Assessments CO2 assimilation on a per-leaf-area basis are related to total leaf area

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Abstract

Net photosynthetic rates often are dependent on leaf size when expressed on a leaf-area basis (CO2 assimilation as μmol·m–2·s–1). Therefore, distinguishing between leaf-size-related and other causes of differences in net photosynthetic rate cannot be determined when data are presented on a leaf-area basis. From a theoretical perspective, CO2 assimilation expressed on a leaf-area basis (μmol·m–2·s–1) will be independent of leaf area only when total net CO2 assimilation (leaf CO2 assimilation as μmol·s–1) is linearly related to leaf area and the function describing this relationship has a nonzero y intercept. This situation was not encountered in the data sets we evaluated; therefore, ratio-based estimates of CO2 assimilation were often misleading. When CO2 assimilation data are expressed on a per-leaf-area basis (the standard procedure in the photosynthesis literature), it is difficult to determine how photosynthetic efficiency changes as leaves or plants mature and difficult to compare the efficiency of treatments or cultivars when leaf size or total plant leaf area varies.

Keywords

developmental stage, intercept corrections, leaf age, leaf area, ratio-based efficiency, regression models, slope-based efficiency.