Title The development of a model to describe the influence of temperature and relative humidity on respiration rate of prickly pear cactus stems in reduced O_2 conditions

Author E.M. Yahia, L.M.M. Tijskens, J.C. Guevara, L. Cedeño and R.M. Beaudry

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Abstract

Respiration rate (R_{O2}) of prickly pear cactus stems (*Opuntia* spp.) was measured as a function of 4 temperature (T) and 6 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 stems. 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 uptake increased with increasing temperature and decreased with increasing RH. The respiratory rate at 25°C was approximately 30 to 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 T (K^{-1}) to determine Arrhenius constants and calculate the apparent Ea of respiration for the six RH conditions. The Ea was similar for each RH level, varying between a low of 113 to a high of 131 kJ•mol^{-1}. An equation having an R^2 of 0.95 was developed describing respiration as a function of RH and T (°C) using only four constants.