Oil palm water use: calibration of a sap flux method and a field measurement scheme

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Abstract	Oil palm (Elaeis guineensis Jacq.) water use was assessed by sap flux density measurements with the aim to establish the method and derive water-use characteristics. Thermal dissipation probes were inserted into leaf petioles of mature oil palms. In the laboratory, we tested our set-up against gravimetric measurements and derived new parameters for the original calibration equation that are specific to oil palm petioles. In the lowlands of Jambi, Indonesia, in a 12-year-old monoculture plantation, 56 leaves on 10 palms were equipped with one sensor per leaf. A 10-fold variation in individual leaf water use among leaves was observed, but we did not find significant correlations to the variables trunk height and diameter, leaf azimuthal orientation, leaf inclination or estimated horizontal leaf shading. We thus took an un-stratified approach to determine an appropriate sampling design to estimate stand transpiration (E-s, mm day(-1)) rates of oil palm. We used the relative standard error of the mean (SEn, %) as a -measure for the potential estimation error of E-s associated with sample size. It was 14% for a sample size of 13 leaves to determine the average leaf water use and four palms to determine the average number of leaves per palm. Increasing these sample sizes only led to minor further decreases of the SEn of E-s. The observed 90-day average of E-s was 1.1 mm day(-1) (error margin +/- 0.2 mm day(-1)), which seems relatively low, but does not contradict Penman-Monteith-derived estimates of evapotranspiration. Examining the environmental drivers of E-s on an intra-daily scale indicates an early, pre-noon maximum of E-s rates (11 am) due to a very sensitive reaction of E-s to increasing vapor pressure deficit in the morning. This early peak is followed by a steady decline of E-s rates for the rest of the day, despite further rising levels of vapor pressure deficit and radiation; this results in pronounced hysteresis, particularly between E-s and vapor pressure deficit.
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