

Long-term Effects of Crop-tree Release on the Growth and Quality of Upland White Oak Stands

by Philip Vogel

White oak is a highly valued tree in Kentucky and is an important species used in construction, flooring, cabinetry, and furniture. However, its use in staves for bourbon barrels has recently driven up the value of white oak. In fact, white oak is the second most valuable hardwood in Kentucky behind black walnut. While its value and use are on the increase, there is evidence that there will be a long-term decrease in white oak throughout the region.

Beginning in the 1950s, foresters across the eastern U.S. have noticed a widespread shift in forest composition that includes a reduction in oak in our forests. The culprit is generally understood to be a loss of fire and other natural disturbances, such as grazing, that resulted in forests that were open and contained less competing tree species. The combination of more light in the forest and fewer competitors helped oak to regenerate easily. With the advent of wildfire suppression and an overall decrease in disturbance, forests became denser and competing species like maple and beech increased, both resulting in less successful oak regeneration that will ultimately reduce the amount of oak in our woods. This article summarizes on-going research at the University of Kentucky that focuses on a silvicultural technique to improve the growth and value of existing white oak sawtimber that will help keep white oak forests healthy and provide improved revenues for woodland owners.

Crop-tree release (CTR) is a silvicultural treatment in which crop-trees are identified in a stand and released from competition by removing adjacent trees. A crop-tree is any tree chosen for a particular management objective (e.g. timber production, preservation of a species, seed production, etc.). Crop-trees are released by removing trees that touch the canopy of the crop-tree, which provides the crop-tree with more room to expand its crown, which typically increases tree growth and vigor as it gains better access to sunlight. While many studies have looked at the effects of CTR on red oaks, few have focused specifically on white oak.

In 1983, three CTR treatments were applied at UK's Robinson Forest to 12 two-acre small sawtimber sized stands ranging in age

from 70 to 80 years old. The first CTR treatment released 20 crop-trees per acre, the second treatment released 34 crop-trees per acre, and a third treatment (a control) where crop-trees were identified but not released. Each crop-tree received a full release from all crown-touching stems. Crop-trees identified for this study needed to meet five criteria:

1. Dominant or codominant crown class
2. White oak species
3. Potential tree grade 1 or 2
4. Even spacing with other crop-trees in the stand
5. All things equal, trees with larger dbh

A half-acre permanent plot was installed in each two-acre stand. Over the past 35 years, these permanent plots were measured 5 times. Measurements included species, crown class, tree grade, and diameter at breast height (dbh) for every tree 1" dbh and larger. In 2019, each crop-tree was assigned a product type, which refers to the specialty product for which a crop-tree could be used because of its exceptional quality. Based on criteria from mills around Kentucky, we identified crop-trees that could be sold as a veneer log, a high-end stave log, or a low-end stave log. For this study, we asked two questions: 1) how does CTR influence the growth and quality of small sawtimber-sized white oak crop-trees? and 2) how does CTR alter the stand structure of 70- to 80-year-old upland oak stands?

We found that CTR positively influenced small sawtimber-sized white oak crop-trees. Regardless of the number of crop-trees per acre released (20 or 34), released crop-trees grew faster than unreleased crop-trees, where periodic annual diameter increment (dbh) was found to be 0.19 inches in the 20 CTR treatments and only 0.14 inches in the



Oaks, including white oaks, are still able to establish groups of seedlings but fewer and fewer of these seedlings are able to survive and become established as dominant canopy trees.

