FIRST-YEAR EFFECTS OF PLASTIC TUBE SHELTERS, WIRE CAGES, AND FERTILIZATION ON PLANTED NUTTALL OAK SEEDLINGS

Troy S. Taylor and Michael S. Golden[1]

Abstract—A Study was implemented in western Alabama to compare the growth and survival of Nuttall oak (*Quercus nuttallii*) seedlings using plastic tube shelters, wire browse protection, fertilization, and control. A total of 324 Nuttall oaks were planted at a bottomland site in Greene County, Alabama. One-third of the seedlings were enclosed in 48-inch tall opaque plastic shelters. One-third of the seedlings were encircled with 48-inch tall wire fencing. The remaining seedlings were left as control. Fertilization tablets were supplied to one-half of all seedlings in each protection treatment. Black plastic mulch mats were utilized with all seedlings to help suppress herbaceous weeds. Initial measurements on seedling height and caliper growth were taken after planting in March 2000. First year growth measurements were taken in January 2001 and will be remeasured each winter thereafter. Plastic tube shelters stimulated both greater seedling height and diameter growth, compared to the wire cages and control treatments. Furthermore, fertilized seedlings exhibited significantly greater height growth and diameter growth compared to those without. Incidence of animal browse was significantly reduced by the presence of seedling protection devices.

INTRODUCTION

The reproductive characteristics of some of the most desirable timber and wildlife tree species, particularly the oaks, create special problems in successfully reproducing them after a harvest. Due to the thousands of mismanaged acres of bottomland forests that exist in Alabama from past high-grading, the oak component in many floodplains is scattered and of poor quality. High-quality sites that have been harvested commonly experience widespread oak regeneration failures. This is a critical problem because the oak species group is one of the major and more valued for the hardwood products industry (Aust and others 1984). The failures range from almost a complete loss of the oak component to a reduction in the relative dominance of oaks in the stand when compared to the composition of the pre-harvest stand (McGee and Loftis 1993). Sander and Graney (1993) report that although oaks are among the most abundant overstory species in many stands, they are often replaced in the reproduction that follows harvesting because of lack of adequate oak advance reproduction. Obtaining adequate oak regeneration is especially difficult on highly productive sites where understories are often well developed and dominated by shade-tolerant species. Often times advance oak regeneration is present in the understory but is outgrown and shaded out by competitor species.

At all sizes, oaks do not survive and grow well in dense, shaded conditions. Even in full sunlight, germinating seedlings allocate much of their growth to their root systems in the first few years and exhibit slow early height growth. The paradox is that developing oak regeneration on productive sites has been difficult because stand prescriptions that encourage oak regeneration are the same conditions which favor the development of potentially faster growing competitor species (Kormanik and others 1995).

A multitude of plant species are able to germinate in the open-light conditions after a harvest on fertile floodplain soils. Many of these have the potential to restrict oak reproduction by creating conditions unfavorable to oaks. For high quality sites that are prone to natural regeneration failures, artificial regeneration can offer an alternative and viable solution. For artificial regeneration to be successful in highly productive river bottoms, some precautions need to be taken to ensure seedling survival and growth. There are two factors that need to be carefully considered when planting oak seedlings along river bottoms in the South: (1) the faster growing competitor species (vines, undesirable tree species, and herbaceous weeds), and (2) the high population density of white-tailed deer (*Odocoileus virginianus*) and, occasionally, of feral pigs as well. To address these issues it is necessary to protect seedlings from animal browse while at the same time creating and environment conducive to seedling height growth.

OJECTIVES

The objectives of this study are to determine whether there are differences in the growth, survival and animal browse intensity on planted Nuttall oak seedlings which have been subjected to various combinations of plastic tube shelters, wire cages, artificial mulch mats, and fertilizer tablets.

[1]Graduate Research Assistant; Associate Professor, School of Forestry and Wildlife Sciences, Auburn University, Auburn, AL, respectively.

