Egg Allocation by *Megalotomus parvus* (Westwood) (Heteroptera: Alydidae) on Soybean

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Alocação de Ovos por *Megalotomus parvus* (Heteroptera: Alydidae) em Soja

RESUMO - Estudos com *Megalotomus parvus* (Westwood) indicaram preferência (> 70% em casa-de-vegetação e > 50% em laboratório) das fêmeas em ovipositar no terço superior da planta de soja, *Glycine max*. Os ovos foram depositados preferencialmente nas folhas (≅ 68%), seguidas das vagens (≅ 25%) e ramos (≅ 7%). A face inferior (abaxial) do folíolo foi preferida (≅ 80%) em relação à face superior (adaxial) (≅ 20%) para alocação das posturas. Os ovos foram distribuídos ao acaso na metade anterior e posterior dos folíolos, mas um número maior de ovos (72%) foi observado na região contendo a nervura central do que na região mais externa (28%), na face superior do folíolo.

PALAVRAS-CHAVE: Insecta, Heteroptera, Coreoidea, *Glycine max*, biologia, oviposição.

ABSTRACT - Studies with *Megalotomus parvus* (Westwood) indicated that females oviposited preferably (> 70% in the greenhouse and > 50% in the laboratory) on the upper third of the soybean (*Glycine max*) plant. Eggs were deposited mainly on leaves (≅ 68 %), followed by pods (≅ 25%) and stems (≅ 7%). The lower surface of the leaflet was preferred (≅ 80%) over the upper surface (≅ 20%) as oviposition site. Eggs were randomly distributed on the anterior and posterior half of the leaflet, but a greater number of eggs were observed in the region close to the midrib (72%), compared to the external region (28%) on the upper surface of the leaflet.

KEY WORDS: Insecta, Heteroptera, Coreoidea, *Glycine max*, biology, oviposition.

The neotropical *Megalotomus parvus* (Westwood) (Heteroptera: Alydidae) is common in Brazil. Other species, such as *M. rufipes* (Westwood) and *M. pallescens* (Stal), are mentioned in the Brazilian literature (Silva *et al.* 1968), but it is almost certain that only one species is involved, for which *M. parvus* is the preferred name (J.C. Schaffner, personal communication to A.L. Lourenção).

M. parvus is extremely abundant on soybean, *Glycine max*, particularly during seed maturation. (Panizzi 1988). It is also a pest of common bean, *Phaseolus vulgaris*, in São Paulo (Paradela F°. *et al.* 1972) and Minas Gerais States (Chandler 1984, 1989). Despite the relative importance of *M. parvus* as a pest, except for the study on its biology (Panizzi 1988), very few data are found in the literature related either to its damage to crops or to its biology. Therefore, studies were conducted on *M. parvus* oviposition on soybean, such as allocation of eggs on different heights, and on different structures of the plant, and considering the leaflets, which side or which particular area within each side, if any, *M. parvus* will select to lay its eggs.

Material and Methods

Egg Allocation on Soybean Plants. *M. parvus* adults were field-collected on soybean plants at the Field Research Station of the Centro Nacional de Pesquisa de Soja, Empresa Brasileira de Pesquisa Agropecuária (Embrapa- Soja) at northern Paraná, Londrina County (latitude 23 11´ S, longitude 51 11´ W). Insects were taken to the laboratory (25 ± 1 C, 60 ± 5% RH, and 14 hL : 10 hD photoperiod) and put in plastic boxes (12.0 x 12.0 x 3.8 cm) lined with filter paper. Food (air dried seeds of soybean, peanut, *Arachis hypogaea*, sunflower, *Helianthus annuus*, sesame, *Sesamum indicum*, and indigo, *Indigofera* spp.) and water were provided. Two days later, five pairs were selected and each transferred to cages (50.0 x 50.0 x 70.0 cm) with potted soybean plants cv. Paraná at full bean stage (R6) (four plants/pot/cage). In the

