Soil fertility and photosynthesis strategy

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Abstract

In photosynthesis production, climate plays a decisive role in the diffusion of CO2 inside the leaf to the chloroplast (Ball et al., 1987). The theory of lower cost of photosynthesis (Wright et al 2000) proposes that this process be optimized to minimize the total unit costs of transpiration (water requirement) and carboxylation (enzyme requirement and nutrient extension) according to climatic conditions of plant habitat. This theory explains about 40% of photosynthetic variations. We propose to increase the precision of this prediction by better identifying the role of the soil in the modulation of the CO2 diffusion process towards the chloroplast but also by including it in the theory. To this end, we use and complete two international geo-referenced databases of photosynthetic features (Globamax: instantaneous photosynthesis measurements, Glob13C: integrated photosynthesis measurements, including 1015 and 3642 site-species combinations respectively) that we couple to basics. climatic and edaphic data (WorldClim and soilgrids, respective resolution of 1km and 25 0m). Preliminary

results show that soil pH and silt content strongly modulate the co-variation between the water requirement and the nutrient requirement, direct parameters of photosynthesis. Considering only the soil variables, we explain 38% of the photosynthetic variations. When soil variables are coupled with climatic variables, we observe an interaction showing a stronger influence of the soil when the climate is arid or the altitude is high, two conditions that increase the cost of water use according to the theory the least cost. We seek to understand the ecophysiological

mechanisms behind the role of the soil and its interaction with the climate in order to integrate this interactive role in global vegetation models.

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