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Nutrient and soil moisture limitations in the Kalahari region of southern Africa

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The Kalahari sandsheet occupies approximately 2.5 million ha of southern Africa. This semi-arid region hosts a variety of co-dominated tree-grass ecosystems that differ in their species composition and structure. These differences are attributed to the dramatic north-south precipitation gradient that persists across the region. The role of nutrients and their interaction with soil moisture on vegetation productivity is not understood across the transect. This study examined the effects of increased soil nitrogen and phosphorus on aboveground grass biomass productivity and net carbon assimilation. Leaf level maximum rubisco catalytic activity (V_{cmax}) and maximum electron transport rate (J_{max}) were determined under varying CO_2 mixing ratios ranging from 100 to 800 mmols m^{-2} $s^{-1}$and PAR mixing ratios ranging from 500 to 2500 photons m^{-2} s^{-1}. Results show variable photosynthetic response to increased soil nitrogen and phosphorus across the precipitation gradient. Grass biomass productivity and foliar nutrient concentrations were inversely correlated with precipitation, suggesting increased competition with trees in regions of higher mean annual precipitation (and higher canopy cover) or the existence of other factors limiting grass productivity, such as light. Variable results for relative soil nutrient effects on net photosynthesis (A_n) across the precipitation gradient suggest other sources of limitation. These findings are helpful in addressing questions regarding desertification and bush encroachment in the Kalahari region. Additionally, these data could be used in leaf- and canopy-scale modeling to predict changes in productivity under a changing climate.