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IS WATER USE EFFICIENCY A USEFUL AND RELEVANT TRAIT FOR ADAPTATION TO LOCAL CONDITIONS AND FOR BREEDING? PRESENT KNOWLEDGE AND RESEARCH NEEDS

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Differences in water use efficiency (WUE) have been extensively investigated in trees using carbon-13 in leaf biomass as a surrogate. We now have evidence of considerable diversity for this trait in several tree species, and valuable insight into the genetic control of this diversity is available. Nevertheless, two main questions remain open: 1) Is the observed diversity of WUE in natural populations neutral, or is WUE subject to selective pressure? 2) Is enhanced WUE a valuable target for breeding in plantation species such as poplar or pines? Based on recent evidence obtained in natural populations of oaks and beech, as well as in clonal plantations of poplar, we discuss these two questions and provide some answers, as well as outline further research needs. Briefly, there is currently little evidence from natural populations that the observed genetic diversity in ¹³C discrimination and WUE is organized along clear patterns related for instance to soil water availability. We therefore urgently need more data on the genetic variability in ¹³C discrimination at local scales, i.e., common garden experiments. Breeding for enhanced WUE will not produce genotypes with enhanced drought resistance, but could possibly increase the sustainability of plantation forestry in regions where water availability is a major issue.

Keywords: ¹³C, functional trait, isotopic discrimination, transpiration efficiency, water availability