Physiological Response of Hardwood Plantations to Thinning

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INTRODUCTION

In the Central Hardwood Forest Region (CHFR) of the United States, pure and mixed plantations composed of hardwood species such as black walnut (*Juglans nigra* L.), white oak (*Quercus alba* L.), and northern red oak (*Q. rubra* L.) have the potential to produce trees of considerable economic [1] and ecological value [2]. Such plantations require active silvicultural management to attain management goals or objectives. These plantations will decline in growth and quality in the absence of management using thinning treatments applied at appropriate timings and intensities [3]. To improve our ability to better predict response after thinning and adjust silvicultural guidelines accordingly, there is a need to understand the biological means by which these species respond to a change in available growing space and environmental conditions.

This project will investigate the physiological response and changes in root system morphology for black walnut, white oak, and northern red oak over three growing seasons after thinning. We hypothesize that thinning significantly increases (1) water and nutrient availability to trees; (2) movement of water and nutrients from the roots to the above ground portions of the trees; (3) the photosynthetic capacity of residual trees.

METHODS

One mixed hardwood plantation will be used as a study trial to refine methodology for additional sites. The 15-year-old plantation is located on Eli Lilly and Company ground in West Lafayette, Indiana. Northern red oak, white oak, black walnut, and black cherry (*Prunus serotina* Ehrh.) were planted at 2.4 x 2.4 m spacing (Figure 1). Black cherry was heavily browsed, resulting in poor form. Four square plots (400 m^2) were established. Each plot consisted of 8 x 8 rows (20 m x 20 m) for a potential total of 64 trees. Planting pattern consisted of four rows (Figure 2). Two plots will be thinned (47% density removal) and two will be used as controls.

Figure 1. Study plot prior to thinning.

Thinned plots will have at least six measurement trees for each species under study. Descriptive statistics from the study plots show that mean black walnut density is highest at 519 stems ha^{-1} (Figure 3).

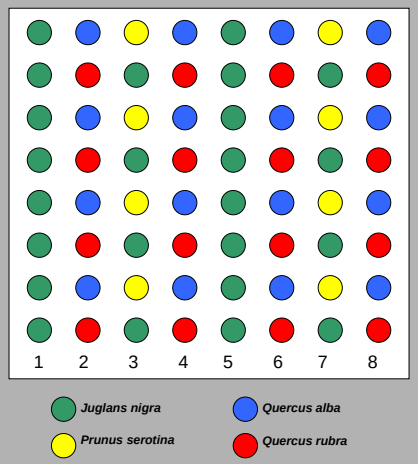

Figure 2. Example of a study plot showing the repeating planting pattern used in the original plantation.

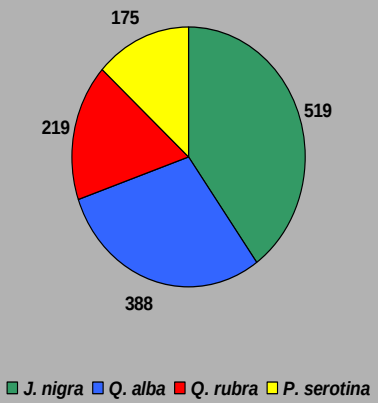

Figure 3. Tree density (stems ha^{-1}) by species prior to thinning.

Compared to other plantations in the state of Indiana, survival was high [4] for all species except northern red oak with 57% survival only (Figure 4). Measurements will begin in the next few weeks.

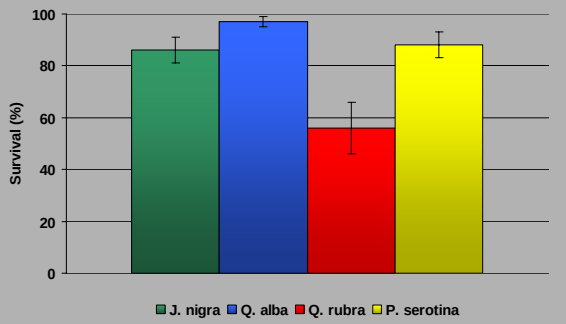

Figure 4. Survival (% ± SE) by species.

POTENTIAL FINDINGS

The study trial will generate results over three growing seasons after thinning. Additional sites will be selected this summer and will provide results over two growing seasons after thinning. The findings of this study will increase knowledge of the physiological response of hardwood trees to thinning and improve our ability to better predict response after intermediate silvicultural treatments such as thinning.

LITERATURE CITED

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