Damage of *Oncideres saga* in *Albizia lebbeck* in Seropédica, Rio de Janeiro State, Brazil

Danos causados por Oncideres saga em Albizia lebbeck em Seropédica, Estado do Rio de Janeiro, Brasil

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**Johnatan Jair de Paula Marchiori**
PhD student in Environmental and Forest Sciences by Universidade Federal Rural do Rio de Janeiro (UFRRJ)
Institution: Universidade Federal Rural do Rio de Janeiro – Campus Seropédica
Address: Seropédica – RJ, Brasil
E-mail: johnatanmarchiori@gmail.com
Orcid: https://orcid.org/0000-0001-8796-4862

**Eliane Maria Ribeiro da Silva**
PhD in Agronomy by Universidade Federal Rural do Rio de Janeiro (UFRRJ), Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)
Institution: Universidade Federal Rural do Rio de Janeiro (UFRRJ), Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)
Address: Seropédica – RJ, Brasil
E-mail: eliane.silva@embrapa.br
Orcid: https://orcid.org/0000-0002-9180-9870

**Anderson Mathias Holtz**
PhD in Applied Entomology by Universidade Federal de Viçosa (UFV)
Institution: Instituto Federal do Espírito Santo – Campus Itapina
Address: Colatina - ES, Brasil
E-mail: anderson.holtz@ifes.edu.br
Orcid: https://orcid.org/0000-0002-1374-1049

**Rafael Vinicius de Lima Nobre**
Master in Plant Health and Applied Biotechnology by Universidade Federal Rural do Rio de Janeiro (UFRRJ)
Institution: Diagnósticos da América SA
Address: Duque de Caxias – RJ, Brasil
E-mail: rafalima.vinicius@gmail.com
Orcid: https://orcid.org/0000-0002-5411-7015
Evellyn Zuqui Bolsoni  
Graduating in Agronomy by Instituto Federal do Espírito Santo – Campus Itapina  
Institution: Instituto Federal do Espírito Santo – Campus Itapina  
Address: Colatina - ES, Brasil  
E-mail: Evellynzuquib@gmail.com  
Orcid: https://orcid.org/0000-0002-1162-3946

Eduarda Carriço  
Graduating in Agronomy by Instituto Federal do Espírito Santo – Campus Itapina  
Institution: Instituto Federal do Espírito Santo – Campus Itapina  
Address: Colatina - ES, Brasil  
E-mail: eduardacarrico41603@gmail.com  
Orcid: https://orcid.org/0000-0002-0123-8964

Felipe Garcia Holtz  
Master’s student in Agronomy by Universidade Federal do Espírito Santo (UFES)  
Institution: Universidade Federal do Espírito Santo (UFES) – Campus de Alegre  
Address: Alegre - ES, Brasil  
E-mail: fgholtz@gmail.com  
Orcid: https://orcid.org/0000-0001-9669-0189

Fabio Souto de Almeida  
PhD in Environmental and Forest Sciences by Universidade Federal Rural do Rio de Janeiro (UFRRJ)  
Institution: Universidade Federal Rural do Rio de Janeiro (UFRRJ)  
Address: Três Rios – RJ, Brasil  
E-mail: fbio_almeida@yahoo.com.br  
Orcid: https://orcid.org/0000-0001-6214-397X