Photo courtesy: Jeff Stringer

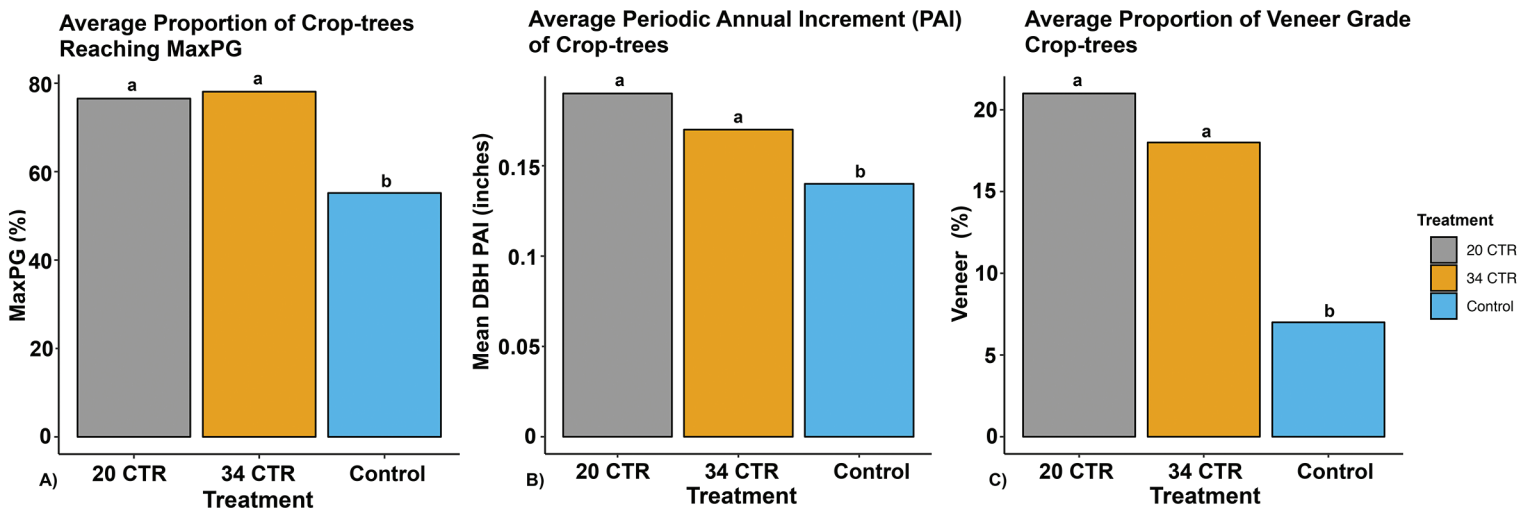


Figure 1. A) Average proportion expressed as a percentage (%) of crop-trees reaching their maximum potential grade (MaxPG) by treatment. B) The average PAI DBH (inches) of crop-trees by treatment. C) Average proportion expressed as a percentage (%) veneer grade crop-trees across each of the three treatments. Letter adjacent to each bar chart indicate a significant difference ($\alpha = 0.05$). Here we see a significant difference in each subfigure between treated CTR and the untreated controls.

control (Figure 1). Additionally, released crop-trees were more likely to achieve their maximum potential quality than unreleased trees. Almost 80 percent of the released crop-trees achieved their maximum value while only 55 percent of the unreleased controls did so over 35 years. Twenty-one percent of the crop-trees contained a high-quality veneer log while only 7 percent of the unreleased trees did (Figure 1).

While CTR certainly enhances the growth and quality of crop-trees, it also affects stand structure, providing a light thinning over the entire stand. Before the trees were released all of the stands had very high tree densities, considered to be “overstocked” in silvicultural terms. CTR reduced stocking to an average of about 76%. During the next 35 years, the released stands increased their density and were again overstocked and very similar to the controls, indicating that CTR promotes stand-wide growth. Fortunately, this level of canopy disturbance does not appear to promote maple or beech growth in the understory as the ingrowth accounted for by maple and beech was similar across treatments.

As oak-dominated forests change over time, landowners need tools that create suitable conditions for oak growth and persistence. This study has shown that crop-tree release applied to small sawtimber-sized upland white oak stands increases crop-tree diameter growth as well as the likelihood that a crop-tree will reach its maximum potential grade. Crop-tree release also showed that it can increase the percentage of trees that can be sold as veneer, the highest valued product from oak. It also stimulates stand-wide growth without harming or altering stand growth and yield. In combination with other treatments that focus on understory conditions, it could promote oak repro-



Photo courtesy: Philip Jay Vogel

Figure 2. Photo taken at University of Kentucky’s Robinson Forest highlighting marked and treated crop-tree as part of this CTR study.

duction as well by creating favorable light conditions at the forest floor. Perhaps most importantly for landowners in Kentucky, CTR is scalable across a variety of sizes of forestland holdings, allowing many landowners to promote the growth and quality of their high-value white oaks.

About the Author:

Philip Jay Vogel, has an M.S. in Forestry from the University of Kentucky. He works for the Lexington-Fayette Urban County Government in the Division of Environmental Services.

Lexington-Fayette Urban County Government, Division of Environmental Services, 200 E. Main St., Lexington, KY 40507; Email: philipjayvogel@gmail.com