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Leaf Foliar Absorption in _Pentagramma triangularis_ and _Polypodium californicum_

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**Abstract:**
In Riparian and moist zones of the Santa Monica Mountains of southern California, ferns flourish. However, the Mediterranean climate they live in is subject to drought, and the area is currently facing the worst drought it has ever seen. With little moisture in the ground and streams drying up, these ferns are running out of sources of water. However, on the coast, the area is subject to fog nightly. This research was done to see if ferns can do leaf foliar absorption, getting their water source from the air rather than the ground. We hypothesized that ferns do leaf foliar absorption, and that fern species with higher unit leaf area will absorb more water. We tested on two species of the seven that live in the area, _Pentagramma triangularis_ and _Polypodium californicum_. _Polypodium_ has rounder, larger fronds than _Pentagramma_, therefore we expected to see a difference if the hypothesis is correct. To do this we used a Scholander-Hammel Pressure Chamber, and standardized the xylem pressure in each fern to -10 bars. Then the ferns were submerged for thirty minutes each and the water potential was taken again. In between each step we took the mass, and at the end of the experiment we took the dry mass and surface area. We found significant results, especially when looking at the _Polypodium californica_, which is indicated in the graphs. This suggests that leaf foliage absorption occurs in ferns.

**Introduction:**
The drought in Southern California is worse than ever experienced before. Now is the prime time to measure how these plants respond to drought and the mechanisms they have to survive in it. Ferns in the Santa Monica Mountains are of the species suffering through the drought. However, Ferns have “numerous adaptive strategies... in order to survive in a constraining and desiccating environment and thus to prevent dehydration” (Dubuisson, et al., 2009). One mechanism we suspected is leaf foliar absorption, or absorbing water through their leaves/fronds, rather than roots. We hypothesized that ferns undergo leaf foliar absorption, and that leaves with greater surface area and dry mass would be more effective at doing this. In order to do this, we standardized water pressures in each species, and submerged them for thirty minutes, to see whether or not the fronds absorbed water. If the xylem pressure gets closer to zero and is significant, we will have evidence that the ferns of the Santa Monica Mountains undergo foliar water absorption.

**Methods:**
Ferns, _Pentagramma triangularis_ and _Polypodium californicum_, where both gathered from deep in Newton Canyon, California. The ferns, no longer than 18.5 centimeters, were cut at the petiole. Seven individual ferns were collected from each species. They were placed in plastic bags which were then breathed into to maintain a high %RH and CO₂ level and subsequently sealed. The ferns were then placed on ice and transported for about twenty minutes to a Lab. Once there, each species was weighed and then placed into a Scholander-Hammel pressure chamber and taken to -10bars. The ferns where taken directly from the pressure chamber and weighed. The petioles were then covered in Parafilm, this was followed by placing the fern horizontally under 1cm of water. The ferns were left to sit underwater for thirty minutes and then removed and blotted dry. They were then weighed and placed into the Pressure chamber. We decreased pressure until we could see water coming out of the petiole; at that moment the pressure was recorded. They weighed and the surface area was taken. The ferns were then placed into an oven overnight to dry. The next day the ferns were removed and a dry weight was taken. For each species one fern was spared from the water and instead placed back into the plastic bag for thirty minutes, after those thirty minutes they proceeded in the experiment just as the other plants. These two plants, one for each species, served as our control.

**Discussion:**
The results suggest that foliar water uptake is happening in both species of ferns. With p values of .0054 for _P. triangularis_ and .63 for the _P. californicum_, it is clear that the mechanisms for the two plants are different. These drastically different values were shocking, as we expected both ferns to undergo the same mechanism. This lack of correlation could have been caused by the methods used. For the _P. californicum_ which has less of a waxy surface, the water may have escaped quickly through the stomata as we manually dried off surface water, therefore resulting in loss of mass in the form of water. We realize that this loss of mass throughout the experiment was a human error, and that in repeat studies, alternate methods of drying may be examined. Although species such as Sequoia sempervirens use foliar water uptake “during [a] drought prone season” it is clear that not all ferns use this mechanism effectively (Limm et al., 2009). This difference shows the diversity of plants and their ability to adapt to their environment.

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**Works Cited**