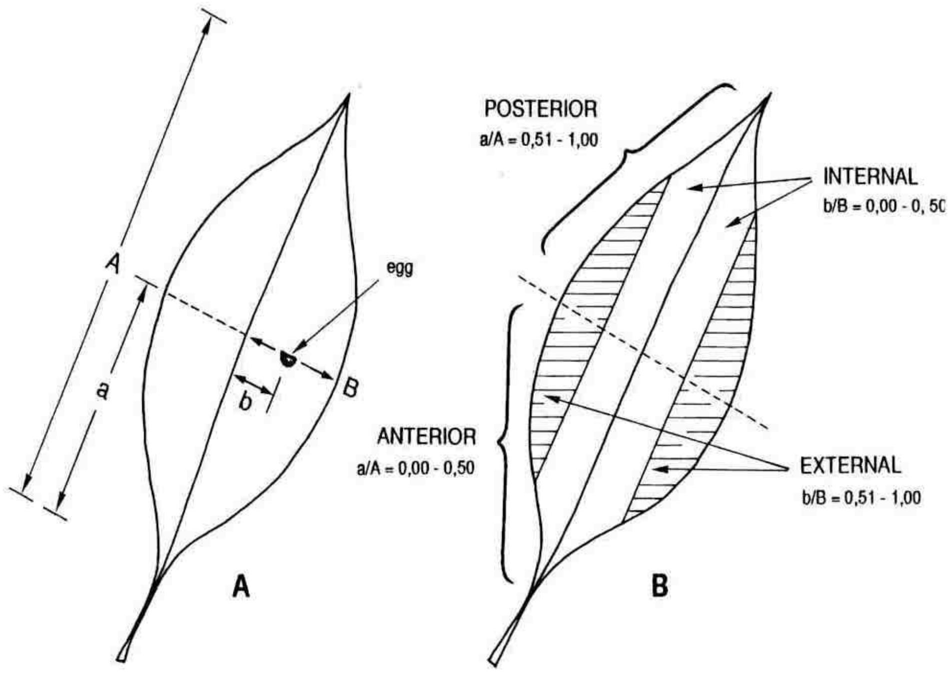

Figure 1. Schematic representation of a soybean leaflet with parameters used to calculate the position of *Megalotmus parvus* eggs and regions delimited: a = distance from the base of the leaflet to the position of the egg along the midrib; A = total length of the midrib; b = distance from the midrib to the position of the egg across the midrib; and B = distance from the midrib to the edge of the leaflet. Anterior region = half area of the leaflet close to the pedicel containing eggs with parameters value (a/A) ranging from 0.00 to 0.50. Posterior region = half area of the leaflet distal from the pedicel containing eggs with parameters values (a/A) ranging from 0.51-1.00. Internal region = half area of the leaflet closest to the midrib containing eggs with parameter values (b/B) ranging from 0.00 to 0.50. External region = half area of the leaflet near the leaflet edge containing eggs with parameter values (b/B) ranging from 0.51 to 1.00.

1st test, two cages were used in a greenhouse; in the 2nd test, another set of two cages were used in a rearing room (24 ± 5 C, and 14 hL : 10 hD photoperiod). Insects were allowed to feed and oviposite for four days. After this period, insects were removed, plants cut at their base, and taken to the laboratory. The number of eggs at each third of the soybean plant (upper, middle, and bottom), and at each plant structure (stem, pod or leaf) was recorded, and the percentage allocated on each region or on each plant part calculated. Data were analyzed with analysis of variance and means compared using Duncan´s multiple range test ($P < 0.05$).

Egg Allocation on Soybean Leaflet. Additional studies were conducted to test a possible preference of *M. parvus* for one of the two sides (upper or lower) of the soybean leaflet to allocate its eggs. Ten pairs from the field-collected adults were separated, taken to the laboratory (25 ± 1 C, 60 ± 5% RH, and 14 hL : 10 hD photoperiod), and each placed in a transparent plastic cylindrical cage (21 x 13 cm). Four cages were used, each containing a soybean leaf (with three leaflets) with the pedicel wrapped with wet cotton, plus soybean pods (immature), and air dried seeds, as mentioned in the previous study. Insects were allowed to feed and oviposite for four days, and the eggs were removed daily. The number of eggs at each side of the leaflet surface was counted, and the mean number and the percentage calculated. Data were compared using the *t*-test ($P < 0.05$).

In a 2nd study, *M. parvus* adults obtained in the field were selected, and 10 pairs were placed in each of three cylincrical cages (40.0 x 60.0 cm) containing a potted soybean plant (cv. Paraná) at R4 (pod- setting period). Air-dried seeds, glued to a piece of cardbord and hanged on the plants, were provided. Insects were allowed to feed and oviposite for four days. After this period, leaflets of each plant containing eggs were removed and placed singly in plastic bags in the refrigerator. The positions of eggs on each side (upper and lower) of the leaflets were determined based on Kudô (1988) by measuring: a = distance from the base of the leaflet to the position of the egg along the midrib; A = total length of the midrib; b = distance from the midrib to the position of the egg across the midrib; and B = distance from the midrib to the edge of the leaflet (Fig. 1A). The ratios a/A and b/B were calculated to indicate the position of the eggs on each of the two regions along the midrib (anterior and posterior), and two regions across the midrib (internal and external) of the leaflet (Fig. 1B). The number and percentage of eggs allocated in each region were calculated and compared statistically using the chi-square test.

