EFFECT OF LIGHT INTENSITY ON DEVELOPMENT OF MONSTERA SP.

Todd Gorman

Abstract

I studied the effects of different levels of light intensity on the rate of development of leaf morphology in Monstera sp. The change in leaf morphology from the climbing form to the pinnatifid form is ontogenetic. The nature of this development is unaffected by variable light intensity, but the rate at which it develops may be influenced by it. I found that there was no correlation between light intensity a plant was receiving and the height at which its leaves changed morphologies. I suggested that if one plant receives more light than another, it may enhance the plant's photosynthesis and/or seed dispersal to climb higher before changing to the pinnatifid form, rather than change to this form lower on the tree. Perhaps a significant correlation did exist, but other factors for which I could not control affected my findings.

Introduction

Monstera sp. is an aroid with a fascinating life cycle. It begins as a leafless seedling which skototrophically finds a tree to climb. When it comes in contact with the tree, it forms small (2cm diameter) phototrophic climbing leaves which are flat against the tree. These climbing leaves increase in diameter as they continue up the tree. Once they are about 25cm in diameter, the leaf morphology changes to a pinnatifid form, which continues climbing from there. Only the pinnatifid form can flower and seed. It is thought that the leaves change morphology in response to increasing light levels as the climbing leaves ascend the tree. However, this process occurs in the same manner with uniform light conditions as well. The climbing leaves are an integral part of this ontogenetic development, and always grow to about 25cm in diameter before the change in morphology will occur (Janzen, 1983).

Although different light intensities do not affect the nature of the development in Monstera sp., Janzen has suggested that different light intensities may influence the rate at which these developments occur. If exposed to higher light intensities, the climbing leaves may become larger more quickly and the change to the pinnatifid form would occur sooner. A plant that changes to the pinnatifid form sooner would also be able to flower and reproduce sooner, so that a plant's fitness may be enhanced by changing to the pinnatifid form as soon as possible. I hypothesized that plants experiencing higher light levels throughout their development in the climbing stage would change to the pinnatifid

form sooner, indicated by a lower height on the tree where the change had occurred.

Methods

I located 11 Monstera sp. plants at the OTS La Selva Station, Costa Rica. 5 were in the arboretum, 2 behind the lab, and 4 were in various parts of the primary forest. The heights at which the change in leaf morphology occurred ranged from 1.0 to 6.8 meters, measuring from the ground to the base of the petiole of the lowest pinnatifid leaf. To measure these heights, I walked 5m from the tree with a measuring tape and used an inclinometer to measure the angle to the base of the lowest petiole. I took the tangent of this angle, multiplied by 5 meters, and added the 1.8 meter height to my eye. Plants were not randomly selected as I wanted such a range of heights. I only used plants in which I could see exactly where the change from climbing to pinnatifid morphology had taken place, as many clumps of pinnatifid leaves could have climbed up from other pinnatifid leaves established lower on the tree. To gauge the light intensity that each plot had had during its development, I used the light meter of a Canon A-1 camera. I stood 1.5 meters from the base of each tree and read the light levels at the base, one meter up and two meters up, following the vine of the sample plant. I could not read higher than this on the tree because I would have had to angle the camera towards the sky, which would give unusually high readings, especially for the taller plants. I made the critical assumption that the light the plant had in its first two meters (at the time I was measuring) would be a fair assessment of the light intensity experienced by the plant throughout its development.

I took these light readings hourly for each plant over the course of a day from 0900 to 1400 hours. Since it took me about 30 minutes to check all the plants each hour, I checked them in random order to be sure that I was not consistently checking some plants 30 minutes later than others. When all the data had been collected, I averaged every reading for each plant to have its own light intensity index. I then tested to see if a correlation existed between the light intensity index and the height at which the change in leaf morphology had occurred, expecting plants with higher light intensities to have changed morphologies lower on the tree. The numbers given from the camera's light meter were not linear, but I was instructed that no conversions would be necessary for the correlation.

Results

The heights ranged from 1.0 to 6.8 meters and the light intensity indexes ranged from 1.44 to 2.51. I ran a Spearman Rank Correlation on the data, and found no significant correlation between light intensity index and height at which change in morphology occurred (r_s = -0.58, U = 9, r^2 = 0.34; $p > 0.05$. See Figure 1).

