Developing Advance Reproduction of Intermediate Light-Tolerant Species Such as White Oak: A Focus on Midstory Removal

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Overview:

White oak regeneration is both disturbance dependent and advanced growth dependent (Clatterbuck 2019). “The answer to the question of how to ensure oak regeneration … is not the development of some radically new method of cutting, but recognition that all cutting operations in a stand, from the very first, should have as some of their objectives the creation of an environment, largely light conditions, favorable for oak regeneration … and furthermore … ensure that cuttings occur frequently enough to maintain growth of oak regeneration” (Hodges 1989).

Regenerating oak is a process that must be cultured and not an event. For oak regeneration to be successful, advance reproduction of oak must be present before the disturbance (natural or anthropogenic) to give them an initial growth advantage over competing seedlings that regenerate after the disturbance. The oak seedling growth strategy prioritizes root over top growth causing slower aboveground (top) growth initially. Growth of many competing species with opposite growth strategies often displaces the development of slower-growing oak seedlings before oaks can emerge into the overstory unless intermediate light conditions are provided that benefit growth of oak reproduction and discourage growth of competing species.

Several practices are available to provide these intermediate light conditions favorable for oak, including shelterwood, variable overstory retention (thinnings), midstory removal, various small opening sizes (groups, edges, islands, clusters), expanding gap or femelschlag, and deferment cuts (two-age). The present research involves midstory removal to promote the partial light conditions favorable for the growth and development of advance oak reproduction while impeding the growth of other competing species.

Summary:

White oak is a keystone species for both wildlife and wood products. The sustainability of white oak is in question considering the regeneration difficulties associated with the species (fig. 1). Although white oak is plentiful in the older age classes (> 40 years) in the near term, the younger age classes are deficient. The issue is with the intermediate light tolerance of the species. Too much sunlight (such as clearcuts or low basal area retentions) supports much faster-growing, sun-loving species while too little sunlight (closed canopy, nondisturbed areas) favors more shade-loving species. Creating the environmental conditions with those intermediate conditions that favor white oak regeneration and development compared to other species has been challenging on both private and public lands.

This study capitalizes on 2nd-year white oak germinants following a bumper white oak acorn crop that exceeded animal predation during the summer of 2018 near Oak Ridge, Tennessee. The release of 2nd-year advance reproduction of white oak through a midstory control treatment is being evaluated to determine whether white oak seedlings may gain a growth advantage that they would not otherwise receive (fig. 2).

Silvicultural Concepts:

Research by Loftis (1983) suggests that without disturbances to create these intermediate light conditions, survival and height growth of northern red oak reproduction diminishes (fig. 3). If these light conditions are established, seedling survival and size are projected to increase. This study tests this premise with white oak with the establishment of 26, 6.5-foot square plots, with 13 plots receiving a midstory release and the other 13 plots remaining as an undisturbed control with closed canopies. The release treatments were 0.4 acres, which involved cutting the midstory canopy level, regardless of species, and overstory beech, maple, and yellow-poplar trees were cut or injected with herbicide to limit future seed production. All cut stumps were treated with herbicide to inhibit sprouting. The overstory white oak mother trees remained casting some partial shade. Available light (photosynthetic active radiation – PAR) was measured with ceptometers twice on each plot.

Preliminary results indicate that there was no difference in total height of white oak seedlings between treatments after one complete growing season (2021), although we anticipate height differences in the future. In the control treatment, seedlings were more etiolated and seedling survival numerically diminished, but not significantly. Additional competing species or number of seedlings in the midstory release treatment were not encountered. At this early growth stage, white oak advance reproduction with midstory release do not appear to be influenced by growth of other, competing species although intraspecific influence among the abundant white oak seedlings was apparent.

Available light levels of 20 to 30% are accepted for enhanced growth of oak reproduction (refer to Clatterbuck 2019 for reference compilation). Available sunlight based on PAR in this study averaged less than 5% in the closed canopy control plots and ranged from 15 to 42% with a mean of 33% in the release treatments, well within the available light range in the literature.

Management Applications:

Regeneration of white oak and most oaks are advance growth dependent. Oak seedlings are one of the slowest growing species. Advance reproduction gives oaks an early advantage over faster-growing, intolerant species that seed in after a disturbance or existing shade-tolerant seedlings that otherwise would not occur.

Oak is also disturbance dependent. Disturbances, whether natural or anthropogenic, should occur more frequently to maintain the partial sunlight and more open stands that are beneficial for oak seedlings to grow and to retain an adequate number of seedlings. Closed canopies without frequent disturbances are detrimental to successful oak reproduction.

