RESPONSE TO FERTILIZATION OF FIVE OAK SPECIES EIGHT YEARS AFTER PLANTING

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Eight years after planting, black oak and scarlet oak responded to slow-release magnesium ammonium phosphate while northern red oak, white oak, and post oak did not.

Growth of planted oaks is characteristically slow. Consequently, selecting an oak species for reforestation may partially depend on how different oak species respond to cultural treatments such as fertilization. This study investigated the effects of a slow-release fertilizer on the growth of five oak species planted in the Missouri Ozarks.

Methods

On April 1, 1968, acorns of white oak (*Quercus alba* L.), black oak (*Q. velutina* Lam.), northern red oak (*Q. rubra* L.), scarlet oak (*Q. coccinea* Muenchh.), and post oak (*Q. stellata* Wang.) collected from local sources were planted in 1 1/2- by 10-inch paper mailing tubes filled with forest topsoil. Seedlings were grown indoors under artificial lighting for 4 weeks, followed by a 2-week conditioning period outside. Twelve hundred tubed seedlings were then planted at a 3- by 3-foot spacing in an oak clearcutting on the Sinkin Experimental Forest near Salem, Mo.

At the time of planting, magnesium ammonium phosphate (8-40-0) slow-release fertilizer was incorporated into the topsoil on one-half of the planting spots at the rate of 100 pounds of nitrogen and 500 pounds of phosphorus per acre.

The study area was arranged in a randomized complete block design. Each of six blocks contained ten 20-tree plots that included one fertilized and one unfertilized plot for each of the five species. Weeds and sprouts were controlled with herbicides during the first 5 years.

Analysis of variance was used to test for treatment differences in mean heights of survivors. Chi-square analyses were used to compare treatment differences in proportions (percentages) of survivors and proportions of trees attaining given minimum height classes.

Results and Conclusions

After eight field growing seasons, there were large differences between treatments and among species in both survival and mean height of surviving tubelings (table 1). Survival was above 70 percent for all species-fertilizer combinations except unfertilized scarlet and post oaks. Scarlet oak was the only species whose survival was significantly improved by fertilization.

Based on mean height of survivors, northern red and scarlet oaks grew fastest; mean heights were not significantly different between fertilizer treatments for either species. However, the percentages of fertilized scarlet oaks that attained 4-, 6-, 8-, or 10-foot minimum heights were significantly greater for fertilized than unfertilized trees (table 1). Black oak responded similarly to fertilization based on both mean height of survivors and on percentages of trees attaining minimum heights of 6, 8, or 10 feet. Fertilized black oak in the 8-foot minimum height class was 28 percentage points higher than unfertilized black oak; this was the largest gain for any species height class.

Although percentages of northern red oak attaining minimum heights were generally greater than for any other species, this species did not respond to fertilization. By contrast, northern red oak in a Tennessee study (*1*) was shown to have significantly benefited from nitrogen fertilization. White and post oaks showed the poorest overall growth, and generally showed little response to fertilization.

The practical significance of these results may be better demonstrated by the increase in percentage of seedlings attaining given minimum heights than by mean heights of survivors. In clearcuttings, success of oak planting will be dependent upon getting an acceptable proportion of planted trees into the upper canopy of competing woody plants during the first decade

Table 1.—*Eighth-year height and survival of oak tubelings*

Oak species	Mean height of survivors		Percent of planted trees that attained a minimum height of									
			4 feet		6 feet		8 feet		10 feet		Survival	
	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized
	- - - feet - - -										*- - - Percent - - -*	
Black	7.5	5.8	76	67	62[1]	43	40[1]	12	17[1]	3	83	85
Northern red	8.3	7.0	78	77	72	71	54	50	25	16	86	79
Scarlet	8.2	7.3	76[1]	57	66[1]	48	49[1]	36	22[1]	12	82[1]	67
White	6.8	6.4	68	63	53	42	27	20	12[1]	4	79	72
Post	4.2	3.8	40	38	13	12	3	0	0	0	73	57

[1]Indicates statistically significant (5 percent level) improvement attributable to fertilization.

after planting. Defining minimum heights for planted tree "success" (e.g., 4 feet) will thus partially depend on the amount and type of competition and on the intensity of weed control. With very intensive weed control, a minimum tree height of 6 feet might be an acceptable success criterion after 8 years. With moderate weed control (e.g., where certain types of natural reproduction such as seedling-sprouts are allowed to develop with the planted trees), an 8-foot success criterion might be reasonable. With no control of competing sprouts, success of planting will require planted tree growth rates of 1 1/2 to 2 feet per year, depending on site quality; to date, planted oaks have not demonstrated this growth capacity (*3,4*). The present study indicates that for black oak and scarlet oak, one application of a slow-release fertilizer can significantly and substantially increase the proportion of trees that attain selected height criteria. Improved cultural techniques in both the nursery and field, together with genetic improvement, hold promise for additional gains.

Literature Cited

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