lyle, Jr., and Jim L. Kitson of the Walker County Soil and Water Conservation District Board in Boldo, Alabama, was completed in 1999 on twenty-seven sites chosen at random. The results showed survival ranges from 77.0 to 99.7 percent, with an overall average of 86.1 percent. The study also showed decreased survival rates with age; however, stands naturally prune unhealthy and undesirable trees, allowing the survivors opportunity to grow better without the added competition. Forest industry in Alabama establishes an average 726 trees per acre during planting and desires an average 500 trees per acre at age 5. Studies have shown that the maximum basal area of tree volume can be achieved at that stocking rate. Dr. Lyle's study showed that we had more than 500 trees per acre surviving at age 5.

Landowners have the option to thin plantations at ages 10-12 years, 20-25 years, and final harvest at age 30. We have no control over their timber stand management, but provide them with a healthy, quality forest to manage for wood production, recreation and wildlife management. Many landowners are now having their forests certified through the Tree Farm Program and Treasure Forest Program, which requires frequent and professional management.

Alabama Leads the Way in Reforesting Abandoned Mine Lands

Alabama's reforestation of abandoned mine lands not only heals scars created by past surface coal mining to fuel the nation's wars and the Industrial Revolution, but establishes young forests for many uses. As trees grow, carbon dioxide is removed and oxygen is added to the atmosphere, carbon is stored in wood tissue, raw material is grown for forest products, soil is stabilized and enhanced, water quality is improved, and widely varied wildlife habitat shelters many terrestrial and aquatic communities.

Another successful tree planting season has been completed by the Alabama Department of Industrial Relations on the State's abandoned mine lands. During the 2001-2002 tree planting season, 47,000 seedlings (loblolly pine, sawtooth oak, and various wildlife-food shrubs) were planted on 124 reclaimed acres across 7 counties. The seedlings were planted by the Walker County Soil and Water Conservation District Board through a cooperative agreement with ADIR. The table below shows that since ADIR began reclaiming abandoned mines in 1976, over 7 million trees have been planted on 9,391 acres of reclaimed lands in 14 north Alabama counties.

TREE PLANTING SUMMARY

TVA ORPHAN MINE LAND RECLAMATION PROGRAM (1976 - 1980)
- AND -
ABANDONED MINE LAND RECLAMATION PROGRAM (1983 - 2002)

County	Acreage Treated	Pines	Wildlife Shrubs	Other*	Total Seedlings
Bibb	195	105,630	14,300	12,230	132,160
Blount	1,244	505,529	214,300	13,850	733,679
Cullman	389	96,300	167,300	4,300	267,900
DeKalb	40	25,450	0	200	25,650
Fayette	58	43,125	400	1,200	44,725
Franklin	27	19,650	1,450	1,600	22,700
Jackson	283	53,000	67,000	0	120,000
Jefferson	624	384,013	45,600	32,300	461,913
Lamar	29	11,800	1,500	1,800	15,100
Marion	1,383	567,100	221,100	2,400	790,600
St. Clair	152	82,000	6,200	9,810	98,010
Tuscaloosa	835	491,600	69,100	52,300	613,000
Walker	2,578	1,684,349	656,200	27,560	2,368,109
Winston	1,554	900,184	419,100	6,350	1,325,634
TOTALS	9,391	4,969,730	1,883,550	165,900	7,019,180

*Sawtooth oak, cherry bark oak, white oak, sycamore, yellow poplar, etc.

As part of the reclamation process, all sites in Alabama are planted in permanent, native grasses and legumes to stabilize the soil after grading. Then, during the following fall, rows are ripped with a subsoiler on 10-foot intervals, and the herbaceous vegetation sprayed simultaneously to reduce competition for new seedlings. Seedlings become available for planting in late November or early December. The Board utilizes a customized machine planter that follows the rows established during the rip and spray operation. All areas are machine-planted where possible; steep slopes and wet areas are hand-planted. Seedling survival surveys are conducted during the following fall, and any areas with less than adequate survival are replanted. Routine maintenance of reclaimed projects ensures soil stability and successful tree growth. Reforestation of reclaimed abandoned mine lands not only stabilizes the soil, but provides cover and habitat for many wildlife species, while increasing land productivity and enhancing the taxable value of property.

A recent survey by the Interstate Mining Compact Commission of States' reforestation efforts indicated that Alabama leads the nation in both number of trees planted on abandoned mine lands, as well as highest survival rate after planting. This achievement is due to the availability of top-quality, genetically-improved seedlings, proper care and handling, supervision by qualified reclamation inspectors, and superior tree planting methods employed by the Board.

Bill Guyette is the Director of State Programs Division of the Alabama Department of Industrial Relations. He has 25 years reclamation experience in the State of Alabama, including

supervising tree planting crews under TVA - sponsored Orphan Mine Land Program, authoring Alabama's State Abandoned Mine Land Reclamation Plan, and serving as agency head planner and deputy administrator prior to his present position. During this time over 8 million trees were planted on Alabama's abandoned mines. He has been involved in all aspects of reforestation on mine lands, from care and handling of seedlings to setting up partnerships with local soil and water conservation districts. He currently serves as president of the National Association of Abandoned Mine Land Programs. He holds a B.S. in Environmental Science and Forestry from Syracuse University and is a licensed forester.