Testing the use of sealable bags as an alternative and less expensive method for tracing isotopes in plant matter

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Objectives

This experiment was done at the University of Arizona's Biosphere 2 (figure 1) in the rainforest (figure 2). The main purpose of the research was to find a less expensive method for sampling isotopes from plants by testing direct vapor equilibration laser spectroscopy as an alternative and less expensive method for tracing isotopes in plant matter. Currently, water isotopes are traced with an infrared spectroscopy (IR) machine which costs about $8 a sample while this new method costs about $2 a sample and takes less time per sample.

Methods

- Gather stopcocks, nuts, ¼ leurxs, a sealer (para-film, rubber washers, ect.,), hole punch, and gas tight, sealable bags.
- Assemble the bags by poking a hole 6 to 7 cm down from the seal in middle of bag. Place sealer, then leurx, then stopcock.
- Once the bags are assembled, collect the samples. With gloves on, obtain a small branch (between 20 and 30 grams), strip the bark from it, cut it in half and then down the middle. Place the sample in the bag being sure not to touch the sides of the bag. Write the time of collection on the bag and heat seal it (figure 3).
- Also make water baseline bags (figure 6). For every 6 plant samples run, a 25mL baseline of tap water, light water and heavy water should also be run (3 bags).
- Fill the bag with dry air and place it in a temperature controlled room, about 23 degrees Celsius. Let the samples sit for 24 hours before they are run through the LGR (figure 4).

Figure 3. Close up of cut sample.

Figure 1. This is the Biosphere 2.

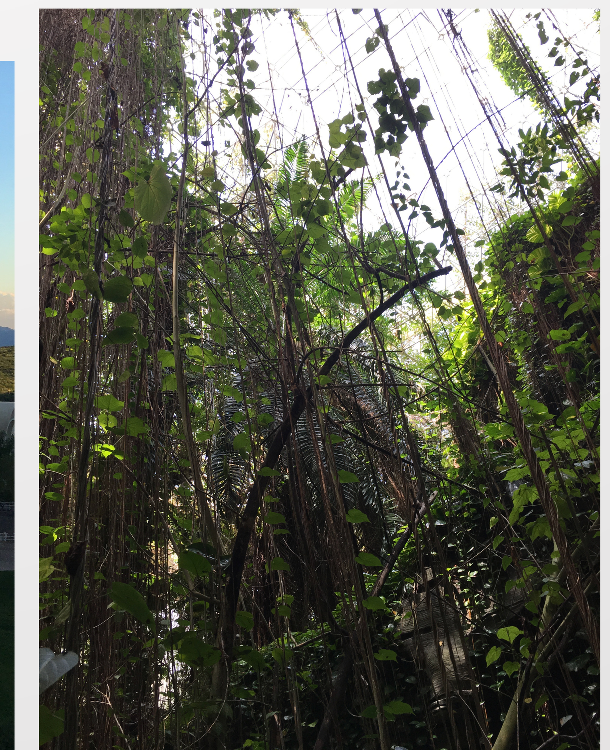

Figure 2. The Biosphere 2 rainforest.

Results

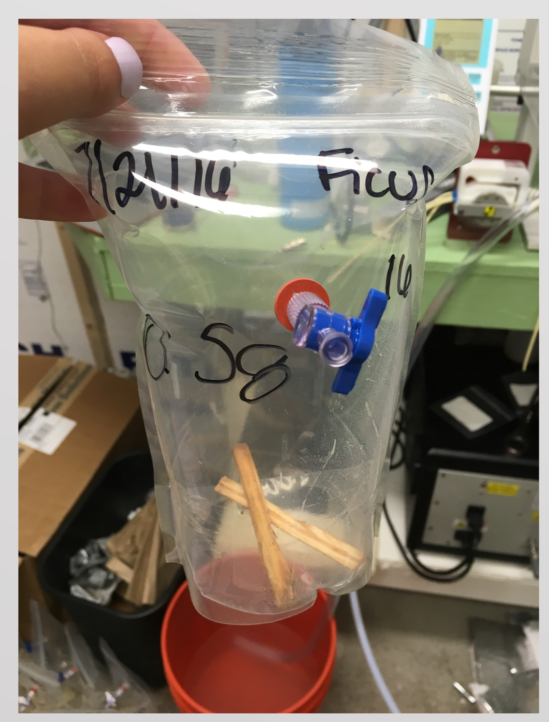

Figure 4. Sample bag ready for testing.

