

Realized Gains from Planting Large-Diameter Seedlings and Intensive Management

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When researchers discuss how to increase wood production with intensive management, claims are sometimes made using data from young row-plots or single-tree plots. However, it is unsound to believe height gains at age 2 or 8 years can accurately predict volume/ha gains at age 25. It is also not valid to assume that percentage gains in volume do not decline over time (e.g. from age 6 to age 50 yr). For our profession, it is essential that the value of intensive management be presented in a realistic and meaningful manner. When the goal is to measure long-term yield of silvicultural treatments, large-block plots are the only type of study to analyze. This paper relies on block-plot data to compare the gains from planting morphologically improved seedlings with gains from applying multiple chemical treatments to regular seedlings.

MATERIALS AND METHODS

Four seedling size/intensive management studies with *Pinus taeda* L. were established in the southeastern Coastal Plain. Each site contained a 2 x 2 study involving two seedling sizes (split-plot) and two levels of establishment intensity (main plot). "Standard seedlings" (SS) averaged 4.5 to 5.2 mm in root-collar diameter (RCD) while "morphologically improved" seedlings (MIS) averaged 8.2 to 9.2 mm in RCD. "Standard" establishment practices (NI) included herbicides (hexazinone and sulfometuron) and fertilizer (DAP) applied during the first year (and no subsequent applications after March). The "intensive" establishment practice (INT) involved the same treatments plus an additional herbicide application (imazypyr and metsulfuron) applied in the first and second year. Four insecticide applications (permethrin) were made during the first two years (for control of tip moth, *Rhyacionia frustrana* Comstock) and fertilizer (KCL) was applied during the third year. Treatments were replicated three times and details are reported elsewhere (South and Rakestraw 2004). A growth and yield program (www.fore.canterbury.ac.nz/euan/taedaRCD.htm) was developed using data from two sites. This model (TaedaRCD) was used to predict the effects of various seedling sizes at planting on volume growth over 12 years (using standard silviculture).

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RESULTS AND DISCUSSION

Overall, standard seedlings averaged 123 m³/ha [mean annual increment (MAI) = 10.2 m³/ha/yr] when given standard silviculture. Under these conditions, planting morphologically improved seedlings increased yields by 16 m³/ha (Figure 1). With intensive silviculture, standard seedlings averaged 170 m³/ha (MAI = 14.2 m³/ha/yr) and morphologically improved seedlings increased yields by 18 m³/ha (average yield = 188 m³/ha/yr). The combination of intensive management plus morphologically improved seedlings increased MAI by 50% (from 10.2 to 15.6 m³/ha/yr). Overall, the use of morphologically improved seedlings increased MAI by about 1.4 m³/ha/yr (equivalent to a 0.7-year age shift).

Regardless of site, volume gains were achieved by planting either morphologically improved seedlings (MIS) or by providing additional chemical treatments (INT). The MAI was greatest for the most intensive silviculture (MIS+INT) and was least for the least intensive treatment (SS+INT). However, the rankings of the two intermediate treatments varied with site. At two sites the MIS-N treatment produced as much or more volume than the S+INT treatment while at the other two sites, the SS+INT treatment produced more volume.

Excluding seedlings, the cost of site preparation, machine planting and chemical applications totaled \$600/ha for SS and \$1060/ha for INT. Seedling costs were about \$63/ha for SS and \$90/ha for MIS. The cost/ha for the extra chemical treatments was approximately \$460/ha more than the standard establishment practices. This investment

