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Thermal acclimation of leaf physiology in tropical tree seedlings is species dependent

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Thermal acclimation of leaf physiology has been extensively studied in temperate trees and to some extent in boreal tree species. In these ecosystems higher temperatures typically stimulate leaf CO_2 assimilation and tree growth. For species in the tropics, however, data are scarce. It has been proposed that acclimation capacity might be limited in tropical species due to a low seasonal and historical variation in temperature. To test this hypothesis we studied the extent to which the temperature sensitivities of leaf photosynthesis and respiration acclimate to growth temperature in four common African tropical tree species.

The tree species were selected to represent both early and late successional as well as montane and transitional tropical rainforest species native to Rwanda. Mean daytime air temperatures in these forests are about 15-20 ˚C with peak temperatures reaching 20-30 ˚C. To cover this range, tree seedlings were grown in chambers set to 20, 25 and 30 ˚C during daytime, with 5 ˚C lower nighttime temperatures. We investigated the acclimation capacity of the temperature sensitivities of maximum rates of Rubisco carboxylation (V_{cmax}) and electron transport (J_{max}) using photosynthetic CO_2 response measurements (so called $A - C_i$ curves) at 5 ˚C temperature intervals from 15 ˚C to 40 ˚C. Additionally, leaf dark respiration was measured at 15, 20, 25 and 30 ˚C, leaves were analyzed for thylakoid membrane lipid composition, and whole plant biomass was measured at the end of the experiment.

Our results indicate that tropical tree photosynthesis acclimates to higher temperatures and that this is partly linked to changes in the thylakoid membrane lipid composition. Respiration acclimates to maintain homeostasis at different growth temperatures. The acclimation of leaf physiology differed among species and will be discussed in relation to species' habitats and ecological strategies.

We conclude that tropical trees are able to acclimate leaf physiology to higher growth temperatures. Since thermal acclimation capacity is considerably higher in some species, warming may – without a change in water availability – give these species a competitive advantage, leading to changes in forest composition.