PA197 The Phyllochron under Elevated Air [CO_2] and Irrigation in Active Growth Period over the Tree Hyerarchy.

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Climate forecasts suggest that [CO_2] in atmosphere will continue to increase. Plant growth dynamics regarding elevated [CO_2] climate changing could be estimated by phyllochron, which is defined as a time interval between the appearances of two successive leaves. Leaf appearance rate is considered a major component of crop yield, since it contributes to crop leaf area index, which determines the interception of solar radiation used for CO_2 assimilation and biomass production. The hypothesis of this study was that the hierarchy over the same tree could have the impact on time intervals of leaf emission, while the elevated air [CO_2] and irrigation would promote the phyllochron in adult Arabica coffee plants.

In adult Arabica coffee plants, about 78% of vegetative growth occurs in the warm, rainy season, named active growth period. Coffee plants were grown, started from winter 2011, under actual (~390 μL CO_2 L^{-1}) and elevated [CO_2] (actual + 200 μL CO_2 L^{-1}) in Free-Air-CO_2-Enrichment (FACE) facility, Jaguariúna, Southern Brazil. Trees of 'Catuaí IAC 99' were codified in dynamic multiscale-tree-graphs, from October 2015 to March 2016, following the VPlants methodology. Leaf emission was observed in a frequency of 15 to 20 days, covering 14 growth dates of irrigated (IRR) and non-irrigated (NI) plants, under actual (a[CO_2]) and elevated air [CO_2] (e[CO_2]). In order to integrate the effect of temperature on leaf appearance, the phyllochron was expressed as a function of accumulated thermal time (i.e. in growing degree-days – GDD, °C day $leaf^{-1}$). The phyllochron was estimated on five branching orders, regarding orthotropic trunks (1st order axes) and 2nd to 5th order plagiotropic axes.

The GDD required to emit one new phytomer varied depending on branching order. The 1st and 2nd order axes did not differ in phyllochron, requesting lower thermal time for one phytomer emission than the 3rd and 4th order ones. The thermal time requested for leaf pair emission on 1st order axes was strongly reduced under irrigation and e[CO_2], requiring in average 253 °C day $leaf^{-1}$ compared to 377 °C day $leaf^{-1}$ under a[CO_2]-NI. The request for leaf pair emission on 2nd and 3rd order axes was modified by their position over the vertical profile and water supply. The phyllochron on 2nd order axes was significantly lower under irrigation in the middle growth zone of orthotropic axes (50 – 60th ranks) and higher in zones that defined the initial and final 1st order ranks that born 2nd order axes. The requested GDD for leaf pair emission on 3rd order axes gradually reduced from the initial to the final 1st order ranks that born 3rd order axes.

The results suggest that the architecture development in coffee plants is hierarchically organized by the phyllochrons and modified by [CO_2] and water supplies. The phyllochron under FACE facility will be observed in longer period to improve the knowledge about complex orchestration in structural development of Arabica coffee plants under elevated air [CO_2] regarding the rates of phytomer growth and mortality.

Keywords: Arabica coffee; dynamic multiscale-tree-graphs; growth degree-days; phytomer ranks; vegetative growth.