INCIDENCE OF HERBIVORY IN INDIVIDUALS OF *INGA* MILL. (FABACEAE)

INCIDÊNCIA DE HERBIVORIA EM INDIVÍDUOS DE *INGA* MILL. (FABACEAE)

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ABSTRACT

The herbivory is an animal-plant interaction where the animal consumes parts of the plant, which may impair the survivor of the planta. Herbivores can be classified according to the way that feed, where chewing, galls and miners inducers gain prominence. So, we verified if the presence of galls or miners alter the herbivory index by chewers in a population of *Inga* Mill. The study population occurs in Dois Irmãos Ecological Reverve where leaves were collected for herbivory analysis using methodology in Dirzo & Dominguez (1995) and recorded the occurrence of galls and miners inducers. Of 110 leaves collected, all showed damage by chewing herbivores, where 19 presents galls and 41 presenting miners. We not found co-occurrence of miners and galls at the same leaf. Finally, we can infer that a presence of galls or miners doesn´t alter the presence of chewer herbivores.

Keywords: Galls. Miners. Insects.

RESUMO

A herbivoria é a interação animal-planta onde o animal consome partes do vegetal, o que pode prejudicar a sobrevivência da planta. Os herbívoros podem ser classificados de acordo com a

maneira que se alimentam, onde os mastigadores, galhadores e minadores ganham destaque. Assim, verificamos se a presença de galhas ou minas alteram o índice de herbivoria por mastigadores em uma população de *Inga* Mill. A população estudada ocorre na Reserva Ecológica de Dois Irmãos onde foram coletadas folhas para análise de herbivoria usando a metodologia de Dirzo & Dominguez (1995) e contabilizada a ocorrência de galhas e minas. Das 110 folhas coletadas, todas apresentaram danos causados por herbívoros mastigadores, onde 19 também apresentaram galhas e 41 apresentando minas. Não foi observada co-ocorrência de minadores e galhadores na mesma folha. Finalmente, podemos inferir que a presença de galhas ou minas não altera a presença de herbívoros mastigadores.

Palavras-chaves: Galhas. Minas. Insetos.

Herbivory is an animal plant interaction, where the herbivorous animal is favored (+), while the plant is impaired (-). This relationship occurs by the consumption of parts of the plant, which may be leaves, flowers, seeds and roots, and usually the plant does not die. However, this relationship may affect plant survival because herbivores may consume a high proportion of photosynthetic tissue or reproductive parts, causing damage to plant growth and also interfering with reproductive success. Thus, herbivory represents an important function in population dynamics (Bianchini & Santos, 2005).

Herbivores are classified into guilds according to their mode of feeding (Townsend et al., 2003). Among the different food guilds, stand out chewers, galls and miners inducers. Chewing herbivores, also known as defoliants, tear and chew the leaves. This action directly affects the photosynthetic area of the individual and is caused by insects such as grasshoppers (Orthoptera), beetles (Coleoptera) and caterpillars (Lepidoptera) (Ângelo & DalMolin, 2007). The galls are abnormal transformations of plant tissues, which are caused by inducing organisms. These tissues experience a hypertrophy (enlargement of cells) and / or hyperplasia (increase in the number of cells) thus forming tumors, where the inducing organisms find refuge, food and a suitable place for

reproduction. In compensation, depending on the degree of the attack, it can cause death of the host plants or reduce the formation of fruits and seeds. Galls are induced by a wide variety of organisms such as algae, bacteria, fungi, viruses, mites, nematodes and insects. Insects are the main inducers of galls and among them, the most expressive orders are: Diptera, Hemiptera, Lepidoptera, Coleoptera, Hymenoptera and Thysanoptera (Maia & Oliveira, 2004). As for the insects that form miners, they feed on the internal tissue of the leaf (palisade parenchyma). The larvae of the miners remain in the mesenchyme throughout their development step, but leave the leaf to imbue in the external environment. The tunnel (mine) that is "printed" on the surface of the leaf corresponds to the foraging pathway in the larval stage and massive infestations can be significant because they decrease the photosynthetic area. The insect miners belong mainly to the orders Coleoptera, Lepidoptera, Diptera and Hymenoptera (Ângelo & DalMolin, 2007; Henning et al., 2010).

This work aimed to examine if certain type of herbivory interferes negatively in the occurrence of one another in a population of *Inga* Mill., assuming that the folivores would avoid leaves with galls and the galls inducers would avoid ovipor in leaves already attacked by the chewers. Then we tried to answer the following question: Does the presence of galls and / or miners alter the herbivory index by chewer in a population of *Inga* Mill.?

