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POPULATION DYNAMICS OF *STENOMA CATENIFER* (LEPIDOPTERA: ELACHISTIDAE) AND RELATED LARVAL PARASITOIDS IN MINAS GERAIS, BRAZIL

Dori E. Nava[1,4], José R. P. Parra[1], Valmir A. Costa[2], Tânia M. Guerra[3] and Fernando L. Cônsoli[1]
[1]Depto. de Entomologia, Fitopatologia e Zoologia Agrícola, ESALQ/USP, Caixa Postal 9, 13418-900, Brazil

[2]Instituto Biológico. Centro Experimental do Instituto Biológico. Laboratório de Controle Biológico
Caixa Postal 70, 13001-970 Campinas, SP, Brazil

[3]Laboratório de Entomologia, Depto. Fitotecnia, CCA/UFSC, Caixa Postal 476, 88040-900, Florianópolis, SC, Brazil

[4]Corresponding author; e-mail: <nava@esalq.usp.br>

Abstract

The avocado seed moth *Stenoma catenifer* Walsingham (Lepidoptera: Elachistidae) can cause total production losses and is considered a key pest of avocado in Brazil. This research aimed to evaluate the larval dynamics of *S. catenifer* and its associated parasitoids in an avocado growing region throughout two consecutive agricultural seasons. The highest percentage of fruits attacked by *S. catenifer* was found in the period near harvest, starting in June. The percentage of infested fruits in the first agricultural season was approximately 60%, near 11% above that of the second season. Five undetermined braconids within five genera (*Dolichogenidea* sp., *Hypomicrogaster* sp., *Apanteles* sp., *Chelonus* sp., and *Hymenochaonia* sp.) and two ichneumonids (*Eudeleboea* sp. and *Pristomerus* sp.) were found. *Dolichogenidea* sp. and *Apanteles* sp. were the most abundant, and therefore are the species with the highest potential as *S. catenifer* population regulators. In both seasons, the emergence peak of parasitoids occurred at the end of the winter (August), when at least 30 and 40% total larval parasitism was observed.

Key Words: *Persea americana*, biological control, larval parasitoids

Resumo

A broca-do-abacate, *Stenoma catenifer* Walsingham, 1912, é considerada praga-chave do abacateiro no Brasil, podendo acarretar perdas totais da produção. O objetivo deste trabalho foi quantificar, identificar os parasitóides larvais de *S. catenifer* e verificar as épocas de ocorrência da fase larval deste hospedeiro e de cada espécie de parasitóide em duas safras agrícolas consecutivas. A maior porcentagem de frutos atacados por *S. catenifer* foi verificada no período próximo à colheita, a partir do mês de junho. A porcentagem de frutos infestados na primeira safra agrícola foi de aproximadamente 60%, sendo superior à da segunda safra, cerca de 11%. Foram encontradas cinco parasitóides da família Braconidae (*Dolichogenidea* sp., *Hypomicrogaster* sp., *Apanteles* sp., *Chelonus* sp. e *Hymenochaonia* sp.) e dois da família Ichneumonidae (*Eudeleboea* sp. e *Pristomerus* sp.). *Dolichogenidea* sp. e *Apanteles* sp. foram as espécies que apresentaram maior potencial como reguladoras populacionais de *S. catenifer*. Nas duas safras, o pico de emergência dos parasitóides ocorreu no mês de agosto, quando foi verificado um parasitismo larval entre 30 e 40%.

Translation provided by the authors.

Mealybugs, leaf caterpillars, wood borer and the Limeira beetle are among the many species of insects reported from avocado orchards, but reports of these species as pests in avocado orchards in Brazil occurred only early in the 90s (Teixeira 1992). By the end of the 1980s and beginning of the 1990s, groves in the States of Paraná, São Paulo, Minas Gerais, and Espírito Santo were fairly infested by the avocado borer, *Stenoma catenifer* Walsingham. Currently, this insect is considered the most important avocado pest in the main avocado producing regions, where it can cause complete crop failure (Hohmann & Meneguim 1993).

Several studies have been conducted to establish suitable management practices to control this pest, especially through chemical control (Fornazieri et al. 1994; Hohmann et al. 2000). However, the use of insecticides is hindered by a lack of larval sampling methods and the fact that the larvae are protected from contact insecticides since they feed inside the fruit.

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Biological control is a suitable alternative method for *S. catenifer* control. Natural rates of parasitism as high as 40% by egg parasitoids have been recorded in Paraná State (Hohmann & Meneguim 1993), and the possibility of using these natural enemies has fostered further research on the thermal requirements and parasitoid strain selection (Maceda et al. 2003; Nava & Parra 2003). Larval parasitoids also seem to be an important component in the natural control of *S. catenifer*, with natural rates of parasitism ranging from 9 to 30% (Boscán de Martinez & Godoy 1982; Hohmann & Meneguim 1993). Despite the potential use of larval parasitoids as biological control agents of the avocado moth through augmentative or inundative releases, studies on the efficiency and rearing of these larval parasitoids were limited until recently due to the lack of an artificial rearing system for *S. catenifer* (Nava & Parra 2005).

Identifying larval parasitoids and determining their temporal occurrence will advance avocado borer biological control efforts. The objective of this research was to identify and quantify larval parasitoid temporal occurrence throughout the avocado production cycle in the state of Minas Gerais (MG), Brazil, to support the establishment of control strategies against this pest.

