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# Unravelling Sampling Bias in $\delta^{13}C$ Isotope Variability in Coffee-Banana Intercropping for Drought Stress Assessment

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Coffee-banana intercropping, widely practiced by smallholder farmers in South America and East Africa, is recognized for its potential to combine sustainability with resilience to climate change. This practice promotes crop diversification, but may also enhance water-use efficiency. However, its effectiveness may vary depending on the local conditions and agricultural practices. The lack of quantitative data on drought stress and the complexity of interactions within coffee-banana intercropping systems pose significant challenges in modelling and optimizing water use efficiency. This study aims to develop and refine innovative methods to assess drought stress in coffee-banana intercropping systems, with a focus on stable carbon isotope values ($\delta^{13}C$), leaf temperature, and mid-infrared spectroscopy (MIRS). While stable carbon isotope analysis is a promising tool, its application may face challenges due to factors such as crop size, canopy heterogeneity, banana-coffee canopy overlapping, leaf age, orientation, or position (leaf morphological aspects), leading to variable competition for water and light. These factors affect the way sampling for stable carbon isotope and leaf temperature analysis should be conducted, in addition to physiological differences between coffee genotypes, agronomic practices, and complexities in data interpretation. Sampling and analytical protocols must be adapted to address these factors and their effects, while accounting for leaf morphology and microenvironmental parameters. Initially, we evaluated the influence of these factors on $\delta^{13}C$ variability in coffee leaf samples, in addition to their correlation with leaf temperature. Samples were collected from a 0.15 hectares experimental farm managed by the Agricultural Research Company of Minas Gerais (EPAMIG) in Brazil, an intercrop of Arabica coffee and Cavendish banana plants at 3.6 a distance apart. Coffee leaves were sampled using a metal puncher and leaf temperature was measured using an infrared thermometer, considering varying levels of sunlight exposure. Ten plants of the Catuaí Vermelho IAC 44 coffee cultivar were randomly selected: five under conventional

management (chemical fertilizers) and five under organic management (cattle manure). For each plant, samples were taken at three different heights (Top, Middle and Bottom), three orientations (South, East and West), and two branch sides, including young and mature leaves, resulting in 36 leaves per plant. The poster presents key findings on the variability of $\delta^{13}C$ isotopes in coffee leaves within a banana-coffee intercropping system and their relationship with leaf temperature under different management practices (organic and conventional). This presentation highlights the observed effects of leaf sampling parameters, such as age, position, and sunlight exposure, on $\delta^{13}C$ values, as well as the implications for improving drought stress screening methodologies.