THE EFFECTS OF WIND AND SUNLIGHT ON CLIMBING VINES IN A TROPICAL CLOUD FOREST

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ABSTRACT (PSW)

In this study we examined the relationship between vine orientation and the direction and intensity of sunlight and wind in a tropical cloud forest. Three sites were selected on Cerro Cacao and Cerro Pedregal in Guanacaste Province, Costa Rica. We found that vines oriented toward sunlight in the high sunlight area of a gap in the canopy, but did not in the moderate environment of the understory. Vines tended to orient away from wind in the high wind environment of Cerro Pedregal, but did not in the moderate environment. In addition, we found 5 fold fewer vines growing in the high wind environment.

Key Words: tropical cloud forest, climbing vines (Araceae), vine orientation

INTRODUCTION (LCB)

Non-woody climbing vines (mostly of the family Araceae) are a prominent feature of tropical cloud forests. They can be seen growing on everything from rocks to lianas, but most often are found on trees. Vines often seemed to grow on the same side of the trees, leading us to investigate the factors that affect vine orientation.

We hypothesized that the side of the tree on which a climbing vine is located is related to both sunlight and wind. We predicted that the side on which a vine first makes contact with a tree (the contact point) is random, but that after contact the vine will grow toward the sun and away from the wind. We further expected fewer vines in a high wind environment, especially vines whose leaves extend laterally from the trunk (free-leaf vines as opposed to clinging vines).

METHODS (LCB)

Data were collected on 20 and 21 January, 1994 in the cloud forest on Cerro Cacao, Guanacaste, Costa Rica. We selected three sites: a high wind area on the eastern face of Cerro Pedregal, a moderate wind area facing south-east on a ridge on the western face of Cerro Cacao below the biological station, and a 39m by 59m gap (high sun, moderate wind) on the north-western face of Cerro Cacao below the station. At the gap site, we chose a point every 20° around the perimeter and surveyed the tree of dbh > 15.0cm nearest to that point. The number of vines, their form (clinging or free-leaf), their contact points and locations were noted. The contact point was defined as the side on which the vine first touched the tree; the location of the vine was the side of the tree on which the vine was found. If a vine was found in more than one area (i.e. wrapped around the tree), it was counted as being in multiple quadrants and was treated

as more than one vine for the purpose of analysis. Contact points and locations were either gap-facing or non-gap facing. We laid out one 20m x 4m transect in the moderate wind area and two 20m x 4m transects in the high wind area and recorded the same information as in the gap except that location and contact points were more finely determined. For non-gap trees, vine location and contact point were categorized using the four cardinal directions. From 0° to 90° was the NE quadrant, 90° to 180° SE quadrant, 180° to 270° SW quadrant, and 270° to 360° NW quadrant. All analyses employed Chi-square tests.

RESULTS (LCB)

Neither sun nor wind affected the side at which vines contacted trees in the gap ($X^2 = 2.25$, df = 1, $p > 0.05$; Table 1) and moderate wind site ($X^2 = 3.96$, df = 3, $p > 0.05$; Table 2). Too few vines (six) were found in the high wind side to evaluate contact points (Table 3).

In the gaps, three times as many vines grew on the sunny side (the gap side) than the non-gap side of trees ($X^2 = 7.76$, df = 1, $p < 0.01$; Table 1). Wind did not affect the location of vines in the moderate wind side ($X^2 = 6.45$, df = 3, $p > 0.05$; Table 2). In the high wind site, as with contact points, locations could not be analyzed because of small sample size; however, no vines were growing in the quadrant that received direct wind (Figure 1). Wind speeds at the Cerro Pedregal site were twice as high as those at the other two sites (Table 4).

Five times fewer vines grew in the high wind site than the gap and moderate wind sites (6, 29, and 37 vines, respectively). The high wind site had half as many trees with vines as the moderate wind site and one quarter as many trees with vines as the gap site ($X^2 = 27.37$, df = 5, $p < 0.001$; Table 3).

Too few clinging vines were found to evaluate location differences between clinging and free-leaf vines (8 clinging vines and 52 free leaf vines for all three sites combined).

Table 1: The number of vines located on gap and non-gap sides of trees and the number of vines with contact points on gap and non-gap sides of trees in the high light environment.

	# vines facing gap	# vines facing non-gap
Gap-orientation	22	7
Gap-contact	11	5

Table 2: The number of vines in each quadrant and the number of vines with contact points in each quadrant at the moderate wind site.

	Number of vines in quadrant			
	NE	SE	SW	NW
Moderate wind-orientation	14	9	10	4
Moderate wind-contact	8	6	10	3

Table 3: The number of trees with and without vines in the high wind, moderate wind, and high sun sites.

	High Wind	Moderate Wind	Gap
trees with no vines	19	0	3
trees with > 1 vine	4	9	16

Table 4: Windspeed at the three sites.

	Speed
High wind (Cerro Pedregal)	>10 mph
Moderate wind (Cerro Cacao)	5.0 ± 1.0 mph
Gap (Cerro Cacao)	6.1 ± 0.5 mph

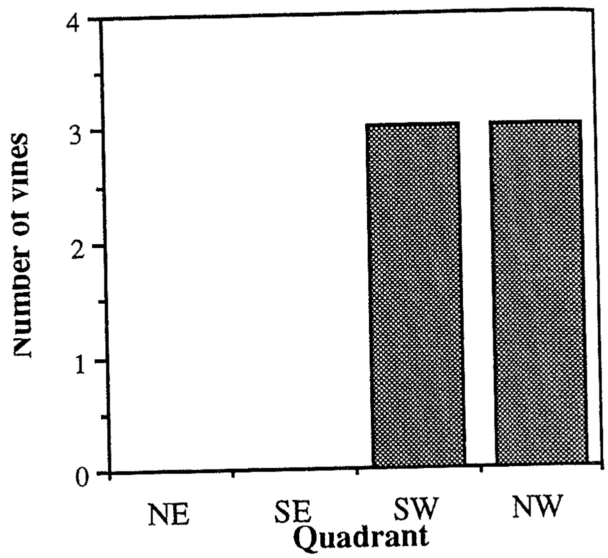

Figure 1. Orientation of vines on trees at the high wind site. NE quadrant was directly exposed to the wind.

DISCUSSION (PSW)

The data supported our hypothesis that vine contact occurs at random around the base of a tree. This is important in establishing that any patterns we observed were the result of vines moving to a preferred location as opposed to growing straight up from their point of first contact. In the high sunlight, moderate wind environment of the gap, vines oriented themselves toward the sun. In the moderate sunlight, high wind environment of Cerro Pedregal, vines tended to orient themselves away from the wind, but due to a small sample size we were unable to test the trend statistically. In the moderate sunlight, moderate wind of the understory vines did not orient themselves in reference to sunlight or wind. A possible explanation for this is that sunlight and wind are not very variable in the understory and no particular orientation results in a great increase in cost or benefit. When either sunlight or wind are high, vines will orient themselves to benefit from the sun's rays or avoid the cost of wind exposure. We were unable to find a location that offered both high sunlight and high wind to determine whether one overrides the other. However, based upon our results showing a decrease in vine abundance in a high wind environment, we predict that wind would be the overriding factor. It remains an open question whether wind exerts its effects on vines through mechanical damage, dessication, or some other mechanism.