

## Changes in photosynthesis and leaf characteristics with height from seedlings to mature canopy trees in some dipterocarp species in a tropical rain forest, Sarawak, Malaysia

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In this study, our objective was to determine tree height effect on leaf photosynthesis, morphological and biochemical properties, in tropical canopy tree species from seedlings under dark forest floor to mature canopy trees at bright canopy layer.

Our study was carried out in an intact lowland mixed dipterocarp forest in Lambir Hills National Park, Sarawak, Malaysia (4°20'N, 113°50'E, 150–250 m a.s.l.), in September 2001. Variations with height of leaf properties were investigated in 65 individuals of five dipterocarp tree species from seedling to emergent tree in the forest. The species were *Dipterocarpus globosus*, *Dryobalanops aromatica*, *Shorea acuta*, *S. beccariana* and *S. macroptera*.

The canopy openness increased significantly with tree height. Photosynthetic properties, such as photosynthetic capacity at light saturation ( $A_{\max}$ ), the light compensation point ( $I_c$ ), the maximum rate of carboxylation ( $V_{c\max}$ ) and maximum rate of photosynthetic electron transport ( $J_{\max}$ ), all increased significantly with tree height. Leaf morphological and biochemical traits, such as leaf mass per area (LMA), palisade layer thickness, nitrogen content per unit area ( $N_{\text{area}}$ ), chlorophyll content per unit dry mass ( $\text{Chl}_{\text{mass}}$ ) and chlorophyll to nitrogen ratio (Chl/N ratio), also changed significantly with tree height. Overall, all leaf properties could be summarized in a simple and significant relation with tree height, with a little intra- and inter-species difference. Our results therefore suggest that the photosynthetic capacity of dipterocarp trees depend on tree height; they relate to their light condition by adjusting their leaf morphological and biochemical properties. These results may be used to set up accurate estimation models for the CO<sub>2</sub> flux and biomass production in a tropical rain forest.