Using Oak Silviculture

TO REINTRODUCE AMERICAN CHESTNUT

By Cornelia (Leila) Pinchot, Research Ecologist, Forest Service, Northern Research Station; Scott Schlarbaum, James R. Cox Professor of Forest Genetics, Director, UT Tree Improvement Program, University of Tennessee Department of Forestry, Wildlife & Fisheries; and Scott Tepke, Forester, Allegheny National Forest

Throughout much of American chestnut's range, the tree co-occurs with various species of oak, commonly northern red and chestnut oak. Oaks benefited from the loss of chestnut, by taking advantage of the increased light and growing space made available when its once abundant cousin was largely extirpated (Wang and Hu 2015). More recent changes in oak-dominated forests, such as increased herbivory and alteration to disturbance regimes, however, threaten the continued dominance of these species (Dey 2014). Because of this, promotion of oak regeneration is now a predominant focus of silviculture research and management, particularly on public lands, throughout the oak-hickory (formerly oak-chestnut) forest type. It would be practical, logistically and financially, then, if the silvicultural strategies used to regenerate oak can also be used to facilitate American chestnut reintroduction.

BC_3F_3 American chestnuts two years after planting in a removal harvest on the Allegheny National Forest.

In Pennsylvania, the three stage shelterwood system is often employed to promote the establishment and growth of oak regeneration (Brose et al 2008). To test the suitability of this system for hybrid American chestnuts, we installed a study on the Allegheny National Forest (ANF) in NW Pennsylvania in 2017 with the goals of comparing hybrid American chestnut survival, growth, and competitive ability across the three silvicultural treatments used in the three stage shelterwood system; and to compare success of chestnuts planted as high-quality seedlings with direct-seeded chestnuts.

Methods

The three-stage shelterwood system involves three harvests over the course of 15-20 years, each removing a percentage of the overstory and midstory trees, with the goal of progressively increasing light availability for oak seedlings as they establish, while limiting light for fast growing shade-intolerant species, like tulip poplar. These three treatments; preparatory cut (prep-cut), shelterwood seed cut (shelterwood) and removal cut, create a gradient of light availability and competition from sprouts and seedlings of other hardwood species. Correspondingly, they offer an opportunity to test the ability of planted hybrid chestnuts and direct-seeded chestnuts to thrive across varying levels of light from above, and competition from below.

With the help of Northern Research Station and ANF personnel and Tidioute Charter School students, we planted 757 high-quality hybrid backcross chestnut seedlings and 617 seeds across nine sites (three replicates of each of the three harvest treatments) in the Coalbed Run project area of the ANF in April, 2017 (**Figures 1 and 2**). Eight BC_3F_3 hybrid chestnut families were sourced from TACF and two BC_3F_2 families from the Connecticut Agricultural Experiment Station. The chestnut seedlings were just over 2½′ tall and 1/3″ thick (at the root collar) on average at the time of planting. Chestnuts were planted on a 12′ x 12′ grid, and chestnut type (seedling vs. seed) and family were arranged in incomplete blocks within each of the nine planting sites. Five-foot tall Plantra© tree shelters were installed on all chestnuts to protect them from herbivory. We recorded survival and height of the chestnuts and height and species of the tallest competing woody stem within 4 ¼′ of each chestnut toward the end of the first two growing seasons.

Figure 1

Chestnuts planted in A. Prep-cut site, B. Shelterwood site, C. Removal cut, all photographed during the second growing season after planting.

Results and discussion

Two years after planting, 92% of the seedling-planted chestnuts were alive, compared with 49% of the direct-seeded chestnuts. Survival was similar across the silvicultural treatments. We suspect lower survival for direct-seeded chestnuts was due in part to predation and possibly desiccation, both of which are common challenges faced by direct seeded chestnuts. The ease and cost savings of direct seeding may justify