Discussion

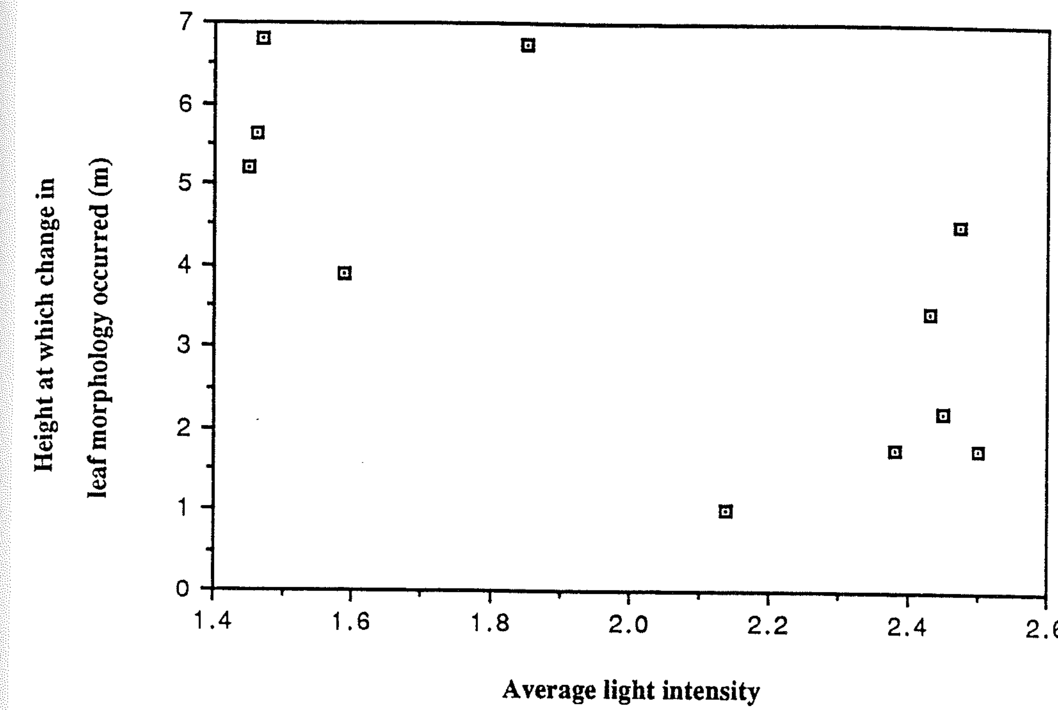
The two forms of the leaves of Monstera sp. seem to serve different purposes. The climbing stage may be able to climb the tree more effectively than the pinnatifid stage, while the pinnatifid leaves seem to be more suited to photosynthesis as they are much larger and project out from the trunk of the tree. The pinnatifid stage is also the one that flowers and seeds. The climbing stage may therefore serve to climb over other epiphytes on the tree, getting higher in the canopy quickly before changing to the pinnatifid form. I observed several instances where the climbing leaves were plastered over other epiphytes. This height attained by the climbing stage would provide better light for the pinnatifid stage, and could enhance seed dispersal. Therefore, it may be beneficial for the plant to not change forms low on the tree. If some plants' climbing leaves are receiving more light than other plants' climbing leaves, they may use this energy to grow higher on the tree faster, rather than change to the pinnatifid form as soon as possible. This would clearly not support my hypothesis that plants receiving more light would change leaf forms lower on the tree.

But Figure 1 does seem to show a trend in support of my hypothesis. It appears that some relationship does exist here between light intensity and height at which the change occurs. There are a number of possible reasons why I did not find a significant correlation where one may have existed.

The day I took the readings was rainy so that different light levels may not have been clearly defined. Also, my assumptions may not have been valid. Perhaps different light levels in areas above two meters on the tree are also crucial to the plants' development, though I did not measure these levels. In addition, the growth around the tree may have changed drastically so that the readings taken now are not indicative of the environment that the plant grew in. Other factors besides light intensity may also be affecting the rate at which the different forms develop. Competition for space and light by other epiphytes on the same tree ought to be considered, as well as water availability. I strictly tested the effect of light intensity, but could not control for other factors such as these.

Better assessments of light intensity indexes may show a significant correlation consistent with my hypothesis. But such a relationship might not exist at all, and perhaps plants with higher light intensities climb higher to enhance photosynthesis and seed dispersal with the pinnatifid form. Further studies considering other such factors may be more conclusive as to the effect of different light intensities on Monstera sp.

Figure 1 Height at which change in leaf morphology occured vs. light intensity in Monstera sp.



Literature Cited

Janzen, Daniel, ed., Costa Rican Natural History. Chicago University Press, Chicago, Ill., 1983, p. 278-280.