

**MODULE SELECTION BY A SCARABAEIDAE BEETLE ON
ERYTHROXYLUM SUBEROSUM IN SERRA DO CIPÓ,
MINAS GERAIS, BRAZIL**

**SELECCIÓN DE BROTES DE *ERYTHROXYLUM SUBEROSUM* POR UN
COLEÓPTERO SCARABAEIDAE EN LA SIERRA DE CIPÓ,
MINAS GERAIS, BRASIL**

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Key words: herbivory, insect-plant interactions, plant stress, plant vigor, Scarabaeidae, Serra do Cipó.

Palabras clave: herbivoría, interacciones insecto-planta, estrés en plantas, vigor en plantas, Scarabaeidae, Sierra de Cipó.

Understanding the pattern of herbivore attack on plants has been a concern of many farmers and ecologists. Many patterns have been extensively investigated and several hypotheses have been suggested. White (1969, 1970) proposed that under stressful conditions, plants would be more vulnerable to herbivore attack. The mechanism accounting for this pattern would be the decrease in protein synthesis coupled with an increase in amino acid content in plant tissue. Concurrently, stressed plants have less ability to produce chemical defenses (Rhoades 1979). Since the eighties, studies have focused on the mechanisms of plant stress and outbreaks of insect herbivore populations on stressed hosts. Hence, plant quality started to be better investigated as an important component in plant- herbivore interactions (Price 1984, Mattson and Haack 1987).

On the other hand, the hypothesis of plant vigor suggests that herbivore attack primarily occurs on younger, relatively fast growing individuals (Price 1991). Price defines vigor as a plant or module, that grows rapidly and ultimately reaches a larger

size, relative to the mean growth rate. Preferential attack on vigorous modules may be related to greater success obtained by the offspring that feed on a better quality resource. Thus, there should be a strong relationship between herbivore preference and offspring performance (see Craig *et al.* 1986, Thompson 1988).

Stress and vigor hypothesis may be considered as opposite extremes of a continuous strategy of herbivore attack (Price 1991). These hypotheses have been widely tested on several temperate systems, but relatively few studies have been attempted in the tropics (e.g., Prada *et al.* 1995).

In this study we tested the following hypotheses: a) the plant vigor hypothesis that predicts that the largest shoots (modules) are preferentially attacked by herbivores, and b) the plant stress hypothesis that predicts that stressed plants suffer more attacks by herbivores.

Erythroxylum suberosum (Erythroxylaceae) is a perennial shrub, characteristic of cerrado

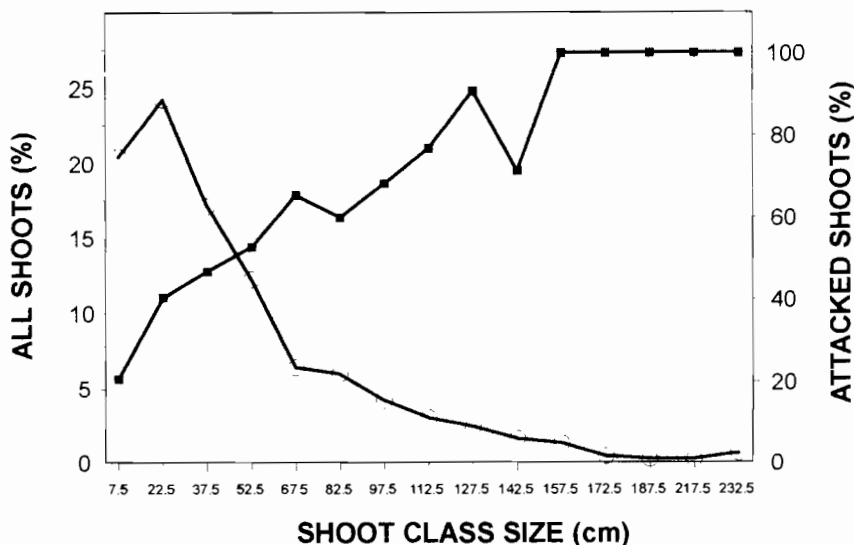


Figure 1. Size distribution of all shoots (O) of *E. suberosum* and attacked shoots (■) by scarabaeid beetle in Serra do Cipó, Brazil.

vegetation, with a height between 1 and 3 meters (Rizzini 1979). Casual observations indicated that a species of adult Scarabaeidae (Coleoptera), is a very common herbivore that chews on the leaf borders of this plant species.

