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Elevated CO_2 mitigates the effects of anomalous drought reducing the proportion of abnormal reproductive structures in Arabic coffee

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The increase in atmospheric carbon dioxide concentration [CO_2] results in higher photosynthesis and growth of the upper layer structures in coffee trees. It was hypothesized that coffee trees would increase the reproductive investments of high plant layers under elevated [CO_2] (e[CO_2]). The aim of this study was to estimate the dynamic in flowering intensity and quality at axis scale in free-air-CO_2-enrichment (FACE) experiment over four years under rainfed conditions.

The effects of actual [CO_2] (a[CO_2], ~ 390 µL CO_2 L^{-1}) and e[CO_2] (~ 590 µL CO_2 L^{-1}) on the flowering of Arabic coffee (cv. Red Catuaí IAC-144) were evaluated in completely randomized split-plot block design. Nonbranched second order plagiotropic axes from the upper layer, characterized by flower buds visually individualized on 13 to 16 metamers, were selected before the main flowering in 2012-2015. We used tulle bags to cover second order axes for reproductive structures collection. After abscission, buds and flowers were counted and classified as normal or abnormal.

Flowering intensity and quality were impacted by e[CO_2], varying by year. The coffee axes produced more reproductive structures in the first flowering year (2012) than later; this reproductive investment by axis was higher under e[CO_2] than a[CO_2] (Figure 1A-B). The % of dropped flower buds in 2012 was more than double compared to later years, without [CO_2] impact (Figure 1C). High reproductive investments in the second-order axes in 2012 resulted from higher production of inflorescences per metamer compared to other years, with a positive e[CO_2] effect. In 2014, drought in rainy period and high summer minimum temperatures (Figure 2) affected the inflorescences differentiation, increasing the proportion of abnormal reproductive structures compared to other years (Figure 1D). The e[CO_2] reduced proportion of abnormal reproductive structures mitigating the anomalous drought effects.

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