

## Water use and productivity in *Populus deltoides* and hybrids in the southeastern United States

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Tree water use, water use efficiency (WUE), and the relationship between WUE and growth was explored in 4-year-old *P. deltoides* and hybrid clones. Nine genotypes, six pure *P. deltoides* and three hybrids (two *P. trichocarpa*  $\times$  *deltoides* and one *P. deltoides*  $\times$  *maximowiczii*) clones, were selected based on year two stem biomass accumulation and represented genotypes with high, average, and low growth potential. We asked the questions: are there differences among genotypes in water use and water use efficiency (WUE) and does WUE correlate with growth? Tree sap flow was measured continuously during the fourth growing season using thermal dissipation probes. Maximum daily transpiration ( $E_t$ ) ranged from 5 to 10 mm day<sup>-1</sup>. Growing season water use (m<sup>3</sup> H<sub>2</sub>O tree<sup>-1</sup>) was correlated strongly with aboveground wood biomass (stem and branches) growth. Tree level WUE ranged between 1.7 and 3.9 kg biomass m<sup>3</sup> H<sub>2</sub>O<sup>-1</sup> and there were significant differences among clones ( $P < 0.001$ ); although, tree WUE was only weakly correlated with growth ( $R^2 = 0.14$ ,  $P = 0.03$ ) and not correlated with total water use ( $P = 0.81$ ). However, there was significant clone variation ( $P < 0.001$ ) in leaf  $\delta^{13}\text{C}$  composition. Leaf WUE inferred from  $\Delta^{13}\text{C}$  was correlated positively with tree WUE and wood biomass growth. Strong positive relationship between  $\Delta^{13}\text{C}$  and growth and the differential family response in tree WUE and  $\Delta^{13}\text{C}$  suggest that genotype variation in WUE is due to both stomatal conductance and photosynthetic capacity. Leaf  $\Delta^{13}\text{C}$  may be useful for examining physiological and morphological determinants of growth among genotypes in *Poplar*.