DO BUTTRESSES CONFER A COMPETITIVE ADVANTAGE FOR TROPICAL TREES?

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Abstract: Many hypotheses have been proposed to explain why some tropical trees form buttresses. We examined the competitive advantage hypothesis, which predicts that buttressed trees will have fewer surrounding trees and fewer vines. However, we found no difference in basal area or number of saplings surrounding buttressed versus non-buttressed trees. Additionally, we found that the two tree types did not differ in vine abundance. Our results tend to refute the competitive advantage hypothesis for buttressed trees in the Monteverde region. Further research on the function of buttresses should focus on other explanations.

Key words: basal area, Monteverde, vines

INTRODUCTION

There has been a continuing debate over why some tropical trees form buttresses. An early explanation was that buttresses provide structural stability (Janzen 1983). However, this hypothesis has failed some tests (Young and Perkocha 1994, Bansak et al. 1993). Black and Harper (1979) proposed (1) that buttresses prevent competing trees from growing in the space that the buttresses occupy around the base of the trunk and (2) that buttresses deter potentially harmful vines from growing on the trunk by forcing the vines to deplete their resources growing over the buttresses, and by severing vines as the buttresses grow outward. To test this competitive advantage hypothesis, we evaluated the predictions that tree and sapling abundance around buttressed trees would be fewer than around non-buttressed trees, and that buttressed trees would have fewer vines growing on them than would non-buttressed trees.

METHODS

We examined the saplings and tree density around 15 buttressed and 15 non-buttressed trees on 22 - 23 January 2004 in a pre-montane cloud forest at Monteverde Biological Station, Costa Rica. Buttressed trees were selected by walking the trails around the station and measuring trees (at least 2 m off the trail) that appeared to be buttressed. For each buttressed tree, we selected the closest non-buttressed tree of a similar diameter (sans buttresses). We calculated a buttress index for each tree as *diameter at ground level / diameter at breast height.* To quantify competition, we measured the number of vines growing on each trunk, basal area (of trees) using a 10X forestry prism (count x 10 = ft^2/ acre), and the number of saplings (DBH < 6 cm) within a 2 m radius of each tree (saplings were not included in basal area measurements). We measured vine abundance by counting the number of vines attached to the tree at breast height, and classified vines into three size classes based on diameter (< 2 cm, 2 - 4 cm, > 4 cm). An index of vine abundance (IVA) was created to account for the increasing impacts of larger sized vines: IVA = *(# of size class one vines + (# of size class two vines * 2) + (# of size class three vines * 3))*. We measured the percent canopy cover beneath each focal tree by taking four measurements with a spherical densiometer, one at each cardinal direction around the focal tree, 1 m from the trunk. Prior to analyses, the number of saplings and the vine index were log-transformed to improve normality.

RESULTS

The buttress index ranged from 0.85 to 1.75 for trees that we classified *a priori* as not buttressed and from 1.64 to 4.02 for trees that we classified as buttressed. Because the natural variation in the extent of buttresses appeared to be continuous rather than categorical, all our subsequent statistical analyses used buttress index instead of the buttress type category. Buttress index was not significantly correlated with basal area, number of saplings, or vine index (Fig. 1; Table 1). None of the possible linear regression models involving buttress index and/or percent open canopy explained significant variation in basal area, number of saplings, or vine index.

DISCUSSION

Our findings tend to refute the hypothesis that buttresses provide a competitive advantage by preventing the establishment of competitive trees and decreasing vine abundance. However, one limitation to our study was our

Table 1. Correlation matrix between buttress index, percent open canopy, basal area, log (# of saplings), and log (vine index)

	A	B	C	D
A. Buttress index	-	-	-	-
B. Percent open canopy	- 0.02	-	-	-
C. Basal area	- 0.03	- 0.10	-	-
D. Log (# of saplings)	- 0.06	- 0.25	0.45 *	-
E. Log (vine index)	- 0.07	0.35	- 0.47 *	- 0.47*

* P < 0.05

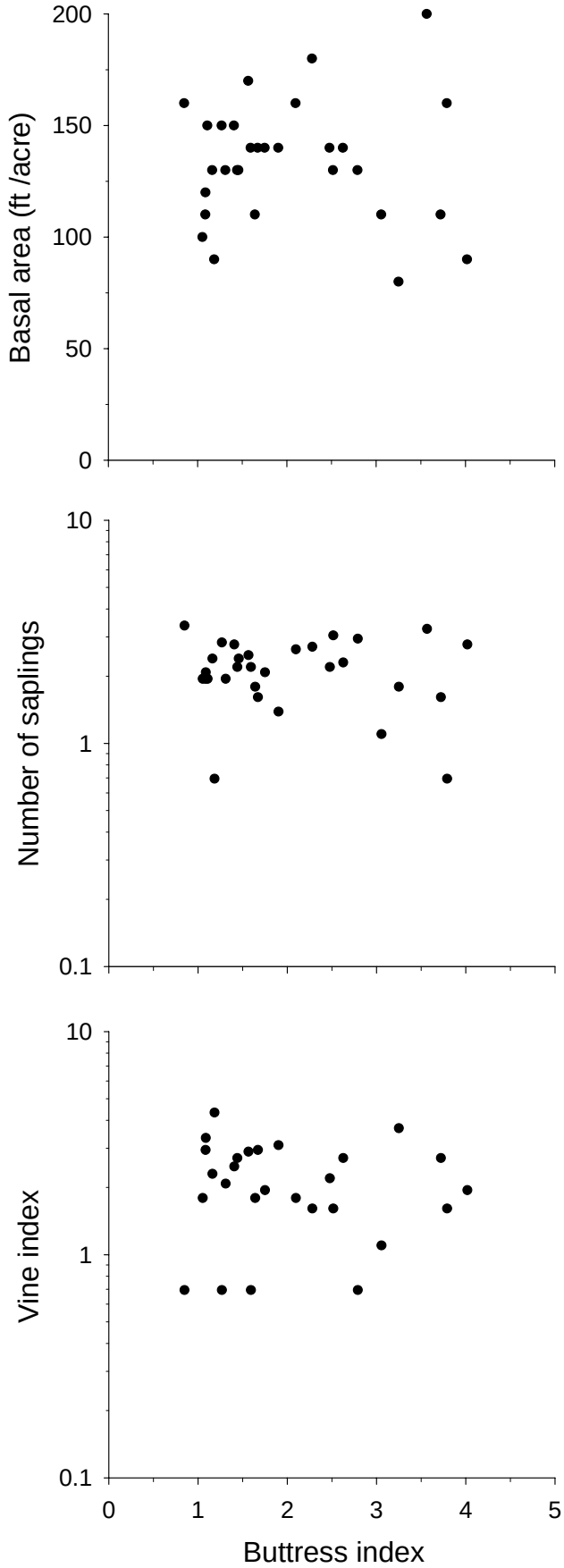

Figure 1. Extent of buttressing was unrelated to basal area (top), number of saplings (middle), or vine index (bottom).

definition and measurement of vine abundance. We could not differentiate between vine-like growth forms that germinate in the canopy and those that establish themselves in the ground first. The vines establishing in the ground are what we expected to be harmed by buttresses because expanding buttresses could sever their roots. There would be value in future studies that focus on vines that establish on the ground

If buttresses are not just for structural support, and if the competitive advantage hypothesis is rejected, some other explanation is needed for the prevalence of buttresses in tropical forests. One possibility is that buttresses can collect leaf litter, thus improving soil quality immediately beneath the tree and facilitating growth (Dallison et al. 1999).

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