White Oak (*Quercus alba* L.) Response to Planting in Gap Openings in the Blue Ridge Mountains of North Carolina, USA

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Purpose and Scope

Artificial regeneration (i.e., planting) of white oak (*Quercus alba*) can contribute to localized restoration targets with an immediate input of advance reproduction (Clark and Schlarbaum 2019). Response of planted oak seedlings to uneven-aged management is not well understood due to lack of empirical research. The goal of this study was to determine how white oak seedlings responded to effects of planting density and orientation in an uneven-aged system, the irregular shelterwood. We implemented the study to examine artificial regeneration responses in an uneven-aged irregular shelterwood.

Methods and Approach

Seedlings (1-0 bareroot) were planted in six 0.1-ha gaps, created as part of a larger irregular shelterwood treatment on the Pisgah National Forest in Haywood County, NC (Westby-Gibson and others 2017). Trees were randomly assigned into treatments to test planting spacing (0.6 m by 0.6 m or 3.7 m by 3.7 m), gap location (center, edge, forest matrix), and gap direction from gap center (north or south). Groups of 10 to 30 trees were planted within each gap along the north and south axis extending from gap center at the three gap locations. Trees were measured for survival and height after the third growing season. Data were analyzed using general linear mixed models to test fixed effects of spacing, location within the gap, and direction from gap center and treatment interactions. An alpha level of 0.05 was used to denote significant differences.

Finding and Implications

Third year survival was 77 percent across all gaps, and effects of treatments ($P \geq 0.29$) and their interaction ($P \geq 0.23$) were not significant. Seedlings in gap centers were 0.8 m tall after three growing seasons, 0.3 m taller than seedlings on the gap edge or in the forest matrix ($P < 0.0001$) (fig. 1). The effect of spacing ($P = 0.77$) and direction ($P = 0.48$) did not affect height, and their interaction were not significant ($P \geq 0.27$).

Planted white oak seedlings did not grow appreciably in height, even in gap centers (43 cm of growth in 3 years). Future gap expansions are predicted to benefit seedlings in the gap edges and forest matrix, where oak seedlings should maintain their physiological demands in intermediate light environments (Patterson et al. 2022). Planting density and gap direction did not affect seedling performance in the first 3 years, but seedling growth dynamics are expected to change over time as the root systems for seedlings become better established and the gaps are expanded, resulting in an increase in light. Despite the limited biological implications of planting density, higher density plots required less establishment time because trees were grouped together in relatively small areas which simplified planting logistics; however, planters had to be careful not to step on already planted trees on such a close spacing. Higher planting density may simplify future tending practices (e.g., reduction of the treated area around seedlings).

Literature Cited

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Figure Example

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Figure 1—Third-year least-squares mean height of white oak seedlings planted in 0.1-ha gaps in western North Carolina, USA. Error bars represent +1 standard error from the mean.

Alt text: Seedlings planted in the gap centers were 0.8 m tall after three years; they were significantly taller than trees planted on the gap edges or in the forest matrix, both of which averaged 0.5 m.