



THE EFFECT OF PLANTING DENSITY ON THE GROWTH AND YIELD OF ATLANTIC WHITE-CEDAR—EIGHT YEAR RESULTS

Bill Pickens. NC Forest Service, Raleigh NC

Abstract--This study examines the influence of planting density on the growth and yield of Atlantic white-cedar (*Chamaecyparis thyoides* (L.) B.S.P.) plantations. Following a clearcut harvest, the study site was root-raked, burned, and planted with bare root Atlantic white-cedar seedlings at three planting densities; 6 ft. x 12 ft. (605 trees/acre), 6 ft. x 6 ft. (1210 trees/acre), and 4 ft. x 6 ft. (1815 trees/acre). After three growing seasons, the tree height was similar across all treatments, averaging 6.4 feet. Survival was 91% (605 trees per acre) 86% (1210 trees per acre), and 83% (1815 trees per acre). Early growth was not affected by planting density in this study.

INTRODUCTION

Atlantic white-cedar (*Chamaecyparis thyoides* (L.) B.S.P.) is a wetland species that has been in decline across its range since the late 1800's when it was extensively logged as a valuable timber product¹. Today it is valued both ecologically and economically. Regeneration efforts are needed to restore Atlantic white-cedar to its original range. Artificial regeneration by private landowners is an important component of the restoration effort. The conical shape and small bole of Atlantic white-cedar (2-16 inch diameter at breast height) allow it to naturally regenerate and maintain dense stands (250 to 300 ft² basal area per acre)^{2,3}. Because of high seedling and site preparation costs, artificial regeneration of Atlantic white-cedar is expensive. Planting fewer trees per acre reduces establishment costs, but may not optimize economic returns. Currently, many resource managers recommend planting densities common to loblolly pine (600-800 seedlings per acre), but that may not be appropriate for Atlantic white-cedar. Little data is available on how planting density affects the growth and yield of Atlantic white-cedar stands⁴. This study examines the influence of planting density on the growth and yield of Atlantic white-cedar plantations to determine if higher planting densities will increase volume yield and result in a better rate of return that will offset high establishment costs.

METHODS

The study is located at the NCSU Hofman Forest, Onslow County, NC on a former pond pine forest. The soil is very poorly drained, but the tract is extensively ditched. The soil type is a Pantego black fine sandy loam that has a site quality index (base age 50) of 95 for loblolly pine. The site was clearcut, raked, and burned in preparation for the planting. Planting density treatments were: 1) 605 trees/acre, 2) 1210 trees/acre, and 3) 1815 trees/acre.

The treatments were established in a randomized complete block design with four replications per treatment. Each treatment plot was approximately 0.25 acre in size. North Carolina Division of Forest Resources personnel hand planted a total of 4061 seedlings with dibble bars in February of 2001. The 1-0 bare root seedlings were propagated from seed at the North Carolina Division of Forest Resources Claridge Nursery in Goldsboro, NC. Overall seedling quality was poor, as a great many of the seedlings planted were less than 4 inches tall and had sparse root systems. The largest seedlings were about 4-5 inches tall.

The first data collection was made after three growing seasons in March of 2004. Surviving trees were measured for height to the nearest 0.1 feet and stocking density and survival was determined. DBH was not measured since many trees were less than 4.5 feet tall. Height and DBH were measured a second time in February of 2009 after eight growing seasons since planting.

RESULTS

After three years in the field survival was 91%, 86%, and 83% for treatment 1, treatment 2, and treatment 3 respectively. Height was 6.2 feet, 6.6 feet, and 6.5 feet for treatment 1, treatment 2, and treatment 3 respectively, with no significant differences among treatments at $P = 0.05$. See Table 1.

Table 1. Average height in feet for AWC trees three years after establishment

Treatment	n	Height (feet)	St. Dev.
Treatment 1 (605 trees/acre)	656	6.2 a	1.39
Treatment 2 (1210 trees/ acre)	1156	6.6 a	1.34
Treatment 3 (1815 trees/acre)	1640	6.5 a	1.38

Means followed by the same letter are not significantly different at p=0.05

After eight years in the field, height was 16.0 feet, 17.6 feet, and 16.0 feet with corresponding DBH of 2.4 inches, 2.5 inches, and 2.2 inches for treatment 1, treatment 2, and treatment 3 respectively. See Table 2.

Even with the smaller seedlings and medium intensity site preparation the survival of the Atlantic white-cedar seedlings was high. The high survival rate is consistent to with rates observed by the author from previous Atlantic white-cedar plantings. Land resource managers should expect good survival with adequate site preparation and competition control.

Seedlings grew quickly and were able to outgrow the emerging competition of gall berry, fetterbush, wax myrtle, cat briar, blackberry, poke weed, and various grasses. Most mortality was in very wet areas or in areas of very dense grass or woody shrubs. Deer or rabbit browse was not a problem on this site as is often the case in other plantings.

For the first three years height growth averaged 2.13 feet per year with the largest trees averaging about 3 feet of annual height growth. The tallest tree measured was 10.8 feet tall. After eight years the trees continued to average height growth of 2.06 feet.

The Atlantic white-cedar height was comparable to loblolly pines planted on adjacent fertilized beds the same year. Atlantic white-cedar is a good choice to reforest

this soil type. In general, the trees are above the predominate competition and do not appear to need a release treatment .

Citations:

1. Frost, C.C. 1987. Historical overview of Atlantic white cedar in the Carolinas. pp. 257-264. IN: Laderman, A. D. (ed). Atlantic white cedar wetlands. Westview Press, Boulder, CO.
2. Korstian, C. F. and W. D. Brush. 1931. Southern White cedar. USDA Tech. Bull. 251. 75 p.
3. Little, Silas. 1950. Ecology and silviculture of white-cedar and associated hardwoods in southern New Jersey. Yale Univ. School Forestry Bull. No. 56. New Haven, CT.
4. Mylecraine, Kristin A. and George Zimmerman. 2000. Atlantic White-Cedar Ecology and Best management Practices Manual. New Jersey Forest Service. Trenton, NJ 85 pp.

Table 2. Average height in feet for AWC trees eight years after establishment.

Treatment	DBH (inches)	St. Dev.	Height (feet)	St. Dev.
Treatment 1 (578 trees/acre)	2.4 a	0.36	16.0 a	1.74
Treatment 2 (1013 trees/ acre)	2.5 a	0.36	17.6 a	1.78
Treatment 3 (1519 trees/acre)	2.2 a	0.18	16.0 a	0.95

Means followed by the same letter are not significantly different at p=0.05

