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Photosynthetic capacities of mature tropical forest trees in Rwanda are linked to successional group identity rather than to leaf nutrient content

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Tropical forests are crucial in the global carbon balance, yet information required to estimate how much carbon that enter these ecosystems through photosynthesis is very limited, in particular for Africa and for tropical montane forests. In order to increases the knowledge of natural variability of photosynthetic capacities in tropical tree species in tropical Africa, measurements of leaf traits and gas exchange were conducted on sun and shade leaves of ten tree species growing in two tropical forests in Rwanda in central Africa. Seven species were studied in Ruhande Arboretum, a forest plantation at mid altitude (1700 m), and six species in Nyungwe National Park, a cooler and higher altitude (at 2500 m) montane rainforest. Three species were common to both sites. At Nyungwe, three species each belonged to the successional groups pioneer and climax species. Climax species had considerably lower maximum rates of photosynthetic carboxylation (Vcmax) and electron transport (Jmax) than pioneer species. This difference was not related to leaf nutrient content, but rather seemed to be caused by differences in within-leaf N allocation between the two successional groups. With respect to N, leaves of climax species invested less N into photosynthetic enzymes (as judged by lower Vcmax and Jmax values) and more N into chlorophyll (as judged by higher SPAD values). Photosynthetic capacities, (i.e. Jmax and Vcmax), Jmax to Vcmax ratio and P content were significantly higher in Nyungwe than in Arboretum. Sun leaves had higher photosynthetic capacities and nutrient content than shade leaves. Across the entire dataset, variation in photosynthetic capacities among species was not related to leaf nutrient content, although significant relationships were found within individual species. This study contributes critical tropical data for global carbon models and suggests that, for montane rainforest trees of different functional types, successional group identity is a better predictor of photosynthetic capacities than leaf nutrient content.