# TREE IMPROVEMENT ON MARGINAL SITES

Clark W. Lantz[1]

Abstract. --Marginal forest sites represent a vast untapped natural resource in the south. At least 25 million acres of low quality hardwood sites have the potential of commercial production. The production of short-rotation pine timber crops on these areas is one direct means of increasing wood supplies from a diminishing land base. An example is presented of a study in Oklahoma of the conversion of a "Cross-Timbers" area (post and blackjack oak) to pine. The first year survival and growth of planted shortleaf, loblolly and Virginia pine seedlings was excellent. Two exotic species (Pinus brutia and P. pinaster) have not survived well.

Additional keywords: Forest type conversion, herbicides, aerial spraying, direct seeding.

## INTRODUCTION

The demand for wood and wood products will continue to increase. Reliable estimates of this demand indicate that by the year 2000 (only 25 years from now!) the population of the United States will have increased to more than 300 million (Southern Forest Resource Council, 1970). These estimates also indicate that the total consumption of paper will double by the year 2000 (Seaton et al, 1973) and that the demand for all other wood products will also double (Southern Forest Resource Council, 1970).

How can *we* produce enough of the raw material (timber, wood, fiber) to meet this demand? Four major alternatives are listed in the Report of the President's Advisory Panel on Timber and the Environment (Seaton et al, 1973):

1. Import more timber and export less.
2. Use less timber.
3. Make better use of the timber available.
4. Grow more timber.

Alternatives 1, 2, and 3 are clearly within the realm of legislation, economics, and manufacturing. However, as tree breeders and forest managers, we can work with alternative number 4. Certainly we need to maximize growth on our most productive sites. The total acreage in these high productivity areas continues to decrease however. For example: from 1962-1970, 20 percent of the South's bottomlands were cleared for row crop production (Seaton et al, 1973). Much of this was in response to the strong demand for soybeans. When beef prices were high, many good pine sites were cleared for pasture. Pressures from concerned "environmentalists" (justified and unjustified) have limited wood production on many areas. The net result of all of these factors is a continual reduction in the productive forest area in the South.

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1./ Associate Professor, Department of Forestry, Oklahoma State University, Stillwater, OK 74074 (Research study by Cooperative Agreement between the Oklahoma Agricultural Experiment Station and Sarkeys Foundation).

The total commercial timberland in the South in 1970 amounted to 192 million acres (U.S. Forest Service, 1973). This is land which has been classified as capable of producing industrial wood and not withdrawn from timber utilization (wood growth of at least 20 cubic feet per acre per year). The productivity of this commercial timberland is outlined in Table 1.

Table 1. Productivity Classes of Commercial Timberland in the South (1970)

| Productivity in Cubic Feet Per Acre Per Year | Million Acres | % of Southern Commerical Timberlands |
|---|---|---|
| 120 + | 13 | 7.0 |
| 85 - 120 | 53 | 27.8 |
| 50 - 85 | 90 | 46.5 |
| 20 - 50 | 36 | 18.7 |
| | 192 | 100 |

The lowest class (all land growing from 20 to 50 cubic feet of wood per acre per year) amounted to 18.7 percent of the commercial timberland acreage in the South in 1970. In addition to this 36 million acres there are 17.6 million acres in the South which are classified as "unproductive", meaning they are growing less than 20 cubic feet of wood per acre per year. Many of these acres are capable of higher productivity levels under more intensive management. These unproductive areas include many familiar names such as pinyon-juniper. chaparral, scrub oak, sand, Cross-Timbers, and just plain "brush fields". Unfortunately these areas are often placed in the "unproductive" category simply due to a lack of data. Even though the natural vegetation is growing less than 20 cubic feet of wood per acre per year, a more productive species under intensive management may produce 2 or 3 times more wood on the same acre.

Anderson and Guttenberg (1971) have estimated that 50 million acres in the South have the potential for conversion to pine plantation. This total includes 25 million acres of oak-hickory timber type and 25 million acres of oak-pine type. Virtually all of this area is growing less than 85 cubic feet of wood per acre per year and much of it less than 50 cubic feet per acre per year.

Increasing the productivity of these marginal sites can be accomplished by a number of methods. Conversion of the native vegetation to a more productive species is often the most efficient method. In addition, direct site treatments such as ripping compacted subsoil strata serve to improve water infiltration rates, increase root pentration, and reduce planting costs. Tubelings and other types of containerized seedlings may be required on droughty soils. In wet areas, bedding and ditching have often improved both survival and growth. Fertilizers and herbicides have also been successfully used on a wide variety of sites. Hybrids and exotic species have survived and produced more wood than the native vegetation of specific sites. Progeny

test results have indicated that certain clones and certain families perform better on marginal sites than other tested material. It seems evident that a careful site evaluation followed by intensive site treatments and management will permit many marginal forest sites to reach profitable productivity levels. The following section is an example of marginal site utilization in Oklahoma.

