HOLEY VINES! LEAF MORPHOLOGY OF *MONSTERA* SP.

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Abstract. Leaves of some species of *Monstera* (Araceae) have holes of varying sizes between many of their veins. We hypothesized that this leaf morphology is a phenotypically plastic adaptation for exploiting light flecks in the forest understory, and tested the hypothesis measuring area of the leaves and holes in each leaf on plants in sunny and shady areas. Leaves in sunny habitats had a higher percentage of holes and were larger than those in shady habitats. This could be a result of an adaptation that manifests itself by having holes that grow proportionally faster than the leaf tissue. As an individual leaf grows, the surface area would increase at a greater rate, thereby increasing the probability of exceeding the light compensation point.

Key Words: Monstera *spp., light flecks, leaf morphology*

INTRODUCTION

Plants use many tactics to increase their photosynthetic potential. *Monstera* spp. are aroid vines that grow in edge habitats of neotropical premontane forests. A distinguishing characteristic is that mature leaves have holes between many veins. These holes appear to increase the leaf circumference with less tissue investment. We hypothesized that these holes are an adaptation for exploiting light flecks in the forest understory. While a leaf with holes and a leaf without holes would receive the same average photons / cm2 over time, the probability of an individual leaf exceeding the light compensation point might increase for the leaf with larger circumference. Under this hypothesis, the variance in photon flux would be less for the leaf with greater circumference because it would have a higher probability of receiving at least some light per unit time. Especially in low light environments, this might make the difference between some leaves being net carbon sources versus net carbon sinks. Consequently, we predicted that the proportion of leaf that contains holes would be larger in a shady habitat than in a sunny habitat.

METHODS

Monstera vines (presumably a single species) were sampled at the San Luis Biological Station on 19-20 January 1996. We sampled 10 vines drawn from primarily shady habitat and 10 vines drawn from primarily sunny habitat. Sampled vines were interspersed along ≈ 2 km of road edge and trail. Shady habitat was defined by little to no direct sunlight for most of the day; whereas sunny habitat was defined by > 75% sunlight for the majority of the day. The third, sixth, ninth, tenth and twelfth mature leaves up from the bottom were sampled on each plant. If a selected leaf had > 10% herbivory we used the next complete leaf on the stem. Total area within the leaf circumference (including holes) was estimated by counting the number of boxes on graph paper (0.5 cm x 0.5 cm grid) covered by each leaf. The area of each hole was estimated by counting the number of boxes visible through the holes. We also counted total number of holes on each leaf. Leaf area with holes, leaf area without holes, and percent leaf that was holes were analyzed with a nested ANOVA that compared variation within and among habitats.

RESULTS

Compared to vines in the shade, vines in the sun had larger leaves (with and without holes included), more holes per leaf, and a larger proportion of the leaf area that was made up of holes (Table 1). Within each habitat, there was variation within vines in leaf area (with and without holes), the number of holes, and the proportion of leaf that was made up of holes. Eleven shade leaves on *Monstera* sp. vines had > 10% herbivory compared to 15 sun leaves. Leaves in the sun appeared to be more desiccated than those in the shade.

DISCUSSION

Results indicated that the leaf morphology of *Monstera* sp. changes in response to light levels. However, the direction of the response (increased leaf area in the sun leaves) runs exactly counter to our hypothesis. In fact, this response runs counter to the usual phenotypic pattern of decreased leaf area in leaves in the sun. Increased proportion of holes in sun leaves might be an unidentified adaptive characteristic, or it might simply be a developmental artifact that is selectively neutral. For example, if holes evolved in *Monstera sp.* leaves to increase competitive advantage in low light, it may be that now these holes increase in proportion as the leaves grow. Consistent with this hypothesis, there was a trend for increasing proportion of holes with increasing leaf area ($r = .17$, $P = .089$).

It is also possible that the holes in the leaf are a mechanism to decrease herbivory of the vine. Berry et al. (1994) showed that herbivores are more abundant in the sun than in the shade, as we observed on *Monstera. Passiflora* vines with egg mimics of *Heliconius* butterflies (Gilbert, 1983) deter oviposition. Similarily, *Monstera* holes might deter oviposition by mimicking previous herbivory. This hypothesis predicts a negative correlation between leaf holes and herbivory.

Table 1. Average leaf area (with and without holes), number of holes per leaf, and percentage of leaf that was holes in *Monstera sp.* in sunny and shady habitats.

	Mean ± SE		F - Statistics	
	Shade	Sun	Habitat	Vines(Habitat)
Leaf area (cm2)	131 ± 48	162 ± 36	11.6**	4.4**
Number of holes	7 ± 2	12 ± 3	70.0**	5.4**
Leaf area without holes	118 ± 8	136 ± 6	5.1*	4.4**
Percent holes	11 ± 1	16 ± 1	79.0**	8.61**

* $P < 0.05$; ** $P < 0.001$

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