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Evaluating water requirements of Robusta coffee trees to reduce irrigation

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Rationale:

Vietnam is the largest producer of Robusta coffee worldwide, with more than 600,000ha of coffee farmlands in the Central Highlands. Most of these farming systems are irrigated during the dry season to trigger synchronous flowering and to sustain coffee physiological processes until the onset of the rainy season. However, there are concerns that the current national recommendation of 400L/coffee tree/round, with 2 to 5 rounds of irrigation per year based on weather conditions, may overestimate the water needs of coffee trees, leading to unnecessary depletion of underground water resources in the dry season. This study thus aims to assess the minimum amount of water needed to sustain coffee needs in the Central Highlands.

Methods:

A trial was set up in 2021 in Dak Lak Province within an existing coffee farm intercropped with avocado trees. The experiment employed a split-plot design incorporating 2 factors: irrigation quantity (400L/ round vs. 250L/round) and coffee system (monoculture – achieved through avocado tree removal – vs. agroforestry). Sapflow sensors measured coffee transpiration from January to May 2023. Pre-dawn leaf water potential measurements were conducted before each irrigation round to assess hydric stress. Complementary measurements of soil moisture sensors were taken to a depth of 60cm, providing insights into the water availability for coffee trees.

Results:

In monoculture systems, coffee trees under 250L and 400L irrigation exhibited similar transpiration rates and leaf water potentials from January to March. Differences emerged in April, towards the end of the dry season, when coffee trees under 250L irrigation displayed reduced transpiration rates and higher hydric stress compared to those receiving 400L irrigation. In agroforestry systems and throughout the dry season, coffee trees used 25-33% less water than in monoculture systems. Irrigation had no significant impact on transpiration and leaf water potentials. Following the onset of the rainy season in May, all coffee trees quickly recovered from hydric stress.

Conclusions & Perspectives:

This study indicates that 250L irrigation is adequate to meet the water demand of coffee trees in monoculture systems at the beginning of the dry season. However, as the dry season extends and temperatures rise, this amount is no longer sufficient. Conversely, coffee trees under shade trees require less water and are not impacted by reduced irrigation treatments. These findings highlight that that the ongoing shift from monoculture coffee to coffee-agroforestry systems based on fruit trees can result in substantial reductions in water consumption for irrigation purposes.