LEAF PHOTOSYNTHESIS AND RESPIRATION OF EVERGREEN WOODY SPECIES IN A TROPICAL SECONDARY DRY FOREST: IMPLICATIONS FOR CARBON BALANCE

P.N.M.S. Piyarathne[1], L.K. Weerasinghe[2], D.P. Kumarathunga[3], D.S.A. Wijesundara[4], M.C.M. Iqbal[4] and N. Geekiyanage[1]

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka
[2]Plant Physiology Division, Coconut Research Institute, Lunuwila, Sri Lanka
[3]Department of Crop Science, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[4]National Institute of Fundamental Studies, Hantana Road, Kandy, Sri Lanka

Photosynthesis and respiration are the two main biological processes that determine the carbon balance of tropical trees. Whereas a positive carbon balance is required for carbon sequestration and growth, rising atmospheric temperature poses challenges for accurate modelling of these fluxes. We quantified the rates of photosynthesis and respiration, together with their thermal sensitivity in two canopy layers; upper and lower canopy in a secondary tropical dry forest regenerated through assisted natural regeneration in Sam Popham Arboretum, *Dambulla*, Sri Lanka. A range of ecophysiological traits; leaf respiration in darkness (R_D) and in the light (R_L; estimated using the Kok method), the temperature sensitivity of R_D, light-saturated photosynthetic rate (A_{sat}), light and CO_2 saturated photosynthetic rate (A_{max}) and leaf dry and fresh mass per unit area (LMA and FMA) were measured in 09 woody species in each upper and lower canopy. Light response curves were fitted for all species. The LMA was higher ($p=0.017$) in upper canopy species than lower canopy species. Both area- and mass-based measurements of A_{sat}, A_{max}, and R_D (at 30 °C) were significantly higher in upper canopy species, indicating their high metabolic capacity. Upper canopy species also showed high carbon gain per unit loss (A_{sat}/R_D). Over the 25 – 40 °C range, thermal sensitivity of R_D was similar in both upper and lower canopy species, exhibiting an average Q_{10} value of 1.9 (nearly doubling for every 10 °C rise in temperature). The degree of light inhibition in the upper and lower canopy was 29% and 42%, respectively. This suggests that exposure to high growth irradiance in upper canopy results in high demand for respiratory products. Our findings may enable the accurate prediction of carbon fluxes between tropical dry forests and the atmosphere.

Keywords: Carbon balance, Light, Photosynthesis, Q_{10}, Tropical dry forests