7-1-2013

Leaf Mechanical Strength Corresponds to Water Relations in Twelve Species of California Ferns

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Leaf Mechanical Strength Corresponds to Water Relations in Twelve Species of California Ferns

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Abstract

In angiosperms and gymnosperms, mechanically strong leaves are positively correlated with dehydration-tolerance. In general, leaves that are stronger mechanically tend to be evergreen while those that are not are usually mechanically weak and deciduous in response to water stress.

Materials and Methods

Six fern species from Santa Cruz (Picture 1) and eight were collected from the Santa Monica Mountains (Picture 2). One frond from twelve individuals of each species was cut at the base of the stipe and stored in an airtight plastic bag with wet paper towels to maintain moisture and transferred to the lab for measurements.

Discussion and Conclusions

The results support my initial hypothesis that pinna of fern species found in xeric conditions are mechanically stronger than those in mesic environments.

Works Cited


Acknowledgment

This research was funded by the National Science Foundation, Research Experience for Undergraduates REU Site Grant 8DBI-1062721 and the Natural Science Division of Pepperdine University. Special thanks to Helen Holmlund, Amir Mohmorud, Nathaniel Greulichmann, Colyn Byrne and Drs. Jarmila Pitterman, Frank Ewers, Marcia Ewers.

Introduction

Ferns are an often overlooked group of plants—little data can be found in the literature regarding either water relations or pinna mechanical strength. Because they produce neither lumber nor fruit, industries find little value in these primitive plants. Ecologically, they are found in a variety of habitats.

Despite the lack of attention, study of the progenitors of gymnosperms and angiosperms, may provide insight to evolutionary adaptations in a broad context. Not only are ferns a good model, they can also be a natural warning system in changes in the environment. As temperatures increase due to global warming, less water will be available for plants and those that rely more heavily on rainfall are at risk of disappearing.

Results

Water Potentials

<table>
<thead>
<tr>
<th>Microclimate</th>
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<tbody>
<tr>
<td>3A</td>
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<tr>
<td>3B</td>
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<td>3C</td>
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</tbody>
</table>

Discussion and Conclusions

- Tissue dehydration-tolerance based on osmotic potentials at saturation and turgor loss point correspond to greater mechanical strength.

- Greater vein density corresponds to greater mechanical strength.

- Microenvironmental factors measured at each fern’s habitat at time of sampling did not correlate with mechanical strength.

Works Cited


Acknowledgment

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Table

<table>
<thead>
<tr>
<th>California Fern Species Collected</th>
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<tbody>
<tr>
<td>NorCal Species</td>
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<tr>
<td>Adiantum aleuticum (Aa)</td>
</tr>
<tr>
<td>Athyrium filix-femina (Af)</td>
</tr>
<tr>
<td>Polypodium glycyrrhiza (Pg)</td>
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<tr>
<td>Polystichum munitum (Pm)</td>
</tr>
<tr>
<td>Dryopteris arguta (Da, Dn, Ds)</td>
</tr>
<tr>
<td>Pteridium aquilinum (Pa, Pr, Ps)</td>
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</tbody>
</table>

Microclimate

- 3A: Correlation between Young’s Modulus and tensile strength at break.
- 3B: Lack of correlation between Young’s Modulus and percent sunlight.
- 3C: Lack of correlation between Young’s Modulus and percent soil moisture.

Discussion and Conclusions

The results support my initial hypothesis that pinna of fern species found in xeric conditions are mechanically stronger than those in mesic environments.

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