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Photosynthetic temperature responses of tree species in Rwanda: evidence of pronounced negative effects of high temperature in montane rainforest climax species

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The sensitivity of photosynthetic metabolism to temperature has been identified as a key uncertainty for projecting the magnitude of the terrestrial feedback on future climate change. While temperature responses of photosynthetic capacities have been comparatively well investigated in temperate species, the responses of tropical tree species remain unexplored. We compared the responses of seedlings of native cold-adapted tropical montane rainforest tree species to exotic warm-adapted plantation species, all growing in an intermediate temperature common garden in Rwanda. Leaf gas exchange responses to CO_2 at different temperatures (20 – 40 C) were used to assess the temperature responses of biochemical photosynthetic capacities. Analyses revealed a lower optimum temperature for photosynthetic electron transport rates than for Rubisco carboxylation rates, along with lower electron transport optima in the native cold-adapted than in the exotic warm-adapted species. The photosynthetic optimum temperatures were generally exceeded by daytime peak leaf temperatures, in particular in the native montane rainforest climax species. This study thus provides evidence of pronounced negative effects of high temperature in tropical trees and indicates high susceptibility of montane rainforest climax species to future global warming.

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