PLANT VIGOR HYPOTHESIS REFUTED: PREFERENCE - PERFORMANCE LINKAGE OF A GALL - INDUCING WEEVIL ON SMALL - SIZED HOST PLANT RESOURCE

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INTRODUCTION

In the last decades, the Plant Vigor Hypothesis (PVH; see Price, 1991) has become popular among the many hypotheses raised to explain the patterns of host plant selection by herbivorous insects. The PVH predicts that insect herbivores will preferentially choose larger, more vigorously growing plants or plant modules and that offspring performance will be greater on these more vigorous plants or plant modules (Price, 1991). Several studies have addressed the relationship between female oviposition preference and offspring performance in an attempt to shed light about the PVH.

Recently, Cornelissen *et al.,* (2008) conducted a meta - analytical review of the literature of the effects of plant vigor on insect herbivore abundance and survivorship by reviewing 71 published articles regarding PVH. In general, their results showed that: a) the preference prediction was corroborated and the insect herbivores were significantly more abundant on more vigorous plants; b) the performance prediction was refuted and no effect was detected on herbivore survivorship; c) PVH did not support a preference - performance linkage; and d) into feeding herbivore guilds, effects of plant vigor on abundance were stronger for sap - suckers, leaf - miners and gall - formers (see Cornelissen *et al.,* 2008). This meta - analysis is extremely important because it highlights the main advances and set a framework to PVH.

OBJECTIVES

This study aimed on testing the Plant Vigor Hypothesis (Price, 1991) in a neotropical herbivore - plant system, the gall - inducer beetle *Prospoliata bicolorata* (Coleoptera: Curculionidae) and its host plant *Miconia prasina* (SW.) DC. (Melastomataceae). We expect that galling insects prefer and achieve higher performance on larger leaves compared to smaller leaves. Therefore, we addressed the following questions: 1) what is the effect of leaf size of *M. prasina* in the oviposition preference and larval survival of *P. bicolorata* ?; and 2) what are the effects of top - down mortality factors on the survivorship of *P. bicolorata*?

MATERIAL AND METHODS

Study site and species.

This study was conducted at Refúgio Ecológico Charles Darwin; a remnant of the Atlantic forest preserved during the last 40 years and which comprises a fragment of 60ha of the highly - threatened Atlantic forest located in an urban area of Igarassu, Pernambuco, northeastern Brazil ($07^0$48'37" - $07^0$49'2"S and $34^0$27'25" - $34^0$56'52" W).

Miconia prasina (Sw.) DC (Melastomataceae), known as camasey blanco, is a shrub or small tree, reaching between one to 12 meters high, commonly found in the Caribbean, Central America and South America. This species is a shade intolerant pioneer species that grows in secondary and remnant forests, and disturbed areas. *M. prasina* is an important colonizing species during early stages of secondary succession in Puerto Rico, but its abundance declines with increasing stand age (Pascarella *et al.,* 2007), and due to its widespread distribution and biotic interactions with several organisms within different trophic levels, *M. prasina* appears to play an important role in the Atlantic forest.

M. prasina is attacked by at least five species of gall inducing insects in four remnants of Atlantic forest of northeastern Brazil: three unidentified species of leaf gall midges (Diptera: Cecidomyiidae), one insect species induce bud gall (Lepidoptera) and one coleopteran species *Prospoliata* cf. *bicolorata* (Curculionidae) (Almeida - Cortez *et al.,* 2006, Silva & Almeida - Cortez 2006). This host plant is also attacked by a diversity of free - feeding herbivores (Braga *et al.,* 2007).

Sampling and statistical analysis.

Patterns of attack were determined in 2007 by randomly collecting 10 leaves around the canopy of 73 randomly selected

M. prasina individuals (at least five leaves). Leaf collection was performed early in September, on a single day, when most leaves were mature. All leaves were bagged, numbered and taken to the laboratory where their length, number of galls, and galled leaves were recorded. The lengths of leaves were divided in 15 size classes of 2cm, based in previous studies, with leaf length classes ranging from 1.5cm (lowest class) to 29.5cm (highest class).

Preference was defined as non - random oviposition on plant resources offered simultaneously, and performance was defined as a measure of offspring survival (egg, larval or pupal), growth, or reproduction (Singer 1986, Thompson 1988). In this study, preference was estimated by quantifying gall abundance and number of galled leaves, while performance was estimated by counting the number of larvae that survived.

The relationship between preference or performance with shoot length classes was tested by simple linear regressions (Zar 1996, STATISTICA 6.0 StatSoft 2001). Number of galls, galled shoots, survival, and mortality factor rates were divided by the number of leaves in each size class in an attempt to eliminate the effects of abundance of leaves and to eliminate the effects of longest leaves having higher probability of being attacked (Cornelissen and Fernandes 2001). Data on larval survival and mortality factors were compared with data on female preference to test for a linkage between female preference and larval performance. Mortality factors, both top - down and bottom - up, acting upon the galling larva were grouped in the following categories: parasitoidism, predation, pathogens, hypersensitivity and unidentified factors (for details see Fernandes and Price 1992). To understand the effect of mortality factors by leaf length, all factors were also divided into 2cm leaf length classes (see Fernandes 1998) and compared with preference and performance distributions.

RESULTS AND DISCUSSION

We recorded 233 *P. bicolorata* galls found on 725 *M. prasina* leaves, one gall per leaf. Of all galls recorded on these leaves during the studied period, around of 83% (n = 194) developed galls resulted in adults of the galling insect, while 17% (n = 39) galls successfully induced were killed by predators, pathogens, parasitoids and unknowns mortality factors. The percent of leaves galled by *P. bicolorata* females was negatively correlated with increasing leaf length ($r^2 = 0.89$; $p < 0.00001$; $y = 91.55 - 3.57*x$). Hence, this result refutes the preference prediction of the PVH. The ratio of survival per leaf was negatively related with leaf length ($r^2 = 0.74$; $p = 0.0003$; $y = 0.76-0.032*x$). These results indicate that the performance prediction of the PVH was refuted. Top - down mortality per leaf length classes did not show any relationship with leaf length.

Prospoliata bicoloratam oviposited and survived preferentially on small - sized leaves. This result does not corroborate the predictions of the PVH, which predicts a strong female preference and increased larval survival on the largest plant modules (Price 1991). The relationship between oviposition preference and offspring performance is crucial to understand the evolution of interactions between herbivorous insects and their host plants (Thompson & Pellmyr 1991). A strong link between female preference and larval performance of *P. bicolorata* was found on small - sized shoots on *M. prasina*. Higher survival rates resulted from the female preferential attack on small - sized leaves can provide an evolutionary mechanism for the maintenance of preference on small leaves.

CONCLUSION

The Plant Vigor Hypothesis (PVH) predicts oviposition preference and higher offspring performance on longer and fast - growing shoots, and although several studies have tested these predictions, there is a lack of long - term studies concerning the patterns of host selection by galling species. A decrease in preference and performance rate of *P. bicolorata* coupled with an increase of leaf length classes of *M. prasina*. These findings do not support the PVH, and show that *P. bicolorata* can maximize the female preference and larval performance on small - sized shoots of *M. prasina*. This research was supported by DCR - FACEPE/CNPq (DCR - 0087 - 2.05/06, APQ - 0008 - 2.05/07).

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