Shade and altitude effects on the ecophysiological performance of *Coffea arabica* L. under agroforestry system on Gorongosa Mountain, Mozambique

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Introduction

Coffea arabica L. productivity is closely influenced by climate conditions. Ecophysiological performance is determined by temperature and irradiation, and the use of agroforestry systems (AFS) might have a positive role, while supporting the recovery of the natural forest (using native trees for shading) in the Gorongosa Mountain.

Materials and Methods

The impact of shade and/or altitude on leaf ecophysiological performance where assessed on 4 years old *Coffea arabica* L. cv. Costa Rica plants, under three altitudes (650, 825, 935 m) and three light levels (deep shade, DS; moderate shade, MS; full Sun, FS) [1]. Net photosynthesis (P_n), stomatal conductance (g_s), and chlorophyll *a* fluorescence parameters were taken in four daily periods (9-10; 11-12; 13-14; 15-16h) once a month, from April to September 2020.

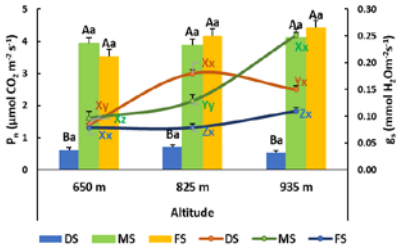

Figure 1. Annual mean (April to September) of P_n (bars) and g_s (lines) on leaves under three shade levels (DS, MS, FS) and three altitudes (650, 825, 935 m) conditions. Mean values ± SE (n=5) followed by the same letter, comparing light conditions within each altitude (A, B) for P_n or (X, Y, Z) for g_s) or altitude treatments within each light condition (a, b) for P_n or (x,y,z) for g_s), are not significantly different according to the Tukey's HSD, after a two-way ANOVA (both at 95% confidence).

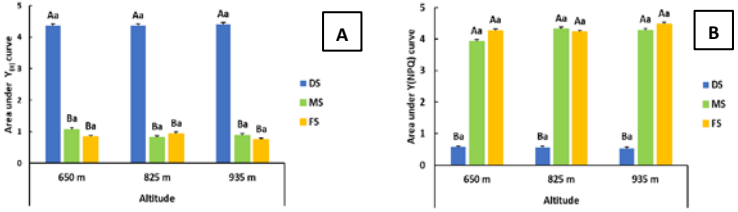

Figure 2. Area under the mean from April to September of quantum yields of the efficiency of electron transport ($Y_{(II)}$) (**A**), and of the non-photochemical quenching ($Y_{(NPQ)}$) (**B**), under three light (DS, MS, FS) and three altitude (650, 825, 935 m) conditions. For statistical indexes meaning see Fig. 1 legend.

Results and Discussion

P_n was higher in MS and FS (Fig. 1), similarly among altitudes. Higher altitude did not strongly alter P_n pattern, but often allowed greater g_s values under FS, likely associated to greater water availability (due to higher rainfall, as well as to fog persistence in some periods).

Despite lower $Y_{(II)}$ and greater energy dissipation ($Y_{(NPQ)}$) (Fig. 2), higher irradiance favored greater P_n in FS and MS plants, in line with the greater yields in 825 and 935 m in such plants.

Conclusions

Overall, this study showed that strong light restriction do not provide optimal P_n, with negative impact on bean yield. The AFS management at MS (825 and 935 m) is suitable for coffee growing, without decreasing coffee productivity as compared with FS, with both MS and FS showing high P_n values.

Reference:
[1] Cassamo, C.T. *et al.*, 2022, *Agronomy*, **12**, 2540. DOI: 10.3390/agronomy12102540.

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