GROWTH STRATEGIES IN *PSYCHOTRIA NUDA*, UBATUBA, SP*

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INTRODUCTION

Morphometric characteristics in plant populations are important tools for describing population structure (Watkinson 1997). The size structure of plant populations is often based on diameter and height (Hutchings 1997) and in allometric studies is possible to relate these measures and obtain information about investment strategies on plant supporting mechanisms and structures to capture light (King 1996).
Plant size and allometric relations may vary in response to the: 1) requirements for occupation and persistence in distinct habitats, and 2) individual developmental phase (Holbrook & Putz 1989). Another important factor that may change the investment in diameter, height or biomass is the growth strategy adopted by the species (Crawley 1997, Stueffer *et al.*, 1996). Many clonal plants may change their investment in growth as a response to resource availability. Clonal offspring can adjust their foraging strategies to improve the uptake of available resources (de Kroon & Hutchings 1995). In particular, connected ramets that occupy heterogeneous habitats can increase the production of leaves and the proportion of clonal offspring (Stueffer *et al.*, 1996).

OBJECTIVES

The goals of this work were to describe the growth forms of *Psychotria nuda* and compare the allometric relations between diameter and length in individuals of two different growth forms (erect and prostate). We also tested if these relations vary in altitude.

MATERIAL AND METHODS

We used two 0.25ha - sampling plots, one in a Lowland Secondary - Dense - Ombrophylous Forest (LL, $44^0$48' W e $23^0$22' S, 50m to 80m altitude) and the other in a Submontane Secondary - Dense - Ombrophylous Forest (SM, $45^0$04' W e $23^0$22' S, 340m to 380m altitude). All individuals in the plots had their diameter at base height (DBH) and their length measured in 2007 (t_1) and in 2008 (t_2).
Growth form was defined by position of stem in relation to the ground and amount of root in plant. Length and DBH were log - transformed ($\log_{10}$) and the relationship between them was described by a least squares regression line. The fit of lines, allometric coefficient (slope) and allometric constant (intercept) were calculated and comparisons between growth form and altitude regression lines in both times were made with an analysis of covariance (Zar 1999). When allometric coefficients were significantly different, a Sheffé test was used to identify which pairs of allometric coefficients differed among each other (Zar 1999). All tests were made using ANCOVA 32 software (Santos 1997).

RESULTS AND DISCUSSION

We sampled 2361 individuals of *Psychotria nuda* in t_1 and 2390 in t_2. The number of individuals was higher in the LL (90%) than in the SM (10%) in both times. It was possible to recognize two growth forms: (1) the erect growth form, when the stem grows perpendicular to the ground or inclined, making an angle smaller than $90^{\underline{o}}$ with the ground. Plants with erect form can fall over and become prostate, however, they do not always develop roots in the crown or in the stem. Another growth form is (2) the prostrate growth form. In this form the stem grows horizontally, close to the ground. Plants with more than one root point are clonal. In clonal growth, two kinds of growth can be distinguished: (1) individuals with two or more fixed root points but only one vertical branch. When the connection between root points is lost, no plants are added to population only occurs reduction in the total individual size since there is only one vertical branch; and (2) individuals with more than one fixed root point and vertical branches throughout the prostrate stem. In this way, breaking off the connections between two fixed points leads to an increase in the number of individuals in the population and reduction in the indi-

vidual size. New individuals produced can belong to either growth form. The initial individual after rupture can also change the growth forms depending on the position of the rupture.

The prostate form was found in more than 70% of recorded individuals (t_1 = 72,9%; t_2 = 77,0%) and most of them showed clonal growth (t_1 = 58,5%; t_2 = 70,3%). This growth form was more frequent in individuals from the LL plot than those of SM. The erect form was less abundant (t_1 = 27,1%; t_2 = 23,0%).

Ramet production could be an environmental exploitation to improve uptake of available resources (de Kroon & Hutchings 1995). These ramets can remain connected or not. Keeping ramets connected could be important for some species in order to increase survival of ramets and avoid compensation of plant parts located in areas with poorer resources (Stueffer *et al.*, 1996, Hutchings 1997, Price & Marshall 1999). As a result, ramets located in areas with richer resources can make these resources available to the whole plant. In this way, the higher proportion of clonal growth in *Psychotria nuda* found in our study is a possible strategy to improve resource uptake in the study area.

Plants can develop new morphological and physiological features in response to variations of resources in space (Fitter 1997, Stueffer *et al.*, 1996), and this is also related with an individual's growth form. Plant length was related to the DHB of individuals in all plots studied, as has been found for other plant species (Santos 2000, Alvarez - Buylla & Martinez - Ramos 1992, Alves & Santos 2002). All regression lines had a significant fit (r^2) of over 60%. The allometric coefficients differed between growth forms in the two years recorded (t_1 = ANCOVA $F_{(3,2306)} = 9.15$, $p < 0.001$; t_2 = ANCOVA $F_{(3,2367)} = 10.52$, $p < 0.001$). These differences in each year were founded to be a result of altitudinal effect ($p < 0.001$). Allometric coefficient was bigger in individuals from SM plots than those from LL in both years. The relationship between plant length and diameter determines the growth strategy in plants, the proportion of biomass allocated to growth and to photosynthetically active areas (Nicklas 1994). In this way, the difference of coefficients between study areas may indicate different growth strategies adopted in response to varying environmental conditions.

CONCLUSION

The variation in growth form of *Psychotria nuda* found in this study may be a strategy to improve resource uptake and increase spatial occupation. Indeed, habitat effects seem to be more important in morphometric measures than growth forms.

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