

Red Oak Resilience to Winter Flooding in Bottomlands: Is There Potential for Tree Improvement?

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Red oaks in bottomlands are experiencing tree die-off and poor regeneration, highlighting the need for better science-based management and tree improvement. One key knowledge gap is our understanding of root physiology in moderately flood tolerant oaks, like willow oak and Nuttall oak (*Quercus phellos*, *Q. texana*), as altered hydroperiods and unusual weather patterns are more frequently exposing bottomland ecosystems to flooding when trees are not fully dormant. We conducted a series of greenhouse and field studies to determine phenology of roots and the impacts of flooding during winter dormancy transitions on red oak seedlings. Root growth and respiration declined during winter, due to low soil temperature. Air temperature also influenced roots, probably through effects on photosynthesis, still active during winter in the semi-persistent leaves common to willow oak and Nuttall oak seedlings. Soil flooding that occurred during winter had minor impacts, such as halting root growth, but caused no seedling mortality. Seedlings that experienced flooding in warm soil had greater, but still limited, stress. Additionally, seasonal flooding beginning before dormancy or extending after release from dormancy can negatively impact seedling growth and survival. Furthermore, flood intolerant *Q. shumardii* had reduced growth during the spring and summer following exposure to dormant season flood. Our results indicate that roots could continue to grow during typical winter weather and soil temperatures in southern bottomlands, but at slow rates. Apparent stress of soil flooding on willow oak and Nuttall oak seedlings under these conditions was low. Still, our results indicate that seedlings require some underlying physiological mechanisms to tolerate or recover from winter flooding, because reduced root activity, which may contribute to stress avoidance during winter flooding, does not persist as air and soil temperatures fluctuate over winter. The implications for tree improvement, as well as challenges and opportunities, will be discussed.