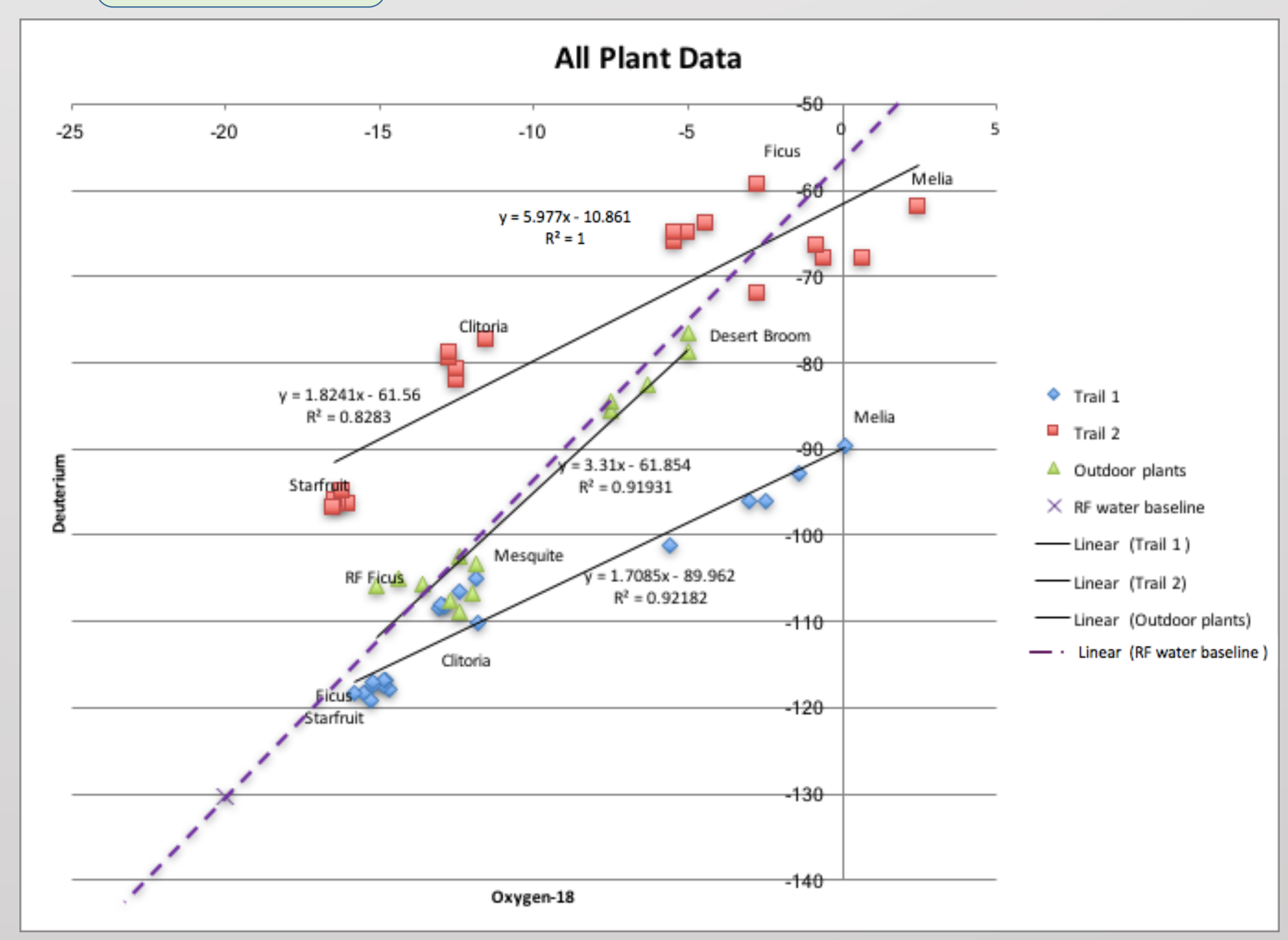

Figure 5. All plant data with plant species.