Marginal Forest Sites in Oklahoma

There are 4.8 million acres of commercial forest land in Oklahoma (Sternitzke and Van Sickle, 1968). About 93 percent of this total is growing less than 85 cubic feet of wood per acre per year, and 65 percent is growing less than 50 cubic feet per acre per year. In addition to this commercial forest acreage, the 6.2 million acres of the "Cross-Timbers" type in Oklahoma (Gray and Galloway, 1959) represents a natural resource with an undefined potential for commercial forestry operations. (The following description of the Cross-Timbers area is quoted from Gray and Galloway, 1959, pp. 29-31). "The Cross Timbers is a large wooded area of rolling to hilly sandstone uplands extending from the Kansas line to Texas. It is an area of scrubby timber in which old growth is more or less open and park-like. Cutting and burning have caused prolific sprouting of the post and blackjack oaks to form many brushy thickets. Since the large areas lie between the eastern and central prairies, they were dreaded by early travelers who had to cross the timber belt on foot or on horseback - hence the name Cross Timbers."

Unfortunately, volume and growth data are not available for these Cross-Timbers areas. The poor form and low stocking rates of the post and blackjack oaks produce stands which vary in growth from an estimated less than 10 cubic feet per acre per year to a maximum of 50 cubic feet per acre per year. The only marketable wood produced consists of firewood and occasional cross-ties.

Attempts to improve the productivity of these Cross-Timbers areas have included chemical, mechanical, and prescribed burning treatments to remove the native vegetation. In some areas these conversion treatments have been followed by seeding and fertilization for improved pasture, whereas, in other areas native grasses have been allowed to take over. These treatments are expensive, and not always economically justified in terms of cattle production. Short-rotation pine timber crops (for example: pulpwood, fence posts, or barn poles) may be an attractive land-use alternative for some landowners of Cross-Timbers land.

Due to the fact that the Cross-Timbers area is outside the natural range of pines, the native vegetation must be killed and pines established by planting or direct seeding. These efforts to establish pines in the past have often failed due to high planting costs, lack of adequate fire control, and unreliable soil moisture. The shallow, rocky soils prevent the use of planting machines and slowdown hand planting crews. When adequate stands of trees have been established, wildfires have often destroyed them. Direct-seeding trials designed to reduce the cost of establishment have frequently failed due to the limited moisture storage in these shallow soils. An additional factor which must be considered when direct-seeding is the absence of specific mycorrhizae in the soil.

The Study Area:

This study is located on a typical Cross-Timbers site, two miles east of Lamar, Oklahoma (Hughes County) on land owned by Sarkeys Foundation. This area lies on the western edge of the natural range of shortleaf pine (Pinus echinata), in the forest-prairie transition zone. The dominant vegetation on the study area consists of post oak (Quercus stellata), blackjack oak (Q. marilandica), and hickory (Carya species), with an understory of tree huckleberry (Vaccinium arboreum), winged elm (Ulmus alata), and persimmon (Diospyros virginiana). Small stands of shortleaf pine are growing near Lamar and Calvin on the South Canadian River and scattered individual pines are growing near the study area. The soils are of Hector and Hartsell series and are shallow, extremely rocky, and well eroded on slight to moderate slopes. Mean annual precipitation ranges from 38 to 40 inches.

## PROCEDURES

The native vegetation was killed by a combined aerial spraying of herbicides (2 pounds of 2, 4, 5-T + 1/2 pound picloram per acre) and prescribed burning. In January 1973, 1974, and 1975, all plots to be planted that season were burned to reduce competing vegetation. The two pine species native to Oklahoma (loblolly pine and shortleaf pine) were hand planted and direct seeded in February of each year. Three exotic species: Pinus brutia (Turkey), Pinus pinaster (Spain, Portugal, France), and Pinus virginiana (Alabama: Kimberley-Clark seed orchard) were also hand planted on these same three dates. All treatments were replicated three times in each of the three planting years. Planting was designed at a 6 x 8 foot spacing while direct seeding was done at the rate of one pound per acre for loblolly and 3/4 of a pound per acre for shortleaf. All seed was stratified for 30 days and treated with arasan. All plots will be evaluated annually for survival, growth, form, and damage from insects, disease, or animals for a 20-year period.

## RESULTS

The first and second year survival and growth of planted shortleaf, loblolly, and Virginia pine seedlings was excellent. The survival percentages of the individual species for the first year were as follows: loblolly 97, Virginia 88, and shortleaf 81 (Figure 1 and Table 2). The second year survival and growth for the same three species also appears to be very good although specific data cannot be included at this time. The height growth of many seedlings has been outstanding, with several loblolly and shortleaf seedlings taller than 26 inches at the end of the first growing season and several trees taller than 4 feet at the end of the second growing season.