The study was accomplished in Dois Irmãos Ecological Reserve located in the Metropolitan Region of Recife, Pernambuco (28 ° 56'05.95 "S / 91 ° 135'79.45" W). The Dois Irmãos State Park is located northwest of the city of Recife, with an area of approximately 370 ha. The climate is type As', tropical coastal, hot and humid, with average monthly temperatures above 23ºC, presenting a period of high humidity between March and August, with maximum rainfall occurring in June and July (Coutinho et al., 1998). And the annual rainfall averaged around 2,200 mm (Fidem, 1987).

The study plant is *Inga* Mill. Belongs to family Fabaceae, subfamily Mimosoideae, Ingeae tribe, which comprises about 300 species (Sousa, 2009). The name of the genus is derived from the Tupi-Guarani, popularly known as ingá (Lewis et al., 2005). It is an exclusively Neotropical genus,

with seven main distribution areas, of which the coast, the interior of Brazil, the southeast of Central America and the west of South America, are the main centers of diversity of the genus (Pennington, 1997). The main characteristics of the genus are the presence of nectaries in the leaf rake (attractive for ants), which are located between each pair of leaflets, its leaves are composed and its fruit is legume type (Bentham, 1876). It presents economic potential in reforestation, phytotherapy, energy production and feeding (Pritchard et al., 1995; Bilia, 2003; Caramori et al., 2008).

At the study site, was collected five individuals who were on the trail along the Prata Dam, located in Dois Irmãos State Park. The *Inga* individuals located in the Park were mostly on the banks of the Prata Dam, so the samples chosen were collected from there. 22 leaves of each individual were collected, being cut always from the third to the fifth leaf of the branch, located at least 1,70 m from the ground. The leaves collected was later analysis where herbivory was estimated using the herbivory index proposed by Dirzo & Dominguez (1995), which is based on the percentage of leaf area loss. The herbivores were classified according to the habit, being verified the presence of galls, miners and chewing attacks on the collected leaves. The presence of chewer attack was inferred by the removal of the limbus. In order to calculate the herbivory index Dirzo & Dominguez (1995), the number of leaves used was 110 and, the percentage of herbivory loss of the leaves were classified into six categories: 0 (0% leaf area damaged), 1 (1-5% of damaged leaf area), 2 (6-12% of damaged leaf area), 3 (13-25% of damaged leaf area), 4 (26-50% of leaf area damaged) and 5 (51-100% of damaged leaf area). After this classification was calculated the herbivory index that was obtained by the formula: $IH = \sum (Ni \times i) / N$, where: Ni is the number of leaves in the category; i is the category and N is the total number of leaves. To analyze the difference between the leaves that were herbivorated by chewer, galls or miners, the one-factor ANOVA test ($p<0.05$) was applied in the Statistica 7.0 program with percentage of herbivory as dependent variable and type of herbivory as categoric variable ($n = 15$).

Of the 110 leaves analyzed from the population the great majority presented damages caused by chewing herbivores. Of this total, 19 leaves contained damage by chewing herbivores and by galls and 41 by miners. The co-existence of miners and galls on the same leaf was not observed, in this population, the presence of galls always excludes the miners and vice versa. However, both can develop in the presence of chewing herbivores. This result does not corroborate with that found by Sendoda (2007) in *Calophyllum brasiliense* (Calophyllaceae), common species of environments such as the one studied. This author observes that the leaves inhabited by miners somehow repels the galls and other types of folivores and vice versa; the explanation would be that galls or miners inducers do not choose leaves already attacked by chewers because the leaf would already be releasing a response to that attack; when it comes to the reverse, chewers do not feed on leaves attacked by other folivores because their presence can drain the nutrients to their region of occurrence by compromising the available amount. The numbers of leaves with presence of miners were superior to the numbers of galls, showing the predominance of the mining habit in this species (Figure 1).

