[P074]

Estimations of leaf CO_2 assimilation, stomatal conductance and transpiration in adult Arabic coffee plants after long-term FACE cultivation

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The air [CO_2] can reach 600 µL CO_2 L^{-1} in the middle or the end of this century, depending on scenario. The first plant response to elevated CO_2 (e[CO_2]) is the increased leaf photosynthetic rate (*A*) occurring parallelly by mainly non-sensitive or decreased stomatal conductance (g_s) and decreased transpiration (*E*). In Arabic coffee, *A* increases under e[CO_2], especially during the dry growing season, while g_s responses vary during years under free-air-CO_2-enrichment (FACE). The aim of this study was to estimate *A*, g_s and *E* over a coffee vertical profile after five years cultivation under FACE, including the responses to water availability.

Coffee was cultivated under two CO_2 conditions, actual (a[CO_2], ~390µL CO_2 L^{-1}) and e[CO_2] (~590µL CO_2 L^{-1}). The irrigation started at the end of the 4th year of experiment. The measurements were conducted in rainy season, in February 2016 (grain expansion). Values of photosynthetic active radiation (PAR) varied from 1131 to 0 µmol photons m^{-2} s^{-1} to construct curves of *A*, g_s and *E* dependence on PAR in four 50 cm-thick layers. Simultaneously, PAR was measured in the morning, midday and afternoon. Punctual values were estimated from nonrectangular hyperbola (*A*) and polynomial (g_s and *E*) models.

PAR reached ~1400 µmol m^{-2} s^{-1} at the highest plant layer at midday, while the transmitted PAR at soil level was about 4 µmol m^{-2} s^{-1}. The *A* diminished gradually from plant top to bottom, from 7.2 to -1 µmol m^{-2} s^{-1}. The *A* was positively impacted by e[CO_2] in the highest and low layers. The g_s and *E* showed similar trends in daily variation and in responses to CO_2 and water availability treatments, showing lower values under e[CO_2] than a[CO_2] over the plant profile, with exception of the most shaded leaves. Results suggest better water economy under e[CO_2] than a[CO_2] under high light conditions.

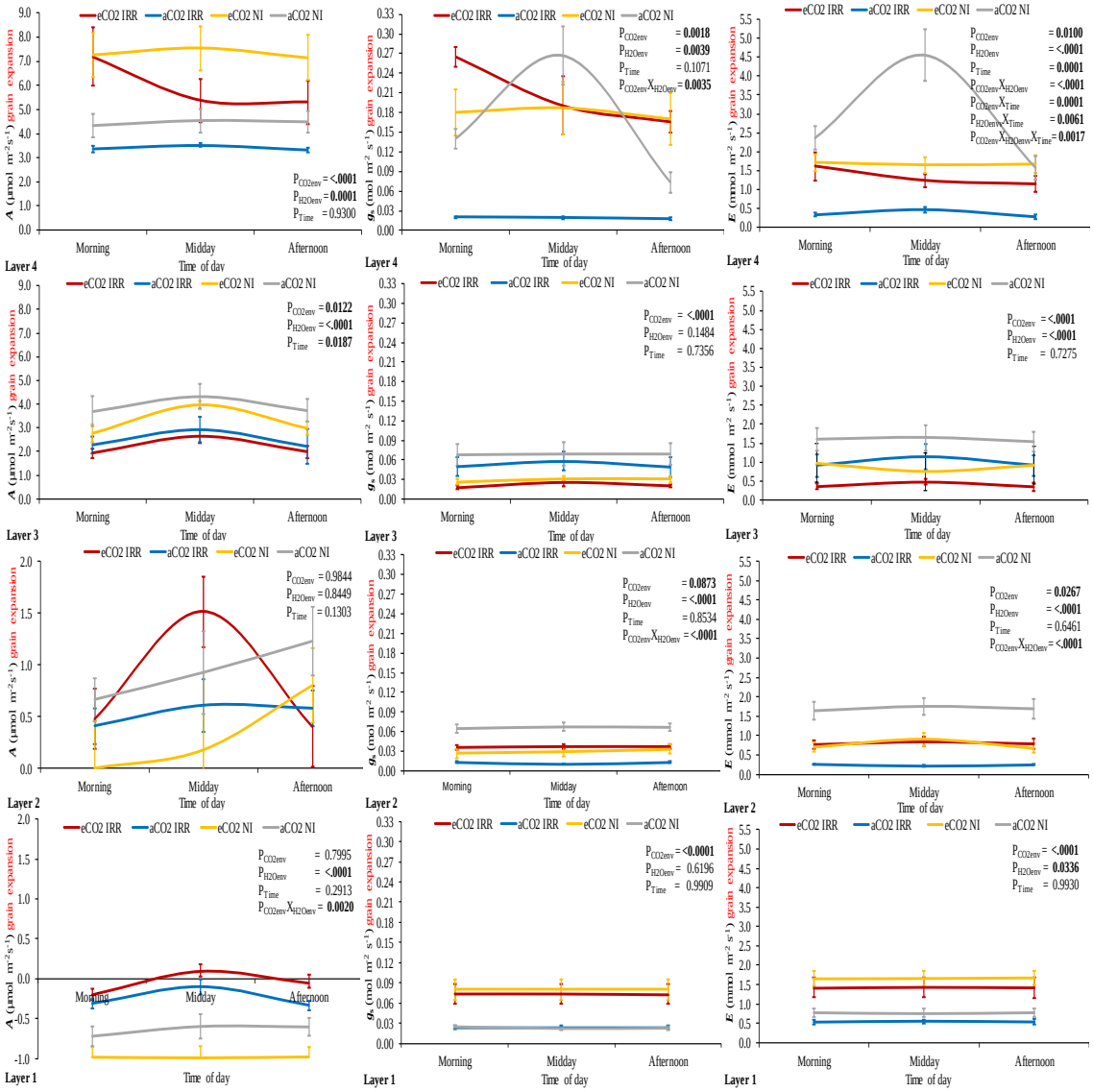

Figure 1. The mean, standard error and ANOVA P-values (n=8-20) of: **left column)** leaf photosynthetic rate (A, µmol CO_2 m^{-2} s^{-1},); **central column)** stomatal conductance (g_s, mol m^{-2} s^{-1}); and **right column)** leaf transpiration (E, mmol m^{-2} s^{-1}) estimated in four layers of coffee plants (**layer 1** = 0 - 50 cm; **layer 2** = 50 - 100 cm; **layer 3** = 100-150 cm and **layer 4** > 150 cm) grown under elevated (e[CO_2]) and actual (a[CO_2]) air [CO_2] under irrigation (IRR) and rainfed (NI) water regimes. Data derived from photosynthetic light response curves measured in grain formation based on microenvironmental light availability. ANOVA P-values corresponding to effects of CO_2 and H_2O environments (env) by layer are indicated. Letters in bold indicate the P<0.1, accepted because of high light microenvironmental variability and consequently, high variability in responses.

Keywords: drought, elevated CO_2, light microclimate, plant vertical profile