DIFFERENCES IN PHENOTYPIC PLASTICITY AND BIOMASS ALLOCATION CHANGE SEEDLINGS' RESPONSE TO SHADE AND DROUGHT

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INTRODUÇÃO

Different hypotheses have been proposed to explain the effects of drought along a light gradient. The trade-off hypothesis assumed that shade tolerant species may be selected for a strong allocation to shoot, at the expense of root, resulting in plants with efficient irradiance capture, but more sensitive to drought (4). On the other hand, if plant displays a conservative resource use strategy, drought may have a weaker impact in the shade than in the sunlight. This strategy is associated with low allocation to leaves and high allocation to below ground resources, which enables the persistence during periods of non-positive carbon uptake balance as occurs under shade. While promotes a decrease in evaporating surface and an increase in water uptake for soil, these traits might conferring drought and shade tolerance simultaneously (1). Finally, independent effect hypothesis suggests that drought and shade have an orthogonal impact, thus species may exhibit different degrees of tolerance to light and water supply (2). Species-specific differences in strategies of biomass allocation and degree of phenotypic plasticity shows by plants are two important traits that allows plants to fill distinct ecological roles under different resource conditions (3,4).

OBJETIVOS

Examine how biomass allocation and phenotypic plasticity of seedlings of four restinga species are affect by combined drought and shade effects.

MATERIAL E MÉTODOS

We have performed a factorial design with (a) three levels of relative photosynthetic active photon-flux density (PPFD%), 2%, 10% and 80%, (b) two watering regimes, well watered versus water stressed, (c) and four shrub restinga species, *Erythroxylum ovalifolium* Peyr.- Eo, *Maytenus obtusifolia* Mart.-Mo, *Garcinia brasiliensis* Mart.-Gb and *Neomitranthes obscura* (DC.) N. Silveira-No. These levels of light and soil water contents were chosen to represent the natural gradient found in restinga. At each light level, half of the seedlings were grown under well watered conditions, and the other half at water stressed. After four months of growth, a sample of ten seedlings for each treatment was harvested and fractioned into leaves, stems and roots. Dry mass of each fraction was weighted to estimate the following variables: total dry mass (mg), root shoot ratio (g g-1), leaf mass fraction (LMF), root mass fraction (RMF) and stem mass fraction (SMF). Phenotypic plasticity in response to both light and water availability, for every trait and all traits together (overall plasticity), were estimated of the RDPI as defined by (5). Differences in RDPI across species were analyzed with one-way ANOVA. Factorial ANOVAs were applied to compare the effects of light, water and their interactions on biomass production and allocation. Whenever necessary, data were log-transformed and Fisher LSD test was used for post hoc analysis. All the statistical analysis was performed using STATISTICA v.8.

RESULTADOS

Total dry mass significantly decreased with decreasing light intensity for all species, except for Gb. Irradiance had a significant effect on biomass allocation for all species, except for No. For Gb, all variables of biomass allocation significantly decreased along an increasing light intensity. For Eo, RMF significantly increased with increasing sunlight, but the allocation to leaves and to stem decreased. For Mo, SMF and RMF significantly decreased, whereas LMF increased along an increasing light gradient, but this effect was not significant. For No, the opposite pattern was found. Root-shoot ratio increased with increasing shade for Gb and decreased for all the others species, but this effect was significant only for No and Gb. Species were affected in different ways by increment in water supply. The ranking of species for the all studied variables together exhibited major changes between well watered and water stressed conditions was No>Mo>Eo>Gb. The increased in water supply promoted a significantly increase in total dry mass for all species, except for Gb. For this species, LMF was higher, whereas SMF and RMF were lower, under well watered condition. The opposite pattern was found in Mo. The increase in water availability increased LMF and SMF in No, but decreased in Eo. In both species, the RMF was higher under well watered treatment. All species (except Eo) showed higher root-shoot ratios in well watered conditions than in water stressed. In general, there was not interaction between light and water on biomass production and allocation. Species significantly differed in overall phenotypic plasticity in response to light, but not in response to water supply. For all species overall plasticity in response to light was higher than in response to drought. The ranking of species for phenotypic plasticity changed with the variable considered. The ranking for overall plasticity in response to light was: Eo> No> Gb>Mo, and to water was: Gb>No>Eo>Mo.

DISCUSSÃO

In this study were found species-specific differences in biomass allocation and plasticity which implies on distinct shade and drought tolerance. The increase of below ground allocation and the decrease of shoot evaporating surface under dry conditions confer to Gb the highest plasticity and tolerance in response to drought. In contrast, the higher allocation to above ground under low light and to below ground under high light results in the highest plasticity in response to light for Eo and No. Mo showed inefficient allocation patterns exhibiting higher LMF and lower RMF under dry and under high light conditions. These traits result in the lowest plasticity and tolerance in response to both light and water availability.

CONCLUSÃO

In general, it was found no significant light x water interaction on biomass production and allocation, which supports the independent effect models. This hypothesis predicts that the proportional impact of drought on biomass production and allocation did not vary across light gradient, it means that shade and drought had independent effects. There are more possibilities for niche differentiation under this hypothesis than occur under trade-off model, because species may specialize on a broad range of light x water combinations (2).

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Agradecimento

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