The survial of planted brutia and pinaster seedlings has been disappointing (Table 2) as has the direct-seeded loblolly and shortleaf. It appears that the severe competition from grass and weeds following prescribed burning is responsible.

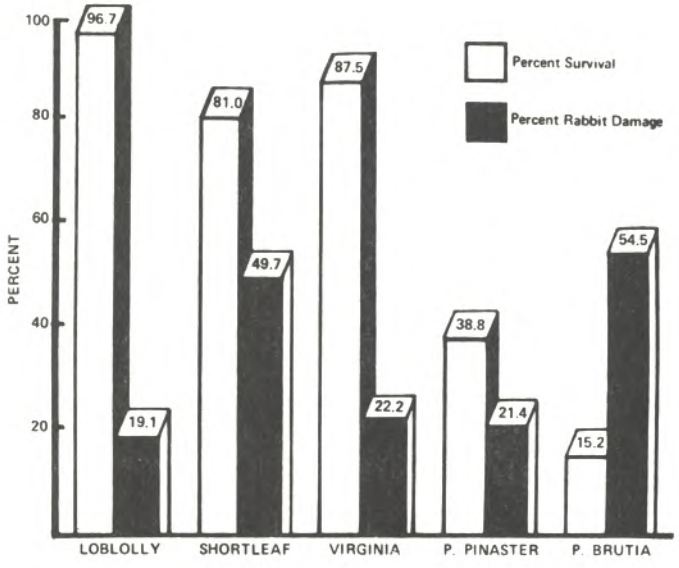


Figure 1. Survival and Rabbit Damage for Planted Seedlings

Table 2. First Year Survival, Growth, and Rabbit Damage of Planted Seedlings

| | Shortleaf Pine | Loblolly Pine | Virginia Pine | Pinus Pinaster | Pinus Brutia |
|---|---|---|---|---|---|
| Survival (%) | 81 | 97 | 88 | 39 | 15 |
| Rabbit Damaged Seedlings (%) | 49 | 19 | 22 | 21 | 54 |
| Mean Height of Rabbit Damaged Seedlings (inches) | 9.4 | 10.0 | 10.2 | 9.0 | 9.8 |
| Mean Height of Undamaged Seedlings (inches) | 16.0 | 17.1 | 17.7 | 12.9 | 16.5 |
| Mean Height of all Combined | 12.7 | 15.7 | 16.1 | 12.7 | 12.5 |

In this study, as in many other pine planting studies, rabbits frequently chewed on needles and buds and clipped the terminal shoots. Although the rabbits damaged 19 percent of the loblolly seedlings, 22 percent of the Virginia seedlings, and 49 percent of the shortleaf seedlings during the first growing season, very little mortality has resulted from this damage. (Notice the marked preferential feeding on the shortleaf seedlings in Table 2.) In most cases, the clipped seedlings have resprouted from new buds, resulting in only a minor growth loss. In addition, the second-year rabbit damage was considerably less severe than in the first year. The 1975 planting included a series of fenced seedlings in an effort to gain a more objective estimate of the rabbit damage.

Another local hazard was observed during the second growing season, when 25-30 of the tallest seedlings were killed by girdling from buck deer rubbing of antler velvet on the stems.

## CONCLUSIONS

A successful forestry enterprise must produce a timber crop which can be sold at a profit. It is entirely possible that some of these trees will be fence posts or pulpwood size in 8 to 10 years. It is also possible that additional income may be available from grazing. At this time, an economic evaluation will be made comparing the establishment and management costs and the income produced.

At this time, it seems safe to say that loblolly, shortleaf, and Virginia pines, from the proper seed source, can be established on this site in adequate numbers. It should be recognized however that insect or animal damage and/or wildfires can destroy these seedlings at any time. In addition, a prolonged drought may reduce growth and possibly cause extensive mortality.

In conclusion, it is possible to establish pines on the Cross-Timbers area of Oklahoma during the years of adequate moisture. It is better to plant than to direct seed because of the greater growth and survival of planted trees during the first year. Loblolly, shortleaf, or Virginia pine can be recommended for planting. It is highly possible that landowners in the "Cross-Timbers" area of Oklahoma will have short rotation timber crops as an attractive land-use alternative in the very near future.

Other marginal sites throughout the South need to be evaluated for potential wood production. If only half of the 25 million acres of oak-hickory type could be brought into wood production averaging half a cord of wood per acre per year, this would yield 800 million cubic feet of wood per year. This is more wood than all of the roundwood harvested in the state of Georgia in 1970!

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