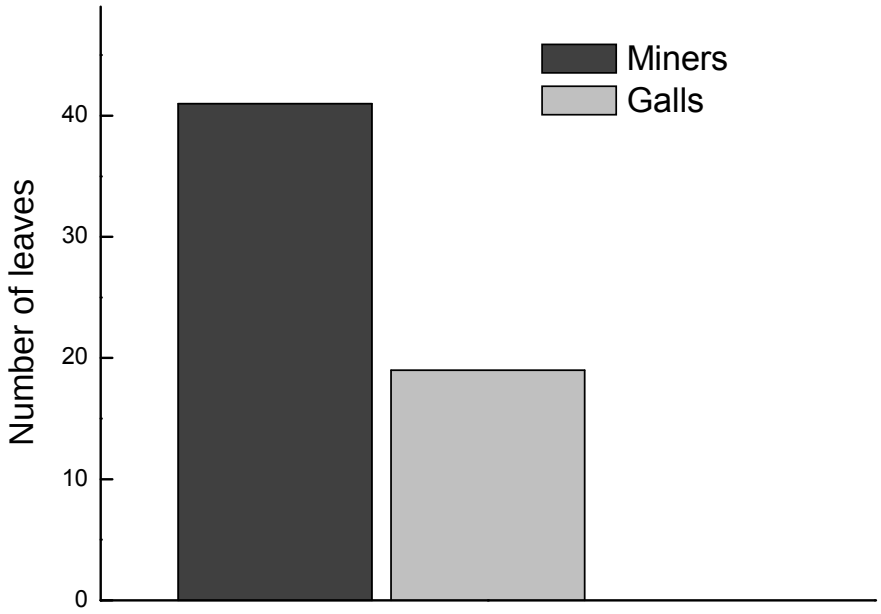

Figure 1. Number of leaves of *Inga* sp. with miners and galls found in the collection for verification of foliar herbivores in Dois Irmãos State Park (n = 110).

Flinte et al. (2006) also found a greater abundance of miners in their study. The authors found that the incidence of leaf miners is higher in plants that are not going through the budding phase of new leaves, that is, mature leaves have more resources for insects, this factor allows a higher frequency of oviposition.

Regarding the percentage of damage by chewers, we found that leaves with miners were less herbivorous than those that did not present miners (Figure 2).

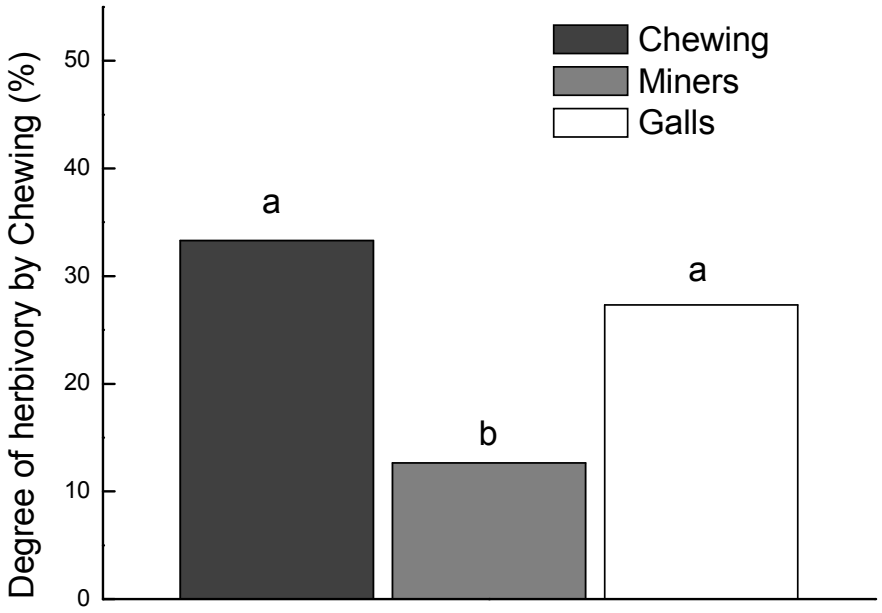

Figure 2. Percentage of herbivory on leaves of *Inga* sp. with chewing herbivores and with chewing herbivores and miners or galls. Different letters in the same column indicate statistical differences by the ANOVA one factor with significance level of 5% between treatments (n = 15 ± D.E.).

Faeth (1985) observed in his study that miners prefer relatively intact leaves for oviposition by selecting the best leaves; the author also found that there is an indirect negative interaction between chewers and miners. The herbivory index calculated for the leaves did not show significant difference between them (Table 1).

Table 1. Index of herbivory of *Inga* sp. by different herbivores of the population of Dois Irmãos State Park.

Type of Herbivory	Index of Herbivory
Chewing	11,6
Miners	6,1
Galls	10,5

As the classification in categories we found a greater number of leaves between categories 1 and 3, that is, the majority of the leaves of the individuals of *Inga* sp. (Figure 3). Among the 5 individuals sampled, the number of miners and galls per individual was recorded, and, except for individual 1, all others had a higher proportion of miners compared to galls (Table 2).

Table 2. Number of galls and miners found on leaves of *Inga* sp. In the population of Dois Irmãos State Park.

Individuals	Miners	Galls
1	1	12
2	22	3
3	15	15
4	10	4
5	17	2

Finally, we can infer that a presence of galls or miners doesn´t alter the presence of chewer herbivores. And it is possible for miners and galls inducers to compete with each other so that only one of them inhabits the *Inga* leaf. Although, to what it is observed, miners present a superiority of occupation in the sample observed of the population of the State Park of Dois Irmãos.

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