This work was done in Serra do Cipó (19° 15'S; 43° 30'W), Minas Gerais, Brazil, in the Espinhaço mountains at 1,300 m above sea level in October 1993. The soil is sandy with low capacity for water retention (Giulietti *et al.* 1987). In the dry season (June to September) soil water is restricted to riparian vegetation, and fire is very frequent. The plant population studied had been burned in August 1993. As all shoots had been burned, the shoot population studied was of similar age.

Fifteen individuals of the *E. suberosum* population were randomly selected near a stream and arranged along a gradient that simulated water availability in the soil. On each individual we randomly collected 30 shoots around the crown. Two assumptions were made: shoots were randomly dispersed and herbivory was similar on all crown. Trunk circumference and height of each plant were also measured to evaluate differences among individual plants. All shoots were collected

and taken to the laboratory where we measured their length. We measured herbivory as presence or absence, and recorded the proportion of attacked shoots. To test hypothesis (a), data were grouped into 15 size classes (see Price 1991). To test hypothesis (b), data was averaged by plant. Data were analyzed by simple regression analysis (Zar 1984, Price 1991).

Adult beetles concentrated their attack on certain branches, and fed in groups. Rates of scarabaeid attack increased with increasing shoot length, although smaller shoots were more abundant (Figure 1). Attack on the longest shoots approached 100%. The regression model between attack rate on shoot size class explained 87% of the variation in beetle attack ($r^2 = 0.87$, $n = 15$, $p < 0.001$, $y = 33.9 + 0.34x$). Although representing the smallest proportion of the available shoot population, attack was primarily on the longest shoots. These data corroborate the vigor hypothesis (Price 1991). Similar results were found by Craig *et al.* (1986) on the attack by the gall-forming sawfly, *Euura lasiolepis*, on *Salix lasiolepis*. Price *et al.* (1990) revised 43 examples of insects that feed on the most vigorous plants (or shoots), but only one species was an adult form.

As predicted by the stress hypothesis, plants that were more distant from the water source were more heavily attacked than plants close to the water ($r^2 = 0.52$, $n = 15$, $p < 0.005$, $y = 20.64 + 0.101x$, Figure 2). However, the attack on the most water stressed plants may be a function of plant shoot size. If plants that were farther from the water had the longest shoots, then the vigor hypothesis would be corroborated. However, we found no relationship between mean shoot size and distance from the water ($p > 0.05$).

One of the complications of the vigor hypothesis is that many herbivores tend to attack larger modules on stressed plants (Price 1991). For instance adult females of *Dioryctria albovitela* on *Pinus edulis* select the longest shoots on plants growing in stressed habitats (Whittham and Mopper 1985, Mopper and Wittham 1986). Many gall-formers also select larger modules in xeric sites (Fernandes 1992). Hence, insect herbivores may use two distinct levels of host selection: scarabaeid individuals select plants that are more susceptible to attack and then select more vigorous modules inside the plant (Fernandes 1992). Future studies shall expand the data presented to observe female beetle selection of plant modules and individuals, and herbivore performance on plant modules and stressed hosts.

Acknowledgements

We are very grateful to J. E. C. Figueira, P. W. Price and two anonymous reviewers that carefully reviewed and commented drafts of this work. This project was funded by CNPq (521772/95-8) and Fundação de Amparo à pesquisa de Minas Gerais (FAPEMIG) (078/91, 1950/95).

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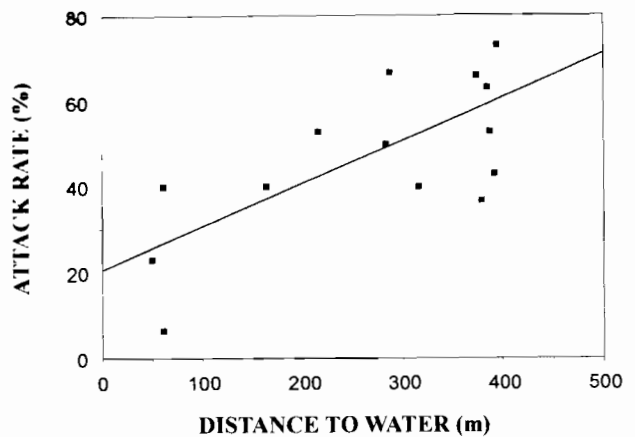


Figure 2. Relationship between beetle attack rate by plant in a distance gradient of water in Serra do Cipó, Brazil ($r^2 = 0.52$, $n = 15$, $p < 0.005$, $y = 20.63 + 0.101x$).

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Received 25 April 1997; revised 18 September 1997; accepted 20 January 1998.