Water Movement through the Surfaces of the Grape Berry and Its Stem

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Abstract: Water uptake and transpiration of detached grape berries (*Vitis vinifera* L. cv. Chardonnay, Müller-Thurgau, Riesling) were determined gravimetrically. Water movement was linearly related to time. Abrading the cuticle from the berry surface increased rates of uptake and transpiration 73- and 7-fold, respectively. Restricting water movement to the berry surface by sealing the stem, including the stem/fruit juncture, decreased rates of uptake (-76%) and transpiration (-16%). Rates of uptake were weakly related and those of transpiration were closely related to the surface area of the berry. Transpiration rates were higher in the stylar (+44%) than the cheek region. The water potential of developing Riesling berries (Ψ_{fruit}) was approximately constant between 20 and 76 days after full bloom (DAFB) ranging from -0.52 (±0.18) to -0.58 (±0.15) MPa and decreased thereafter to -1.56 (±0.04) MPa at 131 DAFB when the solute potential was -3.66 (±0.01) MPa. The permeability of the cuticle of Riesling berries to water uptake decreased from 43.3 (±7.0) nm/s to 4.1 (±1.2) nm/s between 28 and 131 DAFB, respectively, and that for transpiration decreased from 7.3 (±0.3) nm/s to 1.6 (±0.0) nm/s. Water uptake was not affected by NaCl, KCl, $CaCl_2$, $FeCl_3$, or $AlCl_3$ (all at 1 to 100 mM). Only $MgCl_2$ slightly increased water uptake. Increasing temperature from 2 to 35°C increased rates of water uptake in Riesling and Müller-Thurgau berries 2.2-fold (equiv. energy of activation 19.6 [±3.3] kJ/mol). Flow rates, fluxes, and permeabilities of stem and berry surfaces in water uptake and transpiration are discussed and a water balance for vascular and surface transport of water in a Riesling berry under hypothetical weather conditions is estimated.

Key words: water uptake, cuticle, pedicel, permeability, solute potential