Results and Discussion

Egg Allocation on Soybean Plants. The majority of *M. parvus* eggs were laid on the upper third of the soybean plants on both studies, in the greenhouse (> 70 %) and in the rearing room (> 50 %) (Fig. 2 A,B). Of the remaining eggs, 26% (greenhouse) and 30% (rearing room) were deposited on the middle third; and 4.0 and 17.0%, respectively, were allocated on the bottom third of the plant. A clear reason to explain why *M. parvus* preferably laid its eggs on the upper end of the soybean plant was not found. Seed-sucking heteropterans are known to damage a greater number of seeds on the upper than on the lower parts of the soybean plant (Mi- randa *et al.* 1979, Panizzi *et al.* 1986). However, this not necessarily means that eggs are located mainly in this area. In addition, how heteropterans move within a plant from egg-hatching through their development is poorly understood. In contrast, the velvetbean caterpillar, *Anticarsia gemmatalis* Hübner, a leaf-feeding insect, prefers to lay its eggs on the lower part of the soybean plant, with caterpillars moving upward as they develop (Ferreira & Panizzi 1978).

Eggs were deposited mainly on leaves (69 % in the greenhouse, and 66% in the rearing room). The 2nd plant structure selected by *M. parvus* to lay its eggs was the pods (23 and 27%, respectively). Only 7-8% of the eggs were

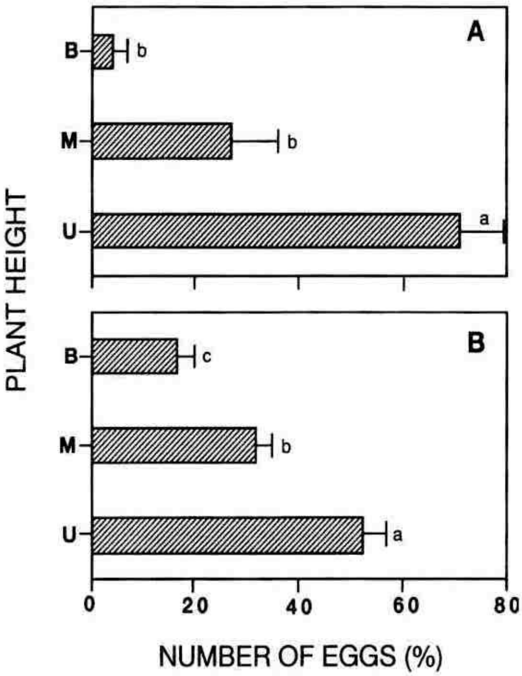

Figure 2. Mean (± SEM) percentage of *Megalotomus parvus* eggs allocated on different heights of the soybean plant (upper = U; middle = M; and bottom = B third) in the greenhouse (A; n = 7, one plant was eliminated) and in the rearing room (B; n = 8). Means followed by the same letter are not significantly different ($P < 0.05$) using Duncan's multiple range test.

allocated on stems (Fig. 3 A,B). Eggs of the alydid *Riptortus linearis* (F.) are mostly laid on leaves of soybean (Talekar *et al.* 1995). *R. clavatus* Thunberg lay eggs on leaves and stems of soybean (Kobayashi 1981). *R. dentipes* F. usually deposit eggs on pods of cowpea, *Vigna unguiculata* (Aina 1975). It seems that, for the species of Alydidae associated with legumes, a general pattern regarding the preferred site for egg allocation can not be established. Different species will choose different structures of a particular plant as egg substrate, and the same species will apparently vary its preference according to host plants. In the laboratory, *M. parvus* will prefer to oviposit on pods instead of leaves of pigeon pea, *Cajanus cajan* (M.U. Ventura, personal communication to ARP).