Maintaining intermediate light conditions in more open-canopied stands is challenging. The intermediate amount of light that favors oak seedlings, also discourages the growth of species that require greater amounts of sunlight (intolerants) or more shade-tolerant species. Most stands progress to full stocking in time with closed canopies. More frequent disturbances are necessary to maintain these more open stands to benefit development of oak regeneration.

Previously mentioned practices, similar to midstory removal outlined in this research, should provide the partial light conditions that allow white oak advance reproduction to grow and eventually become a component of the overstory.

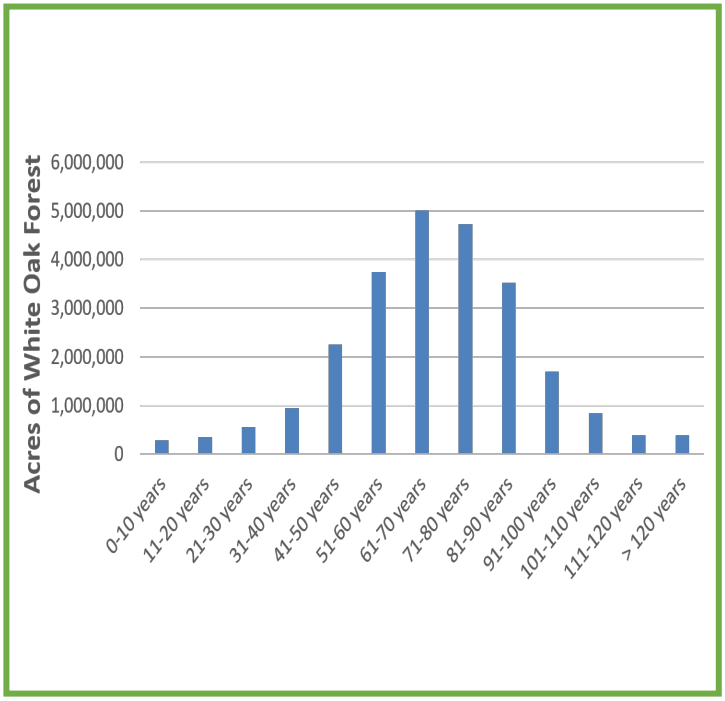

Figure 1—Number of acres of white oak-dominated forests by age class across Illinois, Indiana, Kentucky, Missouri, Ohio, and Tennessee, 2021. Source: Assessment and Conservation Plan. *www.whiteoakinitiative.com.*

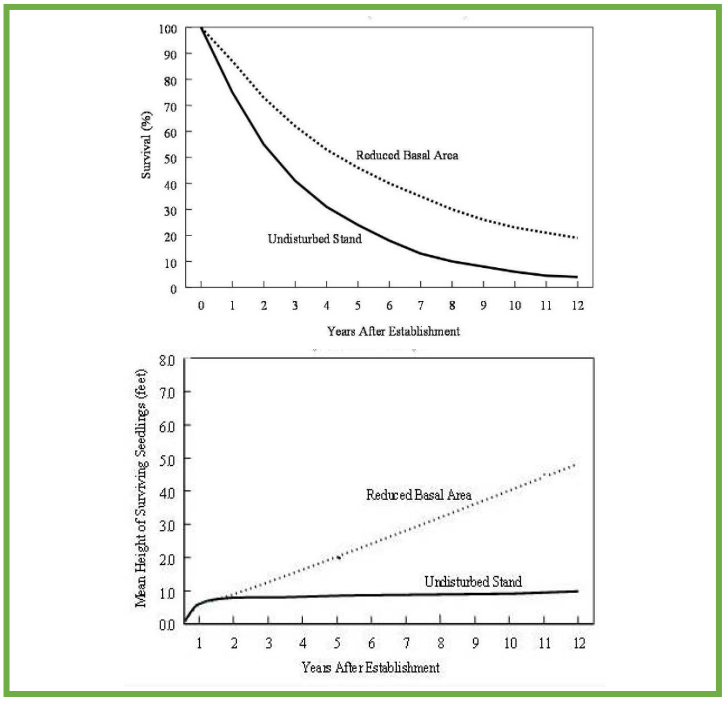

Figure 2—Hypothesized survival (top) and height (bottom) response of northern red oak advance reproduction to reductions in basal area (Loftis 1983).

Figure 3—Examples of a midstory control (left) and control (right) treatments.

References

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