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METHODS/PROCEDURES

A recently cutover bottomland site was located north of Demopolis in Greene County, Alabama, in the floodplain of the Black Warrior River. Two planting areas were located at this site and their boundaries were marked. In the spring of 2000, a total of 324 Nuttall oaks were planted in holes dug using a portable gas-powered auger with a 6-inch bit. Three protection treatments were utilized—plastic tube shelters, wire cages, and control (no protection). One half of all seedlings of each protection type were fertilized at the time of planting with two 10-gram fertilization tablets (20-10-5). Approximately two cups of water were applied to each seedling one week after planting to aid in moisturizing the root systems due to a coincident drought. After planting, seedling height and caliper (at 1-inch above groundline diameter) were recorded. In January of 2001, seedling height and caliper were again recorded, and a measure of browse intensity was documented. At the end of the second growing season, seedling height and caliper will once again be measured, and a portion of seedlings within each protection and fertilization type will be excavated so that differences in root biomass can be examined.

EXPERIMENTAL DESIGN

1-0 Nuttall oak seedlings were obtained from E.A. Hauss Nursery in Atmore, AL, and stored in refrigerated coolers until planted in February, 2000. 162 seedling pairs were planted at the study site. Seedlings were planted at 20-ft by 20-ft spacing. Fertilizer application and seedling protection type were assigned randomly. All protection/treatment combinations were represented equally with 27 seedling pairs (54 total seedlings) for each of the six combinations of protection and treatment (plastic tube shelter, wire cage, control—with and without fertilizer application.

RESULTS

General Linear Model analyses were used to examine the relationships between treatment/protection type and first-season seedling height and groundline diameter growth. The first analysis was computed with height growth as the dependent variable and protection and fertilization class as independent variables. Results were significant: R-square = 0.5655, P = 0.0001 for protection and P = 0.0293 for fertilization. The interaction of protection type and fertilization was not significant for seedling height growth.

The second analysis was computed with first-season groundline diameter growth as the dependent variable and protection and fertilization class as the independent variables. Results were significant: R-square = 0.1431, P = 0.0009 for protection and P = 0.0010 for fertilization. The interaction of protection type and fertilization was not significant for seedling groundline diameter growth.

For seedling height growth, Duncan's Multiple Range Tests indicated significant differences among the means of protection type used. The use of plastic tube shelters stimulated greater height growth among seedlings than either the use of wire cages or control (table 1). There were no significant differences between seedling mean height growth of either wire cages or the control seedlings. Additionally, there were significant differences in seedling height growth for fertilizer application. Fertilized seedlings exhibited significantly greater height growth in the first growing season than those unfertilized (figure 1).

Table 1—Mean first-season height and diameter growth by protection type and fertilizer use. Protection types are as follows: S - plastic tube shelter, W - wire cage, C - control, no protection. Means followed by the same letter within the same column are not significantly different at the alpha = 0.05 level

Protection type	N	Mean height growth (cm)	Mean GLD growth (cm)
S	54	50.06a	4.51a
W	54	11.74b	3.69b
C	54	6.78b	3.28b

Fertilization application	N	Mean height growth (cm)	Mean GLD growth (cm)
yes	81	25.90a	4.27a
no	81	19.82b	3.38b

For seedling groundline diameter growth, there were also significant differences among the means of protection types used. The use of plastic tube shelters stimulated greater groundline diameter growth than seedlings utilizing wire cages or the control group (table 1). There were no significant differences between the mean diameter growth of seedlings of the wire cages and control seedlings. Fertilized seedlings exhibited significantly greater groundline diameter growth in the first growing season than those unfertilized (figure 2).

