Title Modeling the influence of temperature and relative humidity on respiration rate of prickly pear cactus cladodes

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Abstract

Respiration rate (R_{O2}) of prickly pear cactus cladodes (*Opuntia* spp.) was measured as a function of four temperature (T) and six relative humidity (RH) combinations for O_2 partial pressures between 15 and 0.8 kPa, which were considered to support aerobic respiration. The rate of respiration (R_{O2}) was determined based on O_2 depletion of the atmosphere in sealed containers containing 1 kg of cladodes. The O_2 partial pressure declined linearly over time and the slopes of the fitted lines were used to calculate the rate of O_2 uptake. The rate of O_2 consumption increased with increasing temperature and decreased with increasing RH. The respiratory rate at 25 °C was approximately 30–40 times higher than at 5 °C. The respiratory rate at 65% RH was between 30 and 90% greater than at 90% RH, depending on the temperature. Data for $\ln(R_{O2})$ for each RH level were regressed against the inverse of the temperature (K^{-1}) to determine Arrhenius constants and calculate the apparent E_a of respiration for the six RH conditions. The E_a was similar for each RH level, varying between a low of 113 to a high of 131 kJ mol^{-1}. The following equation having an r^2 of 0.95 was developed describing respiration as a function of RH and temperature (°C) using only four constants:

$$\text{Ln}(R) = (-0.1985 + 50.96 \text{ x } (1/273.15+T)) \text{ x RH} + 67.64 - 18430 \text{ x } (1/273.15+T)$$