photorespiration-rate-estimation

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Photorespiration rate calculation Method 1

There are two approaches to estimating photorespiration rate. Firstly, the differences in photosynthetic CO_2 assimilation rate, A_{net} under ambient and non-photorespiratory conditions (no or low O_2) $A_{net,\ non-R_p}$ corrected for CO_2 release will provide an estimate of photorespiration. In this case, the respiration cost could be considered similar under photorespiratory and non-photorespiratory conditions (Equation 1).

$$R_{p,\ apparent} \ = \ A_{net,\ non-R_p} - A_{net,\ R_p}$$

For C3 plants, for every two oxygenations of RuBP, one CO_2 molecule is released (Mallmann et al. 2014). Thus, the apparent Rp can be used to estimate the CO_2 released using Equation 2 as follows:

$$released\ CO_2 = R_{p,\ apparent}\ * 0.5$$

the sum of CO_2 release and apparent R_p is the true R_p (Equation 3).

$$R_p\ = R_{p,\ apparent} + released\ CO_2$$

Method 2

The second method (Erel et al. 2015; VALENTINI et al. 1995) involves partitioning the total linear electron transport (ETR) J_T rate into photorespiratory and non photorespiratory flux as follows (Equation 4).

$$J_T = J_C + J_O$$

where J_T is the total electron transport rate, J_C and J_O are the electron flow for carboxylation and oxygenation of rubisco, respectively (EPRON et al. 1995). This assumes that there are no other electron flow demands for other cellular processes. This ignores the major energy demand is for RuBP regeneration (Genty, Briantais, and Baker 1989). Since four electrons are required for one carboxylation and oxygenation cycle, and one CO2 is released for two oxygenation cycles by glycine decarboxylation in the C2 pathway, J_C can be calculated as follows (Equation 5):

$$J_C = 4A + 0.5J_O + 4R$$

Using Equation 4 this can be rearranged to get J_C as follows (Equation 6):

$$J_C = 1/3 \times (J_T + 8 \times (A + R_{day}))$$

Similarly, J_O can be written as (Equation 7)

$$J_O = 2/3 \times (J_T + 4 \times (A + R_{day}))$$

Thus, with equation 4 above, photorespiration rate is calculated as J_O .

$$R_p = \frac{J_T - 4(A_n + R_{day})}{12}$$

the above equation needs to be solved under 0% and 21% O2 conditions to see if R_{day} can be removed. Also check if Rday can be derived from existing data.

ignore text below.

Data from Puerto Rico *In situ* measurements on x tropical forest species in Sabana, Luquillo, Puerto Rico was conducted during February 2024.

References

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