Plant Water Relation and Drought: Relationship Between Plant Water Potential and Relative Leaf Water Content in Different Tropical Plants

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As global average temperature continues to increase and precipitation events become less predictable, understanding the long-term effects of drought on ecosystems is of increasing importance. However, it is difficult to study phenomena such as drought due to their unpredictable nature and the fact that it is difficult to tag and track the movement of water and carbon through an entire ecosystem. Within the framework of the controlled ecosystem manipulation experiment (WALD- Water, Atmosphere and Life Dynamics) at Biosphere 2, a deliberate drought in the enclosed tropical rainforest biome presented a unique opportunity to study responses in carbon and water cycling due to water stress. Within the scope of this study, the goal of this project was to examine the effect of prolonged water stress on different species within the rainforest and understand how the plants coped with the stress on an ecosystem level. This was accomplished by weekly plant water potential measurements (WP) before, during, and after the drought, as well as leaf sampling for relative leaf water content (RWC) and xylem sampling for water isotope measurements. For both predawn and midday WP, we found significantly different species responses; for Ceiba pentandra and Pachira aquatica, WP did not decrease during the drought, while for Hibiscus tiliaceus and Hibiscus rosa sinensis, WP decreased dramatically during the drought. After the additional of moisture from deeper depths, both C. pentandra and Hura crepitans (largest trees) responded the fastest by increasing in WP, while H. tiliaceus and H. rosa sinensis had the slowest recovery in WP, and only after rewetting from above had occurred. RWC also revealed different responses by different plant species, with Phytolacca dioica and H. rosa sinensis showing the highest RWC values throughout the experiment. The relationship between RWC and WP was also not consistent among species, with half of the species exhibiting a positive relationship, while the other half exhibiting a negative relationship. Other factors such as trunk capacitance and or leaf shedding during the drought might explain some of these contrasting relationships. Establishing such associations could lead to the development of tools that remotely assess average leaf water content of an area of forest via spectral reflectance and use those data to approximate the water stress of plants in that area, a very valuable asset when dealing with such geographically extensive phenomena as drought.