

TWENTY-FIVE-YEAR ANALYSIS ON THE EFFECTS OF ORGANIC MATTER REMOVAL AND SOIL COMPACTION ON A LONG-TERM SOIL PRODUCTIVITY STUDY SITE IN NORTH CAROLINA

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Extended abstract—Forests are subject to large-scale disturbance by harvesting and site preparation. An important question is whether soils can sustain the long-term needs of forest stands under intensive site preparation, shortened rotations, and higher utilization standards (Powers and others 1990). The effects of harvest intensity and site preparation on soil properties and stand productivity are being analyzed as part of the U.S. Department of Agriculture (USDA), Forest Service, Long-Term Soil Productivity (LTSP) studies.

The site installation followed the clearcutting of a 60-year-old natural pine (*Pinus* spp.)-hardwood stand on the Lower Coastal Plain, near New Bern, NC, in 1991. Three blocks of nine treatment plots (0.4 ha each) were established and assigned a 3-m by 3-m factorial combination of organic matter removal [none/stem-only removal (OM0), moderate/whole-tree removal (OM1), and severe/whole-tree plus forest floor removal (OM2)] and compaction [none (C0), medium (C1), and severe (C2)] treatments. Treatment plots were split to include a total competition control (H+) and no competition control (H-) treatment. Thinning in March 2012 removed approximately one-half of the trees and understory, leaving the cut vegetation in place.

Height and diameter measurements of all trees in the measurement plots were recorded annually for the first 10 years of the study and at years 16, 18, 21, and 25. Analysis of variance was used to test for treatment impacts on tree height and diameter. An estimated site index curve was calculated based on information from the USDA Soil Conservation Service (Goodwin 1989).

There was a significant ($p < 0.05$) interaction between the competition control, organic matter removal, and compaction treatments for tree diameter. The trees in the OM0 and OM1 treatments were generally greater in diameter than in the OM2 treatments in the H+ plots for all years. Tree diameters in the H+ plots were always greater in the C2 plots and least in the C1 plots.

There was a significant ($p < 0.05$) interaction between organic matter removal, compaction, and competition control on height for most years. Further investigation indicated significant differences in tree height on the competition control plots was associated with organic matter removal. For example, the mean height in the H+ × OM removal plots was, until year 21, consistently greatest in the OM1 plots and lowest in the OM2 plots, while in H+ × compaction plots, C2 plots consistently had the greatest tree heights, until year 21, when they dropped to the least height. There was a large difference in the tree heights on the H+ plots when compared to the estimated tree heights generated by the site index curve, while all the organic matter removal treatments on the H- plots remained close to estimated heights (fig. 1). Using the H- treatment as an unmanaged treatment, comparison of tree heights by treatment against estimated tree heights (fig. 1) indicated that organic matter removal had no effect on tree height growth in this study up to year 21. From a year 25 perspective, the trend of increased height growth in year 20, compared to the site index curve, continued, and the OM0 and OM1 height responses mirrored the H+ plots in their separation from the OM2 plots.

The significant effect of organic matter on height and the consistently greater heights in the OM1 treatment may have been due to several factors. The OM0 treatment left the most biomass, but also allowed the highest amount of competition due to its low site disturbance. These treatments were generally cooler (Eaton 1996) in the summer months which some studies indicate can result in decreased growth (Heninger and White 1974). On the OM2 treatments, reduced nutrient levels may have initially reduced height growth. The consistently greater tree heights on the C2 treatment, in H- and H+ treatments, may have been due to a decrease in competitive vegetation in the plots. As discussed above, competing vegetation has a significant effect on height growth, and the C2 treatment reduced competition, especially when due to stump sprouting.

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When competition control was applied, tree growth increased above the site index estimation from approximately year 5, even in the OM2 plots. The effect of the competition control treatment was minimized when the thinning removed the competing trees and much of the understory. This trend continued through year 25. Further analyses indicated the impact of the main treatment effects was minimal in the presence of competition and significant once competition was removed. Based on site index comparisons, treatments did not reduce productivity as measured by tree growth, even in the most severe treatments. Thinning resulted in increased growth rate in all treatments, but continued assessment is needed to determine if this trend persists.

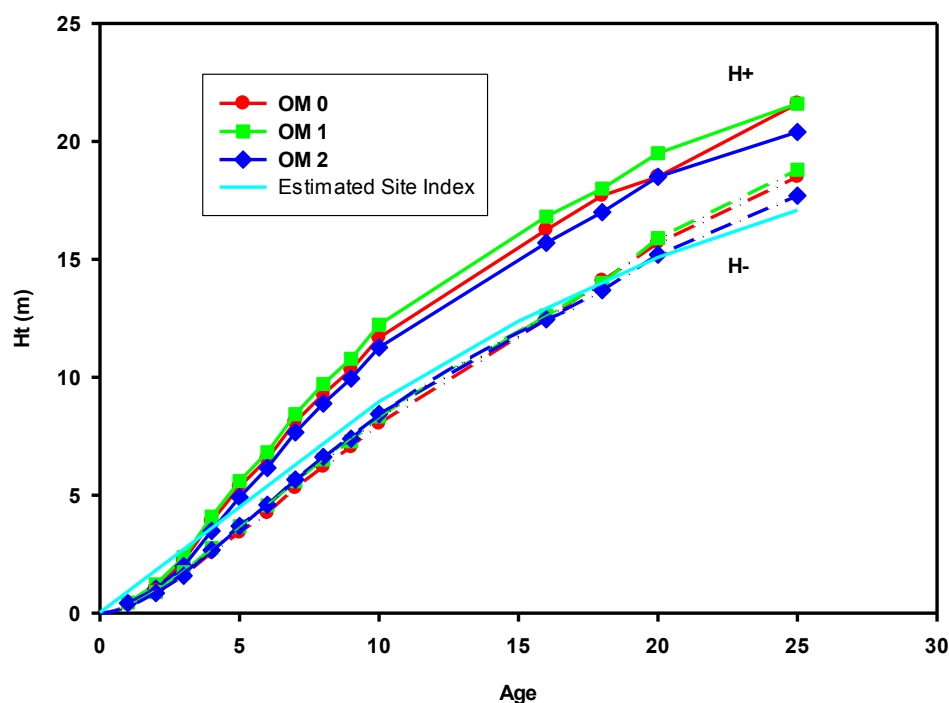


Figure 1—Height curves of organic matter removal treatments [none/stem-only removal (OM0); moderate/whole-tree removal (OM1); severe/whole-tree plus forest floor removal (OM2)] by competition control treatments [none (H-, dashed); total (H+, solid)] with estimated site index.

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