Seedlings protected by either the opaque plastic tube shelters or the wire cages experienced very little damage due to browse, and then only if the terminal bud had protruded

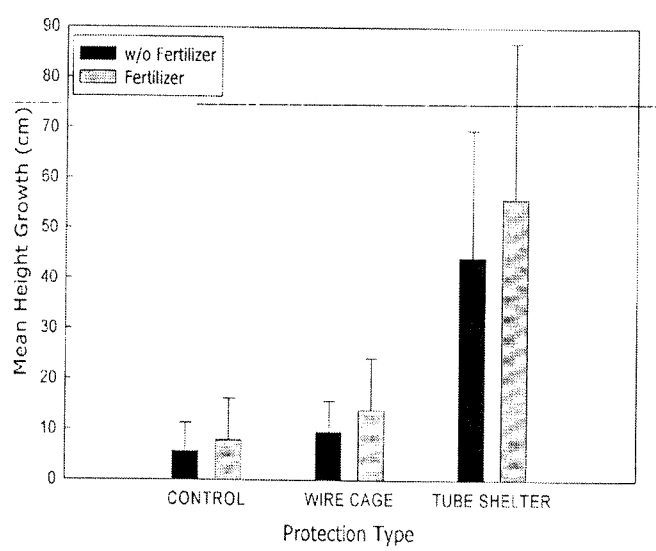

Figure 1—Mean height growth of Nuttall oak seedlings by protection type after one growing season.

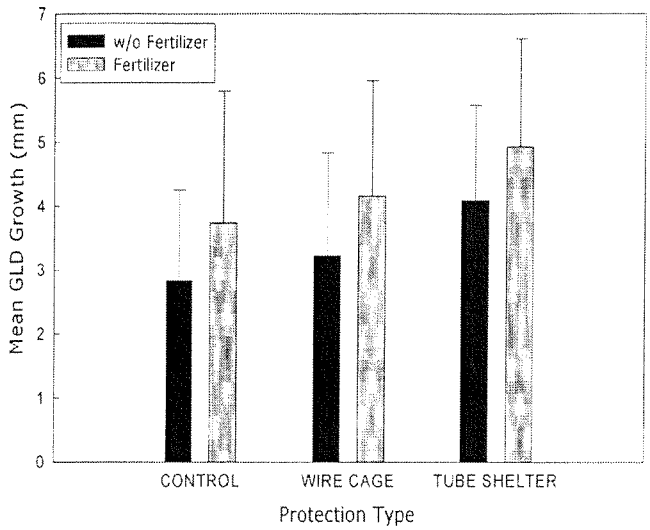

Figure 2—Mean GLD growth of Nuttall oak seedlings by protection type after one growing season.

through the top of the protection device. In contrast, 95.4 percent of the unprotected (control) seedlings were damaged by animal browse of some type and no longer retain their terminal buds. Of these, 28.2 percent of seedlings sustained browse heavy enough to cause extensive forking along the bole while 67.2 percent have only been slightly browsed (figure 3).

CONCLUSIONS

The 48-inch tall opaque plastic shelters stimulated both greater seedling height and groundline diameter growth compared to those enclosed in wire cages or those in the control treatments. Also, fertilized seedlings exhibited significantly greater seedling height growth and groundline diameter growth compared to those utilizing no fertilizer. Incidence of animal browse was significantly reduced by the presence of seedling protection devices.

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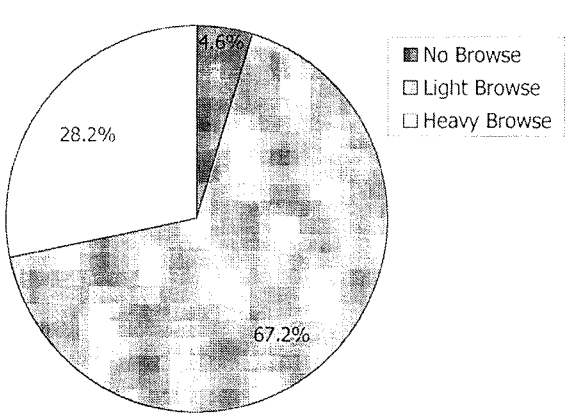

Figure 3—Browse incidence of unprotected (control) Nuttall oak seedlings after one growing season.

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