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"Resilience of agricultural systems against crises"

Preliminary Characterisation of Common Legume Tree Species as Coffee Shade for Climate Change Readiness

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Abstract

Agroforestry practices are proposed for adaptation to the increased temperatures and more irregular rainfall associated with climate change in the coffee growing areas of Mesoamerica. We propose that understanding the functional characteristics of different legume trees can contribute to the design of multi-purpose, multi-strata shade, including climate change readiness. The genera of *Inga* and *Erythrina* of the Fabaceae family are common in coffee fields due to their capacity to fix nitrogen. We studied photosynthetic parameters and biomass accumulation of young trees grown in 15-L pots of five species found as coffee shade - *Erythrina poeppigiana* (Ep), *Inga jinicuil* (Ij), *I. oerstediana* (Io), *I. punctata* (Ip) and *I. vera* (Iv) at 10, 40 and 100 % of full solar irradiance. After 125 days, Ep had accumulated the highest biomass, followed by Iv and Io. Biomass of Ep, Iv, and Ip declinaed linearly with irradiance, while for Io and Ij, biomass declined less at intermediary irradiance. Leaf area for Io and Ij increased in 40 % irradiance compared to others species, although leaf area ratio increased in all species with declining irradiance. At leaf level, the photosynthetic capacity expressed by the maximum carboxylation rate (Vcmax in μmol m^{-2} s^{-1}) and potential light-saturated electron transport rate (Jmax in μmol m^{-2} s^{-1}) were higher in Ep, Iv and Io compared to Ip and Ij, according to the highest biomass accumulation. Vcmax and Jmax reduced with declining irradiance showing an acclimation to shade related to changes in leaf traits as leaf specific area, but the rated of reduction was specie specific. Diurnal courses of photosynthesis and transpiration (T) showed highest values at 100 % full sun. Instantaneous water use efficiency (WUE An/T) was higher for 100 % irradiance for Ep, Iv, and Io compared to Ij and Ip, for WUE was higher at 40 % irradiance. These results indicate that species differences need to be further characterised to provide the basis for the design of climate-change ready multi-strata. Follow-up field studies are needed to pruning and thinning. These parameters are also essential for modelling long-term photosynthesis and productivity in these agroforestry systems.

Keywords: Agroforestry, biochemical model, light, photosynthesis, shade species, water use efficiency

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