

# INTERCROPPING OAKS AND PINES

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**Extended abstract**—Work in northern Michigan pine plantations and oak plantings in the 1990s (Buckley and others 1998) suggested that oak seedlings may have better growth and survival when grown in pine shelterwoods than hardwood shelterwoods, and when intercropped with pine seedlings in mixed-species plantings. In 2000, loblolly pine (*Pinus taeda* L.) seedlings were inter-planted between northern red oak (*Quercus rubra* L.) seedlings in the same rows as a part of a larger study investigating the effects of oak seedling quality, planting practices, and competition control on the performance of outplanted oaks in Tennessee (Buckley 2002). Over the next 10 years, height growth of small- and medium-size class northern red oak nursery seedlings was significantly greater when grown with loblolly pine, but signs of diminishing apical dominance in the overtopped oaks generated several new questions concerning:

- 1) The optimum time for releasing the oaks from competition with the pines;
- 2) The growth of different pine species relative to the growth of intercropped oaks;
- 3) The performance of different oak species when intercropped with pine; and
- 4) The effects of different spatial arrangements of intercropped oaks and pines.

A replicated study with a randomized complete block design was established in 2014 to address several of these questions. Specific objectives were to:

- 1) Quantify and compare the growth and survival of oak and pine seedlings when intercropped and planted alone;
- 2) Document the performance of different oak and pine species combinations;
- 3) Determine the effects of oak seedling size on performance; and
- 4) Investigate the effects of different spatial arrangements on seedling performance.

Three 22- by 146-m blocks were established parallel to the contour in three recently clearcut areas having predominantly northeastern, eastern, and southern aspects. Stump sprouts and first-year seedlings of competitors were sprayed with glyphosate in late summer, 2013.

Ten treatments were assigned at random to ten 0.03-ha plots within each block:

- 1) White oak (*Quercus alba* L.) planted alone on a 2.44- by 2.44-m spacing;
- 2) Loblolly pine planted alone on a 2.44- by 2.44-m spacing;
- 3) Shortleaf pine (*Pinus echinata* Mill.) planted alone on a 2.44- by 2.44-m spacing;
- 4) Eastern white pine (*Pinus strobus* L.) planted alone on a 2.44- by 2.44-m spacing;
- 5) White oak planted on a 2.44- by 2.44-m spacing with a loblolly pine planted 0.31 m away from each oak;
- 6) White oak planted on a 2.44- by 2.44-m spacing with a shortleaf pine planted 0.31 m away from each oak;
- 7) White oak planted on a 2.44- by 2.44-m spacing with an eastern white pine planted 0.31 m away from each oak;
- 8) White oak planted on a 2.44- by 2.44-m spacing with loblolly pines planted in alternating rows 1.74 m away from each oak;
- 9) White oak planted on a 2.44- by 2.44-m spacing with shortleaf pines planted in alternating rows 1.74 m away from each oak; and
- 10) White oak planted on a 2.44- by 2.44-m spacing with eastern white pines planted in alternating rows 1.74 m away from each oak.

All oak and pine seedlings planted were 1-0, bare-root nursery seedlings purchased from the Tennessee Department of Agriculture, Division of Forestry State tree nursery in Delano, TN. Two grades of white oak were planted: standard seedlings and large diameter seedlings. All seedlings were planted in March, 2014. Blackberry (*Rubus* sp.) and hardwood competitors have been removed periodically since 2014 with a brushcutter and lopping shears.

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After three growing seasons, there were no significant differences in the height of loblolly pine, shortleaf pine, or eastern white pine seedlings whether planted alone or planted within 0.31 m or 1.74 m of planted white oaks. It should be noted that interactions between oaks and pines spaced 1.74 m apart in the alternating row treatments were likely to be minimal at this point in the development of the plantings. The treatments involving 0.31-m spacings were included to force interactions between oaks and pines early on, but the heights of pines planted in these treatments were not significantly different from those planted alone. Mean heights of loblolly, shortleaf, and eastern white pines were approximately 1.5, 0.9, and 0.8 m, respectively, after three growing seasons.

Similar to the pines, there were no significant differences in the heights of white oak whether planted alone or intercropped with any of the pines at the 0.31- or 1.74-m spacings (fig. 1). Again, it is unlikely that important interactions occurred between oaks and pines in the treatments with 1.74-m spacings. The lowest mean height for white oak occurred in the shortleaf pine intercropping treatment with 0.31-m spacings (fig. 1), but no differences were statistically significant.

These third-year results suggest no significant positive or negative effects of intercropping on the oaks and pines planted. Long-term monitoring of these treatments is planned as interactions between these species are likely to intensify over time as the planted trees continue to develop. Whether intercropped pines will eventually have positive impacts on oak seedling growth and survival remains to be seen, but the results to date suggest that oaks and pines may be compatible in mixed-species plantings. Interest in oak-pine mixtures exists on the part of private landowners, and the potential benefits of intercropping different species in forest plantations (Burton and others 1992, Hartley 2002, Kelty 2006) are worth exploring.

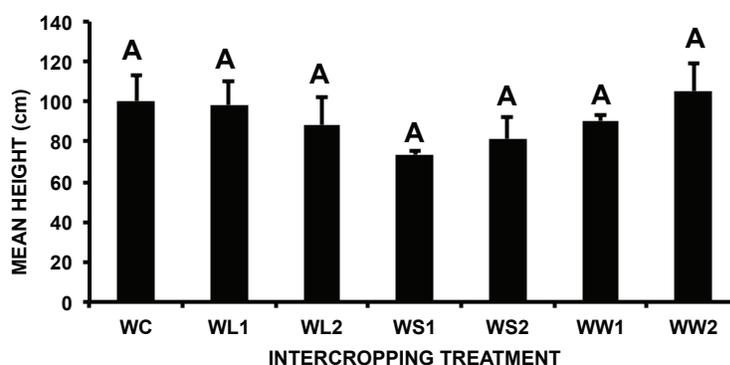


Figure 1—Mean third-year height of white oak seedlings by treatment. WC = white oak control, WL1 = white oak intercropped with loblolly pine at 0.31-m spacing, WL2 = white oak intercropped with loblolly pine at 1.74-m spacing, WS1 = white oak intercropped with shortleaf pine at 0.31-m spacing, WS2 = white oak intercropped with shortleaf pine at 1.74-m spacing, WW1 = white oak intercropped with eastern white pine at 0.31-m spacing, and WW2 = white oak intercropped with eastern white pine at 1.74-m spacing. Means with the same letter are not significantly different. Error bars represent one standard error.

## LITERATURE CITED

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