COMPARISON OF TREE SAPLING GROWTH STRATEGIES IN LIGHT GAP AND UNDERSTORY AREAS OF A TROPICAL CLOUD FOREST

Eden H. Abram, Brendan M. Everett and Jonathan J. Ruel

ABSTRACT (JJR)

We examined variation in sapling tree growth strategies in tree fall light gap and forest understory habitats. We predicted differences in available light would result in understory trees being wider with a greater total leaf surface area composed of tougher, larger leaves. Our results did not support our predictions. Our data may have been confounded by methodological constraints and limits of our methods and/or various ecological factors. Our results were somewhat difficult to interpret because we could not distinguish patterns due to genetic variation from those due to phenotypic plasticity.

Key Words: light gap, understory, tree growth

INTRODUCTION (BME)

Light is an essential resource in any forest system. A change in light levels, as occurs after the creation of a light gap, causes changes in the understory plant community. In a gap, plants can most effectively compete for the available light by growing upwards (i.e. taller). Under the forest canopy, light gathering capacity is more readily increased by spreading horizontally (allowing diffuse light to reach more leaves), rather than growing upwards. Completing the wider canopy, understory trees should have greater numbers of leaves, each with a larger surface area. Coley (1985) predicted that leaves found on gap trees would be less tough than those on understory trees.

In this study, we compared leaf characteristics and growth form of trees in the understory to trees in light gaps in a premontane tropical forest.

METHODS (EHA)

This study was conducted on 21-22 January, 1994, near the Cerro Cacao Biological Field Station. We systematically chose areas of forest gaps and understory along the SW fork of the main trail running south from the station. Selected gaps were at least $100m^2$. We haphazardly chose a direction of the trail at each site to run a 10m transect. At 1m (first two transects) or 2m intervals along each transect, we chose the nearest tree of suitable size to sample (< 6m tall to keep trees within reach, > 75cm because smaller trees may not be exhibiting a measureable strategy). We measured tree height and width (maximum horizontal distance between two points on the tree) of each tree, estimated total number of leaves per tree, and took a sample of ten leaves, for which we measured leaf surface area and leaf toughness (using a penetrometer which measures grains of pressure required to puncture a leaf).

We used t-tests to evaluate differences in leaf toughness, tree height, leaf area per tree,

Table 1: Comparisons of leaf toughness, tree height, total leaf surface area per tree, and surface area per leaf between understory and gap areas (n=3 transects per habitat)

	Gap (mean± SE)	Understory (mean± SE)
leaf toughness (g)	177 ± 71	238 ± 21
tree height (cm)	221 ± 42	177 ± 31*
tree width (cm)	111 ± 10.3	124 ± 3.06
leaf area per tree (cm^2)	10,300 ± 4500	7580 ± 2400
area per leaf (cm^2)	134 ± 79.8	37.5 ± 6.30

*significant difference between gap and understory, $p < 0.05$

and area per leaf. We used regression analysis to examine relationships between tree height and width, and tree height and surface area per tree.

RESULTS (JJR)

There was no significant difference in leaf toughness, tree width, leaf area per tree, or area per leaf between gap and understory trees. Trees randomly selected within our 75-600cm range were significantly shorter in the understory areas (Table 1).

Trees of equivalent height tended to have wider canopies in the understory than in the gaps (134cm vs. 98cm for a 2m tree) but this difference was not significant ($t = 0.34$, df = 48, $p = 0.7$; comparison of slopes in Figure 1). Variation in tree height explained < 17% of the variation in total leaf surface area per tree (Gap: $y = 1305 \pm 35.27x$, $r^2 = 0.17$, $p < 0.05$; Understory: $y = 3254 \pm 27.37x$, $r^2 = 0.004$, $p = 0.4$; slopes did not differ, $t = 0.32$, $p = 0.70$).

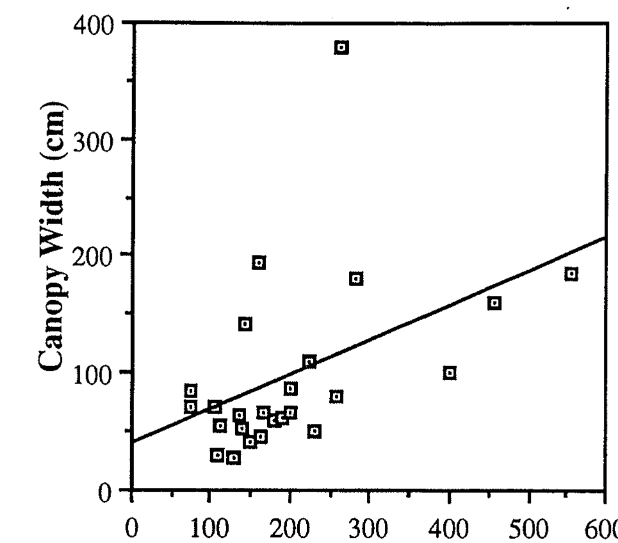

Figure 1a: Regression of canopy width as a function of height for gap trees.

DISCUSSION (JJR)

Although regression analyses indictated that trees of a given height tend to be wider in the understory, the difference was not statistically significant. The fact that the two habitats did not differ in leaf toughness, tree width, surface area per leaf, surface area per tree, or leaf area per tree, function of height suggests that perhaps our experimental methods were not suf-

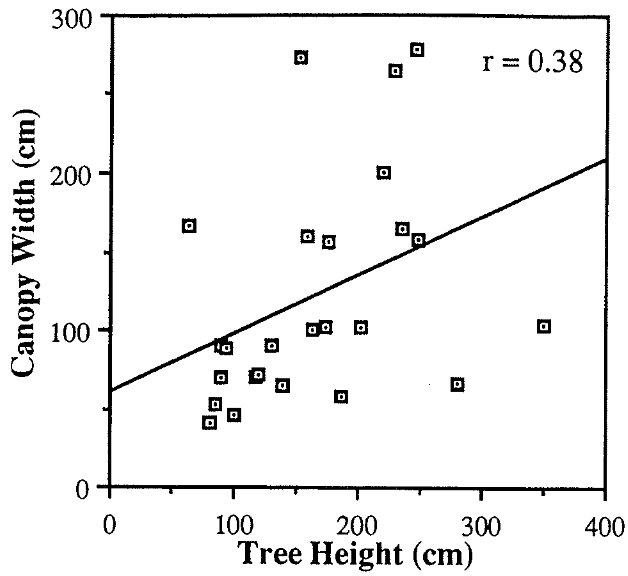

Figure 1b. Regression of canopy width as a function of tree height for understory trees.

ficiently robust to detect important patterns. More likely, ecological factors independent of gap and understory differences control most of the variation in these parameters.

Our understory trees were shorter than those in the gap areas. This suggests the two data sets differed in terms of species composition and growth stages where could have confounded our data.

Further study should inlcude large sample sizes, and an investigation of microhabitats within these areas. It would also help to narrow the scope of the topic, focusing on one species or family and perhaps discern between genetic or phenotype variation.

LITERATURE CITED

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