ABSTRACT
Ringing insects, *Oncideres saga* (Dalman, 1823) (Coleoptera: *Cerambycidae*), are a unique species found in the Americas, known for their tendency to ring branches and stems of several tree species, including *Albizia lebbeck* Benth, often in afforestation contexts. The purpose of this study was to examine the presence of *O. saga* in *A. lebbeck* trees in Seropédica, analyzing the attacked branches, the number of postures, and the emergence holes. In November 2018, eight fallen branches were randomly selected based on girdling attributed to *O. saga*, along Estrada Dutra (BR-116). These branches were collected, duly identified, and sent to the Entomology Laboratory of the Department of Forest Products of the Forestry Institute of the Federal Rural University of Rio de Janeiro, where they were monitored until the emergence of adults to confirm the species. In these same branches, the postures and number of emergence holes of adults were evaluated nine months after collection. Of the eight branches examined with *O. saga* postures, adults emerged from six of them. The average number of ringed branches was 147 per sample. The average base-apex dimensions were recorded as 3.25 by 2.32, respectively. An average of 71 postures per branch were recorded. Pearson correlation analyses revealed a strong relationship between the size of the base and the apex of the branches, as well as between the apex and the occurrence of emergence holes. The results indicated a preference on the part of *O. saga* to deposit its postures on ringed branches with wider base and apex dimensions.
RESUMO
Os insetos anelídeos, Oncideres saga (Dalman, 1823) (Coleoptera: Cerambycidae), são uma espécie única encontrada nas Américas, conhecida por sua tendência de anelamento de galhos e troncos de várias espécies de árvores, incluindo Albizzia lebbeck Benth, muitas vezes em contextos de florestamento. O objetivo deste estudo foi examinar a presença de O. saga em árvores de A. lebbeck em Seropédica, analisando os galhos atacados, o número de posturas e os orifícios de emergência. Em novembro de 2018, foram selecionados aleatoriamente oito galhos caídos com base em anelamento atribuído a O. saga, ao longo da Estrada Dutra (BR-116). Esses galhos foram coletados, devidamente identificados e enviados ao Laboratório de Entomologia do Departamento de Produtos Florestais do Instituto Florestal da Universidade Federal Rural do Rio de Janeiro, onde foram monitorados até a emergência de adultos para confirmação da espécie. Nesses mesmos galhos, as posturas e o número de orifícios de emergência dos adultos foram avaliados nove meses após a coleta. Dos oito galhos examinados com posturas de O. saga, os adultos emergiram em seis delas. O número médio de ramos anelados foi de 147 por amostra. As dimensões médias da base e do ápice foram registradas como 3,25 por 2,32, respectivamente. Foi registrada uma média de 71 posturas por ramo. As análises de correlação de Pearson revelaram uma forte relação entre o tamanho da base e o ápice dos ramos, bem como entre o ápice e a ocorrência de orifícios de emergência. Os resultados indicaram uma preferência por parte do O. saga em depositar suas posturas em galhos anelados com dimensões mais largas da base e do ápice.

Palavras-chave: Cerambycidae, anelamento, florestamento.

1 INTRODUCTION

The genus Oncideres and other genera belonging to the Cerambycidae family are phytophagous insects that feed on plants. However, in adulthood, they also cause damage to plants. Studies such as Costa and Cantarelli, (2020) confirmed this harmful characteristic. These insects, popularly known as Serra-pau, serrador, and ringer, have a wide geographic distribution in South America, being present in Argentina, Bolivia, Brazil, and Paraguay, causing injury or damage to more than 35 forest tree species (MONNÉ, 2018).

In Brazilian territory, they can be found in several states, causing economic and environmental damage when in large populations, as they damage the trunks, impairing the translocation of plant sap (CORDEIRO, 2011). These insects have herbivorous habits, attacking plants of different ages (ALVES et al., 2019). However, when plants are less than two years old, they are typically unable to recover from the damage inflicted by these insects.
The damage caused by these insects mainly results from the action of females, which surround the branches and/or trunks of healthy young trees, as illustrated in Figure 1. This behavior prevents the healthy development of the plant, as the tree's crown is weakened due to a lack of sap circulation. This girdling occurs because females interrupt the flow of sap by gnawing on decomposing wood, which they use as a food source (MONTEIRO, 2016). They have a mouth structure adapted for this purpose, which causes the ringed branches to fall due to mechanical action. This process prepares the ground for the female to lay her eggs (LEMES et al., 2015).

Figure 1 – Ringing caused by female *O. saga* on *A. lebbeck*.

This behavior not only paves the way for pathogens to enter plants but also causes changes in the crown structure, impacts photosynthetic activity, influences seed production, and has direct effects on the reproductive capacity of trees (MONTEIRO, 2016). Furthermore, this action interrupts the tree's sap flow, making the branch more nutritious, with a high nitrogen and phosphorus content, ideal for the development of larvae (CALDERÓN-CORTÉS et al., 2016; CORREA et al., 2019). The slits made for egg laying extend along the branches, and a single branch can host multiple slits where egg laying occurs, although only one egg is deposited per incision, as illustrated in Figure 2.
With the birth of the larvae, the inside of the branches becomes their refuge, serving as a source of food. The larvae carve galleries in the wood, which gradually expand as the larvae are observed and develop. This insect development cycle lasts approximately one year (COSTA LIMA, 1955; CORRÊA, 2019).