Figure 2

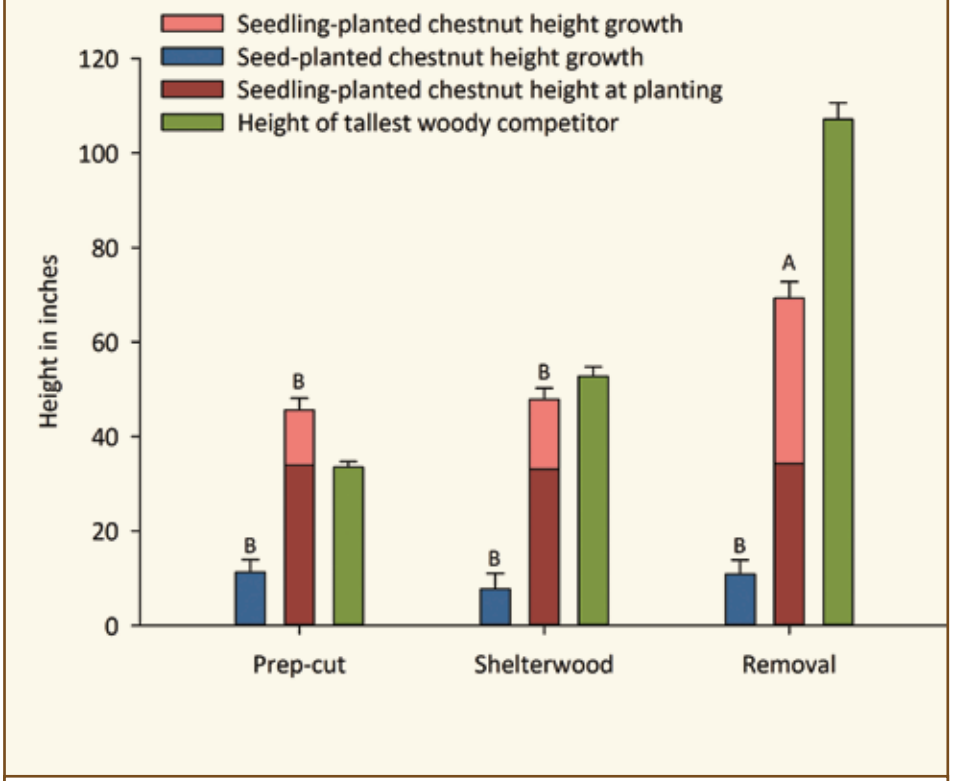
Direct seeded chestnut during its second growing season. The tree shelter was temporarily removed to take the photograph. Units on height stick are cm.

their use, even with reduced survival, though the long-term competitive ability of these direct-seeded chestnuts across the treatments is unknown. Given the substantial investment that goes into developing backcross seeds, however, it may be worthwhile to plant seedlings in order to maximize survival, particularly while its availability is limited.

Both chestnut height growth and total height over the first two years were statistically similar between planting types (seedling-planted vs direct seeded) in the prep-cut and shelterwood treatments (**Figure 3**). Growth and total height were greater, however, for seedling-planted chestnuts in the removal treatment. Basal area of residual overstory trees and percent canopy openness were similar between the prep cut and shelterwood treatments (99 ft/ac^2 and 24%, 95 ft/ac^2 and 25%, respectively), indicating light availability was comparable between these sites, which likely explains the similarity in height growth. The increased harvest intensity in the removal treatment (10 ft/ac^2 residual basal area and 65% canopy openness) provided more light to the chestnuts (and competing vegetation). The seedling-planted chestnuts responded to this increased light availability by growing over twice as much in height compared with the two other treatments (**Figure 3**). The direct seeded chestnuts, however, did not differ in their growth among the silvicultural treatments. This was likely caused in part to the robust sprout, sapling, and herbaceous competition in this treatment; the average height of which was ten times the height of the direct-seeded chestnuts, while only 1 ½ times the height of the seedling-planted chestnuts. Furthermore the stored carbohydrates in the root systems of the seedling-planted chestnuts presumably contributed to their increased competitive ability compared with the direct-seeded chestnuts.

The prep-cut and shelterwood treatments appear to be most efficacious for planting due to their reduced competition response, whereas the removal cut will probably require competition control, particularly if planting direct-seeded chestnuts. We will continue to monitor these chestnuts in future years to evaluate their survival and their growth relative to competing vegetation. Patterns we have found may change over time, particularly as the stands progress through the harvest sequence for the prep-cut and shelterwood treatments. Stay tuned!

Figure 3



Height and height growth of direct-seeded and seedling-planted chestnuts and height of tallest competitor two growing seasons after planting.

ACKNOWLEDGEMENTS

The American Chestnut Foundation provided chestnuts and generous funding through their External Grants program that made this work possible. Sandra Anagnostakis also provided chestnuts for this study. We thank Andrea Hille, Ecosystem Management Staff Officer, the Allegheny National Forest (ANF) for supporting this work, and Greg Sanford, Forester, ANF for assisting with site selection and study establishment.

REFERENCES

Brose PH. Root development of acorn-origin oak seedlings in shelterwood stands on the Appalachian Plateau of northern Pennsylvania: 4-year results. Forest Ecology and Management. 2008 May 15;255(8-9):3374-81.

Dey DC. Sustaining oak forests in eastern North America: regeneration and recruitment, the pillars of sustainability. Forest Science. 2014 Jan 23;60(5):926-42.

Wang, GG, and Hu, H. The replacements of American chestnut: A range-wide assessment based on data from forest inventory and published studies. In Proceedings of the 17th biennial southern silvicultural research conference. e-Gen. Tech. Rep. SRS–203. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 3 pp. Vol. 2015. 2015.