Using Carbon Stable Isotope to Evaluate Water Efficiency Following Seasonal Variation in Coffee Leaf

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Improper water management, indiscriminate water use, and climate change are the major factors reducing the global freshwater resources, and the major challenges facing many parts of the world. This study aims to determine the water use efficiency (WUE) index based on the carbon isotope discrimination ($\delta^{13}C$) to investigate the relationship between carbon absorption and water loss in coffee plants. The contents consist of the followings: (1) The design of the sampling area, collecting coffee leaf samples corresponding to the design of irrigation season and regime; and measuring temperature, rainfall, and humidity parameters in the area; (2) Testing and optimizing the procedure for analysis of $\delta^{13}C$ stable isotope in coffee leaf samples on the EA-IRMS system at the Dalat Nuclear Research Institute; (3) Analyzing $\delta^{13}C$ stable isotope in coffee leaf samples in Lam Dong (about 90 samples); (4) Using this stable isotope data for the water use efficiency index calculation of coffee plants and the. The results showed that the accuracy of the procedure with $\delta^{13}C$ is $\leq$ 0.3‰, and the precision (absolute standard deviation) with $\delta^{13}C$ is $\leq$ 0.2‰ in coffee leaf samples. And water use efficiency index and $\delta^{13}C$ were positively correlated with temperature (T°C), humidity (H%), and annual precipitation (Rmm) while carbon content was negatively correlated. In the data observed, the results showed that in the rainy season, the water use efficiency index was nearly 14% higher than that in the dried season; in the dry season WUE was 0.19 whereas in the rainy season, the amount of water in plants increased with the WUE index (0.22) and p-value = 0.017.

Keywords: Water use efficiency (WUE), elemental analyzer-isotope ratio mass spectrometry (EA-IRMS), coffee leaves, $\delta^{13}C$, and carbon content.