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Evaluation of Water Use Efficiency of Short Rotation Poplar Coppice at Bohemian-Moravian Highlands

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The water availability of the locality constitutes one of the main constraint for short rotation coppices grown on arable land. As a convenient characteristic assessing how the water use is coupled with the biomass yields, so called water use efficiency (WUE) is proposed. One method of water use efficiency determination is presented within this study. The study was carried out at short rotation poplar coppice (poplar clone J-105) at the Test Station Domanínek, Ltd. at Bohemian-Moravian Highlands during the growing season 2013. Diameters at breast height (*DBH*) were measured for 16 sample trees where sap flow measuring systems (Granier's Thermal Dissipation Probe, TDP) were installed. TDP outputs are expressed as temperature differences (ΔT) between the heated and non-heated probes. Estimation of sap flux density (F_d) by the Granier method relies on the measurement of temperature difference (ΔT). Determination of maximum temperature difference (ΔT_{max}) is fundamental for sap flux density (F_d) calculation. Although ΔT_{max} can be theoretically defined as ΔT at $F_d = 0$, many factors may prevent the occurrence of the zero flow state, such as night-time water movement for new growth (vegetative or reproductive) or water loss from the canopy due to high vapour pressure deficit (VPD). Therefore, the VPD condition was established for determination of ΔT_{max}. VPD condition was established as follows: VPD reaching values 0.2 at least 6 hours during night (from 21 p. m. to 3 a. m. and when the condition was fullfilled, the value at 3 a. m. was taken) because it is a supposed time after that the tree has no transpiration. The programmable part of Mini 32 software (www.emsbrno.cz) was used for application of the script establishing ΔT_{max} values under this VPD condition. Nevertheless, another script was applied on ΔT data set to determination of ΔT_{max} values for every night at 3 a. m. (as this is when ΔT should be at its daily maximum) without VPD condition restriction for comparison of both approaches. Since application of the two mentioned scripts led to two sets of resulting values, calculations of F_d and consequent sap flow values were computed for both variants of ΔT_{max}values. The sample trees were divided into 3 diameter classes according to DBH values at the beginning of regular measurements (April 24, 2013). Allometry was carried out on February 20, 2014 to calculation of aboveground woody biomass. The input data for calculations of WUE of aboveground woody biomass productivity was biomass increments and monthly totals of sap flow for 16 sample trees. The total WUE for 16 measured trees reached 4.93 g kg^{-1} (when calculated with data set without VPD condition) and 4.63 g kg^{-1} (when calculated with data set under VPD condition). This study was funded by project "Building up a multidisciplinary scientific team focused on drought" No. CZ.1.07/2.3.00/20.0248 and LD130030 supporting COST Action ES1106.