WHITE OAK GENETICS AND TREE IMPROVEMENT PROGRAM: RANGE-WIDE COLLABORATIVE EFFORT AND EARLY RESULTS

Laura E. DeWald[1*], Zachary J. Hackworth[2], and C. Dana Nelson[3]

[1] Tree Improvement Specialist and Adjunct Professor, University of Kentucky, Lexington, KY USA; [2] Research Analyst, University of Kentucky, Lexington, KY, USA; [3] Research Geneticist and Project Leader, USDA Forest Service, Southern Research Station, Lexington, KY USA and Southern Institute of Forest Genetics, Saucier, MS USA; *Laura.DeWald@uky.edu

White oak (*Quercus alba*) occurs throughout the eastern US forests where it is important to the health and how these forests function. White oak also provides habitat for wildlife such as turkey and deer, and it has high value to the forest products industry. The White Oak Initiative (whiteoakinitiative.org) is working to ensure there is a never-ending presence of white oak in the eastern forests. It supports the sustainable growth and production of white oak for a wide range of environmental, social and economic benefits. White oak research and the role of genetics and tree improvement is a focus area of the White Oak Initiative in recognition of the importance this work plays in our ability to respond to increasing pressures on the white oak resource. The White Oak Genetics and Tree Improvement program (WOGTIP) (white-oak-genetics.ca.uky.edu) also supports the goals of the James B. Beam Institute for Kentucky Spirits.

Unimproved **Improved**

10-year-old white oak growing in adjacent rows, Indiana DNR Vallonia Nursery (photo by L. DeWald)

Limited research indicates there are good opportunities for improvement in white oak (see Figure 1). WOGTIP was developed as a collaborative program including industry (forest, wood, distilling), and agencies and organizations (forestry, conservation, wildlife) to: (1) quantify genetic variation in white oak and, (2) improve traits that have economic and ecological value. The project will support white oak users by: 1) providing a sustainable supply of high quality, improved white oak seedlings via a tree improvement program to meet current and future demands, 2) improving our ability to conserve and restore white oak in the forest to achieve a variety of ecological, conservation and economic goals at regional and national levels, and 3) providing genetic resources for academic and industrial research and development.

WOGTIP has three phases: 1) collecting and archiving genetic material, 2) progeny testing, and 3) acorn production and seedling deployment.

Phase 1 - Collecting and Archiving Genetic Material: White oak genetic material is being collected from the entire geographic range of white oak. Acorn collectors include federal and state agency personnel, academic institutions, woodland owners, NGO's and many citizen volunteers including those in the Master Naturalist programs. Acorns are planted and seedlings

are grown at the Kentucky Division of Forestry's (KDF) Morgan Co. nursery. Other than hand-planting, standard nursery operating procedures are followed. Scions from the trees that acorns were collected from are grafted onto swamp white oak root stock and out-planted to create a clone bank to conserve genetic material of the parent trees for creation of future seed orchards. Acorn and scion collecting will continue until the entire geographic range of white oak is represented in the program. Despite being a poor mast year, 91 collections from 9 states were obtained in 2019 and 17,000 acorns were planted at the KDF nursery. In 2020, 112 collections from 18 states and over 35,000 acorns were planted at the KDF nursery. 2021 is a good mast production year across the range of white oak and multiple collections from every state in the natural range will be collected. 1-0 seedlings varied significantly among seed sources in height, root collar diameter and branchiness. Acorn size and percent of acorns resulting in seedlings also varied significantly.

Phase 2 - Progeny Testing: 1-year-old seedlings are planted in progeny tests to evaluate parent tree traits of interest to stakeholders. Depending on the trait, identification of superior performance can occur within 7-15 years. A progeny test located at Maker's Mark Star Hill Farm in Loretto KY includes seed sources representing the entire geographic range of white oak. Planting began in March 2021. Many smaller regional progeny tests are also being established throughout the geographic range of white oak. These tests will allow us to describe genetic patterns to ensure seed sources do not get moved outside their range of adaption, and we can look for local and non-local genetic superiority. Partners hosting regional tests include academic institutions, USFS National Forests and Research Stations, and state natural resource agencies.

Phase 3 – Acorn Production and Seedling Deployment: Parents of superior progeny based on the progeny tests results are used to create grafted seed orchards using material stored in the clone banks. Pollen mixing among top parents within seed orchards creates genetically diverse, high quality offspring. Controlled pollination can be used to breed for insect and disease resistance, or for other traits that will support ecological success in the forest and/or increased economic value for wood products industries. Demand for white oak acorns is very high, and acorn production is highly variable in white oak. Therefore, to ensure a sustainable supply to the nurseries, two addition types of acorn production areas of genetically superior trees will be established. Poorer performing trees will be removed from the regional progeny tests after 15 years and these tests will be converted to acorn production areas. Superior seedlings will also be planted in small areas on private woodlands and within National Forests to become additional acorn production areas. The establishment of many acorn production areas using superior white oak throughout its range will supplement the grafted seed orchards to ensure a consistent annual supply of acorns is available to the nurseries for the production of superior white oak seedlings.

Reforestation using superior white oak seedlings will achieve the goals of the white oak genetics and tree improvement program.

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