COMPETITION CONTROL AND INCREASING CANOPY OPENNESS BENEFIT ARTIFICIAL WHITE OAK (*QUERCUS ALBA*) REGENERATION IN AN EXPANDING SHELTERWOOD IN INDIANA, USA

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PURPOSE AND SCOPE

White oak (*Quercus alba*) artificial regeneration can theoretically be used in tandem with shelterwood regeneration systems to bolster flagging or nonexistent natural oak regeneration, particularly on sites where the use of prescribed surface fires may be logistically or legally difficult. Few have explicitly examined the efficacy of combing these two management strategies. Likewise, competition control has been shown to benefit growth of white oak understory regeneration (Dreisilker et al. 2014), but has not been examined in combination with underplanting and shelterwood harvesting in central hardwood forests. We tested the impacts of competition control on artificial white oak regeneration planted along a canopy closure gradient in an expanding shelterwood (i.e., femelschlag) in southern Indiana. Our objective was to inform successful white oak regeneration practices in the Central Hardwood Region.

METHODS AND APPROACH

This study was installed on the Naval Surface Warfare Center in Crane, IN. Four plots were installed on two sites that received an expanding group shelterwood treatment (Greenler and Saunders 2019) in winter 2018/2019; the plots extended from the center of a 0.5-ha group, through an area of midstory removal, and into unharvested forested matrix. This design created an overstory canopy and light gradient, which was quantified using a camera with a fisheye lens. Each plot was further split and randomly assigned to 0, 2, or 4 years of understory competition control, by both chemical and mechanical means. In each split-plot, 1-0 and 2-0 bareroot white oak stock were planted at a spacing of 1.8 m by 1.8 m. Height and groundline diameter were measured seasonally, and incremental growth as a percentage of these metrics at the time of planting was analyzed using mixed effects models.

$$\text{Incremental growth} = \frac{(\text{Year 2 Size} - \text{Size initial})}{\text{Size initial}} \times 100 \qquad [1]$$

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FINDINGS AND IMPLICATIONS

The analysis presented here summarizes growth after two complete growth seasons; hence 2- and 4-year weed control treatments were collapsed into a single treatment (i.e., weed control versus no weed control). Incremental height growth (HT) and groundline diameter growth (GLD) were significantly influenced by competition control (P_{HT} = 0.013, P_{GLD} <0.001) and canopy closure (P_{HT} <0.001, P_{GLD} <0.001). HT was greatest in untreated split-plots, and GLD was greatest in split-plots with competition control. Canopy closure impacted HT and GLD similarly, with both metrics at their greatest in areas of greater canopy openness (table 1).

Table 1—Average (± 1 standard error) incremental groundline diameter growth (GLD) and height growth (HT) as affected by overstory canopy closure

Canopy closure (%)	GLD (%)	HT (%)
0–25	66.7 ± 6.0	40.0 ± 5.1
25–50	61.8 ± 6.0	32.8 ± 5.7
50–75	43.2 ± 5.2	20.4 ± 5.1
75–100	33.3 ± 2.7	21.1 ± 2.6

Given that GLD is commonly utilized as a proxy for belowground growth, competition control likely improved the resilience of white oak to disturbances such as drought and surface fire. Underplanted white oak also grew most vigorously in group openings regardless of understory competition control. This contradicts Greenler and Saunders (2019) who indicated that natural white oak regeneration thrived in edge conditions, but was not unexpected given the higher resource levels in the opening. These resources, however, are fleeting as faster-growing competitors eventually make the environment light-limited for white oak (Lhotka and Stringer 2013). We suggest that midstory control and competition control should both be used to expand the zone where white oak can successfully compete in gap-based harvests.

LITERATURE CITED

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