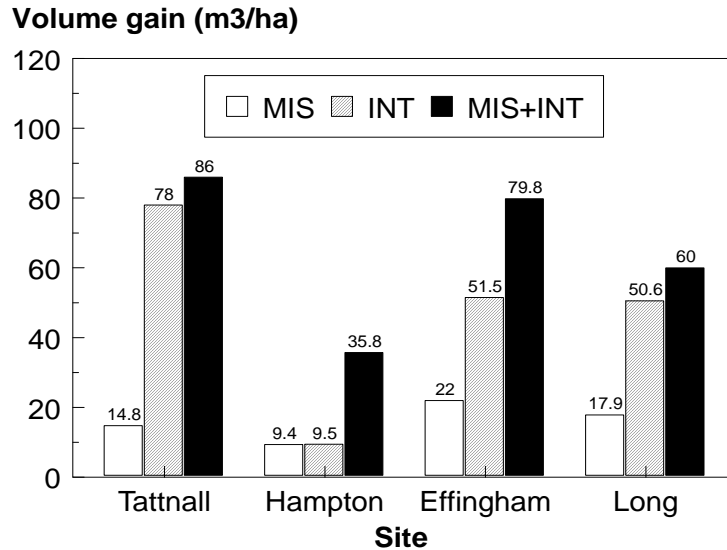


Figure 1. Realized volume increases during the first twelve growing seasons. MIS = Morphologically improved seedlings and INT = Intensive silviculture. There were no significant ($\alpha = 0.05$) treatment effects at the Hampton site. Extra chemicals resulted in significant gains at the Effingham and Tattnall sites while seedling type was significant at the Effingham and Long sites. At each site, the greatest gain was obtained by combining morphologically improved seedlings with additional chemical treatments.

increased wood production of standard stock by 47 m³/ha. This marginal cost works out to \$9.8/m³. Likewise, MI seedlings cost \$27/ha more than the standard seedlings and the extra wood produced had a marginal cost of \$1.6/m³. For this study, the use of MI seedlings reduced the cost of producing a cubic meter of wood while applying extra chemicals increase the unit cost of wood production. Regardless of site, the internal rate of return for planting MI seedlings was greater than that obtained from applying additional chemical treatments. Of course the amount of expected gain from planting MI seedlings will vary by site and seedling size (Figure 2).

The intensive management treatments and morphologically improved seedlings reported here were used operationally by the Union Camp Corporation during the 1990's. Since then, the ownership of the studies has changed hands twice and the concern over a pulpwood shortage had declined. The current owners are not interested in spending over \$1,000/ha for chemical treatments to shorten the rotation to 16 years. However, the potential volume gains from planting large-diameter seedlings are the same today as they were a decade ago.

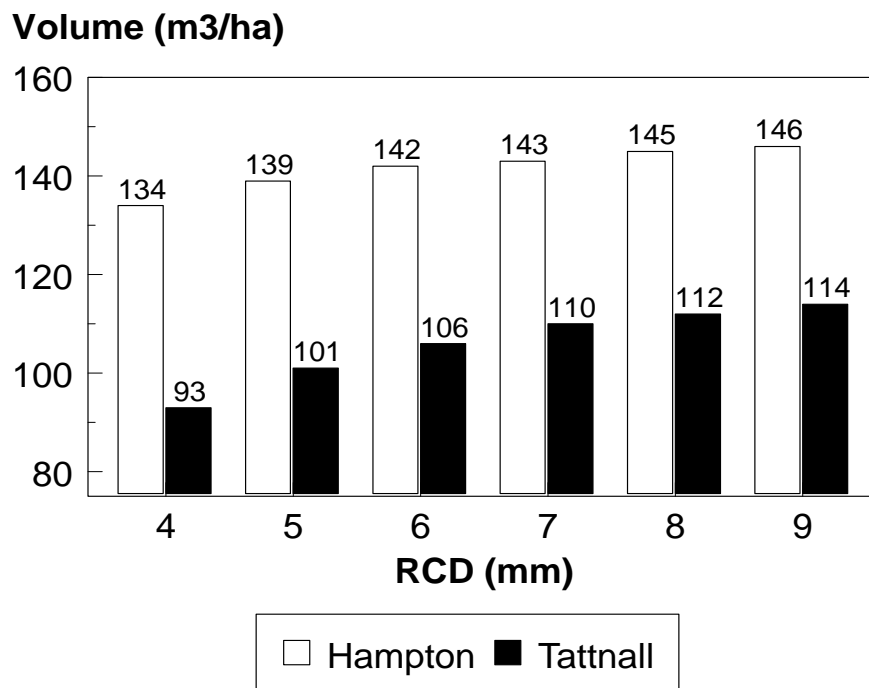


Figure 2. The effect of initial seedling root-collar diameter (RCD) on predicted volume at age 12 year (values modeled using TaedaRCD). Site productivity at age 12 years is a function of seedling morphology at time of planting.

REFERENCE

South, D.B. and J.L. Rakestraw. 2004. Large-diameter seedlings: a method of reducing chemical use in some pine plantations. *J. Sustainable For.* 18(4):47-58.