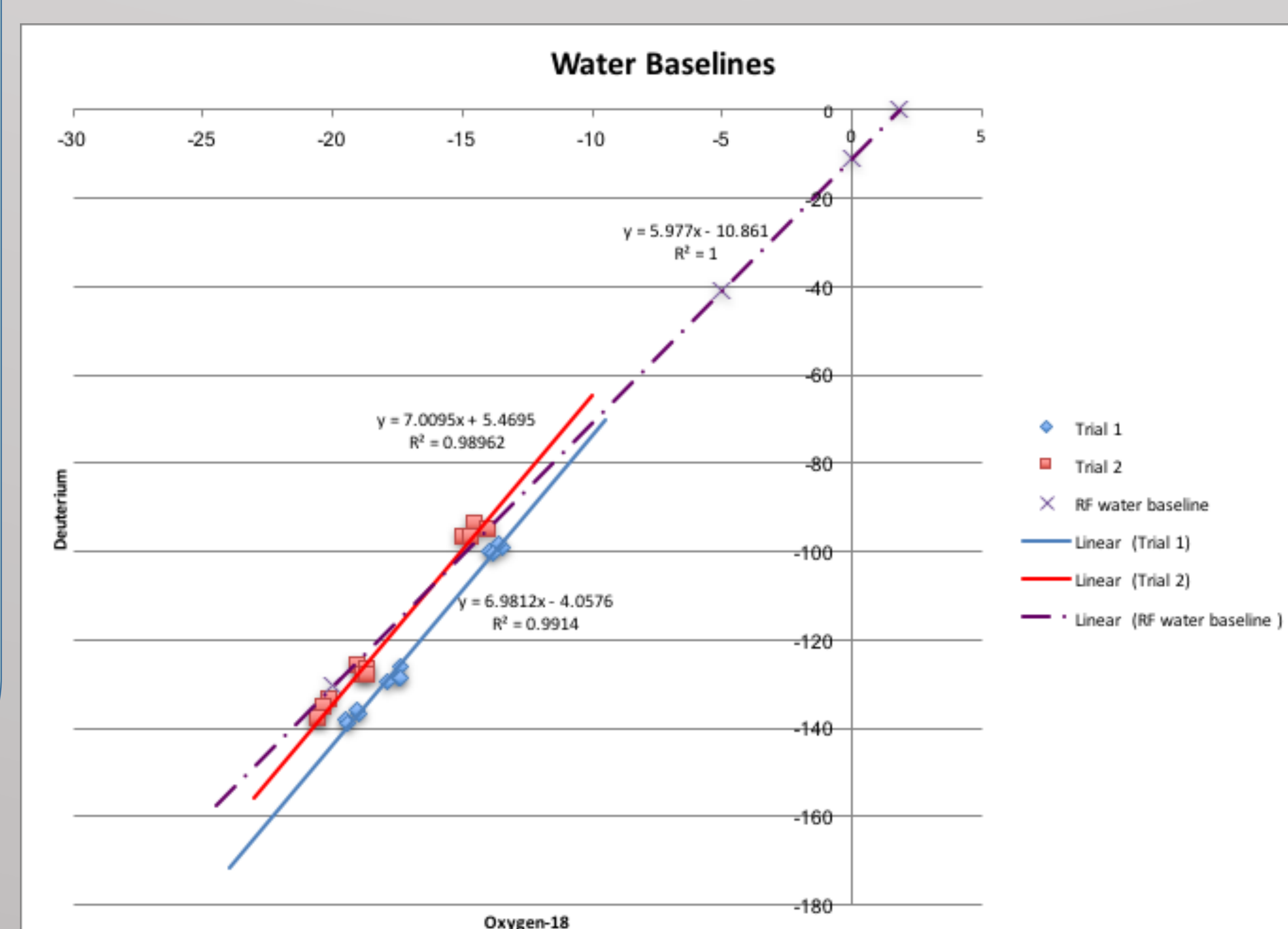

Figure 7. Water baseline from all trials with known rainforest baseline.

Discussion

- After the first test, a tracer of deuterium was added to the rainfall in the Biosphere 2 rainforest.
- Data to the left of the RF water line were likely subjected to evaporation in not fully suberized plant twigs and/or emitted more contaminants.
- The slope of outdoor data was steeper (figure 5).
- The water baseline (figure 7) matched with the rainforest water baseline and also shows that the machine had a slight drift over time
- R^2 values averaged at 0.92 which means the data is agreeable.

Figure 6. Water samples.

Conclusions and Future Work

- This was reproducible and with more testing and analysis could be a less expensive and more accessible method to tracing water isotopes.
- Possible points of error include organic contamination, fractionation and equalization.
- The addition of deuterium halfway through the testing makes running statistical tests hard because some of the deuterium levels are very low and some are then very high making them look unreproducible.
- For future tests, collect samples to be run in the IR machine as well to get data from a known method to compare to the bag method data.

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