NOT ALL CLONES ARE EQUAL: VARIATION IN DROUGHT RESPONSE AMONG THREE CLONES OF LOBLOLLY PINE

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Abstract-- To better understand loblolly pine (*Pinus taeda* L.) drought response we conducted an intraspecific study on three 2-year-old loblolly pine half-sibling clones. Three soil water treatments were imposed. Two were constant soil water treatments at either high (-0.3 MPa) or low (-1.5 MPa) water availability and the third was a wetting-drying treatment that alternated between three weeks of drought (-1.5 MPa) and one week at field capacity (-0.3 MPa). The experiment was replicated three times with 171 ramets per clone and treatment combination. Biomass growth was measured by harvesting a subset of plants every four weeks. In addition, pre-dawn needle water potential, morning water potential, photosynthesis, stomatal conductance, transpiration and instantaneous water use efficiency were measured throughout the experiment

Increases in the frequency and severity of drought necessitate a better understanding of loblolly pine drought response. We conducted a study on intraspecific variation of loblolly pine (*Pinus taeda*) drought response in which 171 plants of each of three closely related 2-year-old loblolly pine clones were grown in well-watered and simulated drought conditions. Three soil water treatments were imposed. Two were constant soil water treatments at either high (-0.3MPa) or low (-1.5 MPa) water availability and the third was a wetting-drying treatment that alternated between three weeks of drought (-1.5 MPa) and one week at field capacity (-0.3 MPa). Biomass growth was measured by harvesting a subset of plants every four weeks. In addition, pre-dawn needle water potential, afternoon water potential, photosynthesis, chlorophyll fluorescence, stomatal conductance, transpiration, instantaneous water use efficiency, and leaf anatomy were measured throughout the experiment.

There was a significant difference in biomass growth among clones with a clear genetic by environment (G x E) interaction ($p=0.004$). Specifically, clone 1 preformed the best under low water conditions but significantly worse under high water conditions. In contrast, clones 3 preformed the best under high water conditions and significantly worsted than the other two clones under low water conditions. We interpret the results to suggest a fundamental tradeoff in which a particular set of traits can maximize growth under low water conditions at the expense of growth at high water or vise versa. Carbon isotope discrimination (12C/13C) also showed clear intraspecific variation and a significant treatment response, with average delta 13C of -32.09, -31.64 and -32.32 for clones 1, 2, and 3, respectively under well-watered conditions ($P<0.001$), with a similar response in drought conditions, indicating variation in water use efficiency. Needle water potential, needle gas exchange and chlorophyll fluorescence measurements all showed strong treatment effects but little variation among clones. This study indicates that there is genetic variation, even among closely related clones, in

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response to drought. These results will help provide tools for developing greater drought resistance in loblolly pine.