One of the challenges most associated with this type of damage manifests itself when girdling occurs in the main trunk of the tree, leading to the formation of unwanted bifurcations that contribute to depreciating the commercial value of the wood, as pointed out by OLIVEIRA (2019). Nowadays, the practice of girdling raises many questions, due to the lack of comprehensive studies on the biology, behavior, and control methods of these insects, but these habits certainly cause a lot of damage to plants (COSTA and CANTARELI, 2020). In this context, a deep understanding of the biology, ecology, and ethology of these data assumes crucial importance in developing approaches for control.

The central objective of this research was to examine the presence of *O. saga* in ringed branches of trees of the species *A. lebbeck* in the region of Seropédica-RJ. The purpose of the
study was to characterize the affected branches, quantify the postures carried out by the insects, and evaluate the emergency incidences that resulted from these actions.

2 METHODOLOGY

The study was carried out in the municipality of Seropédica (22° 75' 18.675''S 43° 85' 31.105''W), along the banks of the Presidente Dutra Highway (BR-166), the main connection route between the states of Rio de Janeiro and São Paulo, at the beginning of the Serra das Araras, which is known for its wide environmental richness and diversity. The average annual maximum temperature of the place is 29.3°C, with a minimum average of 20.4°C and an average annual temperature of 24.5°C. Average precipitation is 1,326 mm annually, with a higher concentration of rain in the period from October to March, and low incidence in July and August (INPE).

Eight randomly fallen branches were selected due to girdling caused by *O. saga*, in November 2018, which were collected, duly identified, and sent to the Entomology laboratory, in the Department of Forest Products, of the Institute of Forests, at the Federal Rural University of Rio Grande do Sul. Rio de Janeiro, and observed until the emergence of adults to confirm the species. The length, and diameter of the base and apex of the branch were measured using millimeter tape. On the same branches, the adult's posture and number of emergence holes were evaluated in July 2019.

3 STATISTICAL ANALYSIS

We calculated the absolute and relative frequency of the number of branches cut and ringed per species, as well as determining the average diameter and average length of the branches. Furthermore, we explored the hypothesis of a correlation between the number of emergence holes and the size of the base of ringed branches, employing R software to conduct Pearson correlation analysis.

4 RESULTS AND DISCUSSIONS

Of the eight branches collected, all showed signs of *O. saga* egg laying, however, emergence holes were only observed in six of these branches. The average length of the ringed branches was 147 centimeters (Table 1). The basal average was 3.25 by 2.32 centimeters at the apex. In this study, an average of 71 postures per tensioned branch was identified (Table 1). The
results revealed an inclination of *O. saga* to choose ringed branches with wider dimensions at both the base and the apex. This pattern led to a greater emergence of individuals and, consequently, a reduction in the number of adult spawns as branch size decreased.

Matrices number two and three had higher emergence rates compared to the other matrices (Table 1). These matrices had overlapping branches towards the ground, a location with reduced incidence of solar radiation, which is in line with previous studies (LUNZ *et al*., 2011).

The same individual worked more than once in the same matrix (branch) (Table 1). The high presence of these individuals in the same plot can result in a series of harmful factors for fauna and flora, as when these branches fall, a substance is released that can attract other individuals to the location. When the primary shoots are affected, an emergency release occurs to increase the height of the affected tree, causing antagonism between the component individuals, generating secondary branches due to the stress on the plant generated by the Coleoptera attack (MAGISTRALI *et al*., 2013).

Table 1 - Branch number, Summit, and apex length exposed in millimeters, total length in centimeters. Number of postures per branch and number of emergency holes found.