Egg Allocation on Soybean Leaf. The lower surface of the leaflet was preferred (12.0 eggs, corresponding to 79.4 % of the total) by *M. parvus* to allocate its eggs compared to the upper surface (2.9 eggs, corresponding to 20.6 % of the total) (Table 1). For *R. linearis,* both lower and upper leaflet surfaces were equally preferred for egg deposition (Talekar *et al.* 1995). The rice bug, *Leptocorisa oratorius* (F.) laid eggs mostly on the upper surface of rice (*Oryza sativa*) leaves, while the congeneric *L. acuta* (Thunberg) preferred the dry parts of rice leaves or stems (Cobblah & den Hollander 1992). When the latter species oviposited on fresh leaves, the upper surface was preferred (Rai 1981). In the case of *M. parvus* on soybean the preference for the lower leaflet surface could increase egg survivorship, mitigating the impact of biotic (e.g., less exposition to predators and parasites), and abiotic (e.g., greater protection

Table 1. Mean (± SEM) number of *Megalotomus parvus* eggs deposited on the upper and lower surfaces of the soybean leaflet in the laboratory.

Leaflet Surface	Mean Number of Eggs[1]	Mean Percentage of Eggs[1]
Lower	12.0 ± 1.70 a (16)	79.4 ± 4.94 a (16)
Upper	2.9 ± 0.66 b (16)	20.6 ± 4.99 b (16)

[1]Means followed by the same letter are not significantly different (P < 0.05) using *t* - test.

against dessication and harmfull effects of heavy rain) factors. However, additional work is needed to prove this hypothesis.

close to the leaflet midrib on the upper surface (P < 0.001; chi-square test). On the lower surface, eggs were equally distributed near the

Table 2. Total number and percentage of *Megalotomus parvus* eggs deposited on different regions of each surface of the soybean leaflet in the laboratory.

Leaflet	Leaflet Surface	
Region	Upper	Lower
Anterior	84 ns (47.0)	172 ns (52.0)
Posterior	95 (53.0)	161 (48.0)
Internal	128 * (72.0)	173 ns (52.0)
External	51 (28.0)	160 (48.0)

* Asterisk indicates significant difference using chi-square test (P < 0.001).

Considering each leaflet surface, *M. parvus* females deposited its eggs on similar numbers at the anterior and at the posterior regions, in a random distribution (Table 2). However, they concentrated a greater number of eggs midrib (internal region) and close to the leaflet edge (external region). A greater number of eggs close to the midrib has been reported for *L. acuta* on rice (Rai 1981). Considering that this insect lays eggs on linear rows, and con-

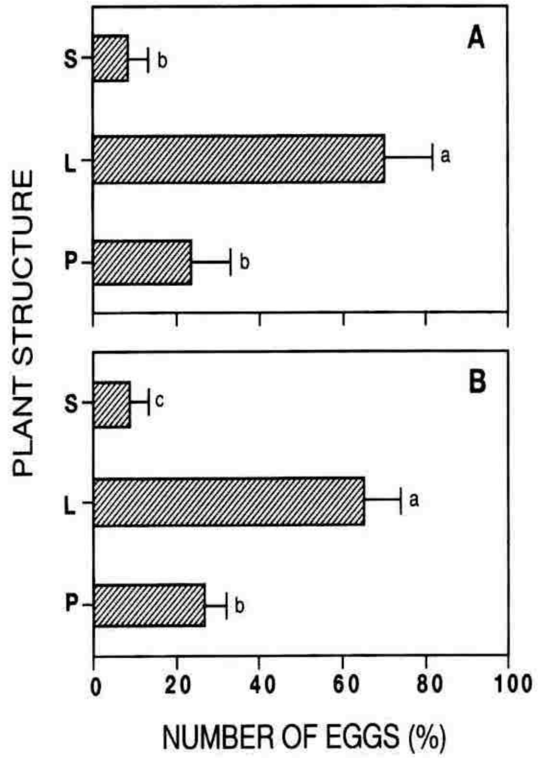

Figure 3. Mean (± SEM) percentage of *Megalotomus parvus* eggs allocated on different structures of the soybean plant (stem = S; leaf = L; and pod = P) in the greenhouse (A; n = 6, one plant was eliminated, and one data was not considered in the analysis) and in the rearing room (B; n = 8). Means followed by the same letter are not significantly different (P < 0.05) using Duncan´s multiple range test.

sidering the shape of the rice leaf, this behavior could be of adaptive advantage, with better fixation of eggs to a stronger area of the leaf (i.e., the midrib). However, in the case of *M. parvus,* which lay eggs singly on a much broader leaf, this fact may be negligible, despite the difference observed for the upper leaf surface. Clearly, further research is needed to test if egg allocation in a particular area of the soybean leaflet will affect egg survivorship. In conclusion, results of these studies demonstrate that *M. parvus* females choose the upper part of the soybean plant and the leaves as preferred oviposition sites, tending to concentrate eggs near the leaflet midrib. The ecological consequences of this behavior to the insect fitness is yet to be evaluated.

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