<table>
<thead>
<tr>
<th>Nº</th>
<th>Basis (mm)</th>
<th>Apex (mm)</th>
<th>Length (cm)</th>
<th>Nº of postures</th>
<th>Emergency holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.34</td>
<td>22.99</td>
<td>122</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>32.59</td>
<td>28.38</td>
<td>131</td>
<td>124</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>41.10</td>
<td>37.38</td>
<td>128</td>
<td>77</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>40.48</td>
<td>31.87</td>
<td>155</td>
<td>85</td>
<td>7</td>
</tr>
<tr>
<td>5</td>
<td>31.99</td>
<td>16.82</td>
<td>158</td>
<td>116</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>34.76</td>
<td>17.38</td>
<td>194</td>
<td>61</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>24.64</td>
<td>13.27</td>
<td>159</td>
<td>45</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>27.03</td>
<td>17.89</td>
<td>129</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Avarage</td>
<td><strong>32.49</strong></td>
<td><strong>23.24</strong></td>
<td><strong>147</strong></td>
<td><strong>71</strong></td>
<td><strong>4.5</strong></td>
</tr>
</tbody>
</table>

Source: Authors

*O. saga* mating occurs mainly in front of the place where it is present on the branches, the female is considerably larger than the male, as shown (fig. 3). Because they have jaws, the attack of this insect causes deep girdling of the branches, to the detriment of abiotic factors and the weight of the branch, the place where the Coleoptera had action, may or may not fall in the place where the female carried out her activity (PEDRON, 2022). The larval phase of *O. saga* occurs in the winter period, while adults carry out their activities in the spring (BESSA *et al*., 2022). Studies carried out with forest pests have demonstrated that the damage acts from the
larval stage on multiple occasions on the plant, proving that due to stem deformities, tend to compromise the aesthetic and functional quality of the plant (PEREIRA et al., 2016).

Figura 3 - Copulation between male (top) and female (bottom) of O. saga in a ringed branch of A. lebbeck.

Source: author himself

When applying Pearson's correlation analysis to the data, we observed that the relationship between the base and apex of the branches is positive, implying that branches with larger bases tend to also exhibit larger apices (fig 4). This observation aligns with the logic of the natural growth of tree structures, where a robust base often coincides with a more developed apex (ROQUETTE, 2019).

Regarding the relationship between the apex and emergency opportunities, we see a positive view (fig 4). This suggests that branches with larger apices may show a tendency to have a greater number of emergence holes. Thus, differences in nutritional quality along the woody residues rotated by O. saga influence the increase in the number of postures according to the number of resources (CORREA et al., 2019). This association can be attributed to the developmental dynamics of O. saga and the preference for choosing more prominent groups.
Figura 4: Pearson correlation analysis between the response variables studied for *Albizia lebbeck Benth*.

Significant at *p* < 0.05; **p** < 0.01. Positive and negative correlations are shown in blue and red, respectively; color intensity and circle size are proportional to the correlation coefficients. PN= posture number; EO: emergency orifice.

Source: author himself. Created by R studio software.

By contextualizing these observations, additional studies can enrich our understanding. For example, research carried out by Saldanha *et al.* (2022) presented similar results, emphasizing the importance of the relationship between branch dimensions and the behavior of ringing insects. Furthermore, Silva *et al.* (2020) also explored the ecological implications of these correlations in different habitats. These studies together reinforce the validity and relevance of the results observed in the present work. Therefore, it is a fact that the incidence of postures decreases as the branches become shorter, revealing a link with the availability of wood, establishing a connection between the dimensions of the apex and the behavior of *O. saga*. It is important to note that correlation does not imply causation, but these observations may provide interesting clues to understanding *O. saga*'s behavior.
5 CONCLUSION

This study reinforces the vulnerability of the species A. Lebbeck to attack by O. saga. It can be observed that the incidence of postures decreases as the length of the branch decreases, revealing a behavior closely linked to the availability of wood volume. This discovery establishes an intriguing link between the dimensions of the apex and the behavior of O. saga towards ringed branches. The relationship between these factors reinforces a complex interaction between the insect and the host tree, paving the way for a deeper understanding of O. saga's reproduction strategies and resource use. This work contributes to society uncovering even more nuances of this relationship and informs more effective management strategies to mitigate the impact of O. saga attacks on susceptible tree species.

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