Materials and Methods

Study Site

The present study was carried out in a commercial avocado grove (cultivar Margarida) located in São Tomás de Aquino, MG (20°52'30"S, 47°07'30"W and 1,000 m elevation). The study was conducted during the 2001-2002 and 2002-2003 cropping seasons, from December to September of the following year.

The avocado grove occupied an area of approximately 4 hectares, with trees spaced at 10 m within rows and 15 m between rows, totaling around 100 trees per hectare. The survey was conducted every 15 d, totaling 15 and 21 collections of fruits for avocado borer population dynamics and larval parasitoid studies, respectively. In the first cropping season, seven sprays were made by alternating pyrethroids and organophosphates, while the second cropping season required 11 applications.

Population Dynamics of *S. catenifer*

Eleven trees were selected in a zigzag sampling technique. Each tree was circled and one fruit was collected from each side (north, south, east, and west) of the tree at an intermediate height, totaling four fruits/tree, to evaluate the population dynamics of *S. catenifer*. Fruits were brought to the lab to evaluate the population dynamics of the avocado moth after fruit dissection and determination of the percentage of infested fruits throughout the production cycle (January-August).

Parasitoids Associated with *S. catenifer*

In the larval parasitoid survey, 50 infested fruits were collected at random. The fruits were taken to the laboratory for dissection and removal of larvae. Larvae were individually placed in plastic containers (10 cm height × 6 and 8 cm at the top and base, respectively) and fed avocado seeds until emergence of the *S. catenifer* adult or parasitoids. The stage at which the host was at the moment parasitoid emergence occurred, and the number of parasitoids emerged per host were determined. All insects were maintained under controlled conditions (25 ± 1°C, 70 ± 10% relative humidity and 14:10 (L/D) photoperiod).

The percentage of parasitoids was determined based on the number of parasitized larvae from which parasitoids developed successfully in relation to the total larvae collected. We did not score for cases of superparasitism or parasitization of hosts at an unsuitable stage which would lead to an unsuccessful parasitoid development and/or host's death. The specimens obtained were preserved in 70% alcohol for identification, and voucher specimens were deposited in the entomological collection of the Museu "Oscar Monte", Centro Experimental do Instituto Biológico, Campinas, SP.

Results and Discussion

Population Dynamics of *S. catenifer*

Infestation of fruits by *S. catenifer* was less frequent during the initial stages of the survey (December, January, and February), but increased as fruits were getting ready to harvest (Fig. 1). The infestation in the 2001-2002 cropping season reached 60% in June and was much higher than the peak observed during 2002-2003 season. Although the infestation in the first cropping season was considerable, there is a report from Venezuela demonstrating it can reach up to 80% of the fruits (Boscán de Martínez & Godoy 1982).

The difference in infestation between both cropping seasons was probably related to the more intensive use of insecticides in the second cropping season (11 vs. 7 applications). The difficulty in establishing control strategies is also due to the fact that cultivar Margarida is a medium- and late-cycle plant, and the fruit may remain in the field for approximately one year. Therefore, a more detailed sampling of groves should be made by initial growers, and insecticide application should be made when the first fruits showing attack symptoms (punctuations with white exudate on the fruits due to larvae boring through the exocarp) are detected.

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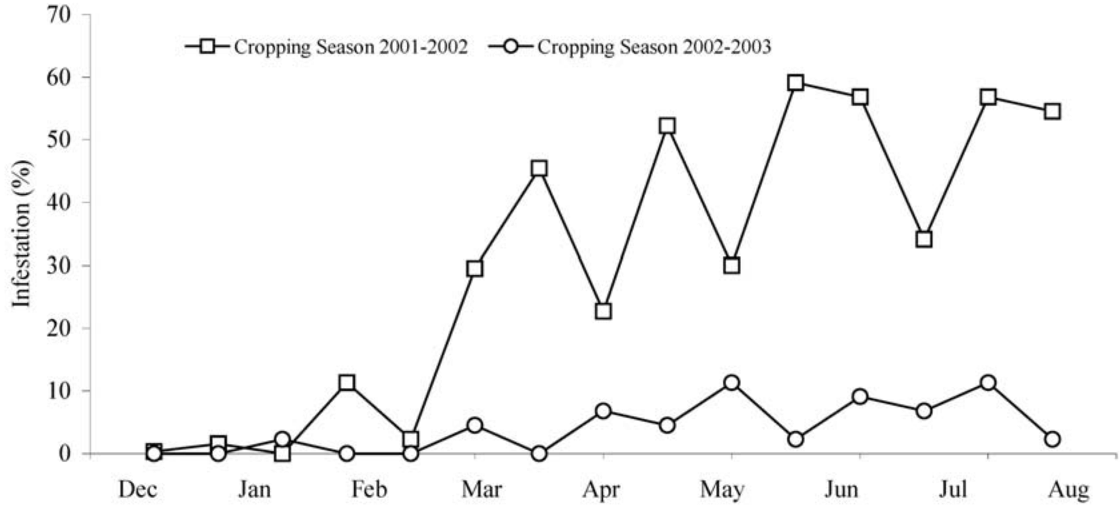

Fig. 1. Seasonal abundance of the larval stage of *Stenoma catenifer* on cultivar Margarida avocado trees, during the 2001-2002 and 2002-2003 cropping seasons (December-August). São Tomás de Aquino, MG.

Parasitoids Associated with *S. catenifer*

Undetermined species of the genera *Dolichogenidea* sp., *Hypomicrogaster* sp., *Apanteles* sp., *Chelonus* sp., *Hymenochaonia* sp. (Hymenoptera, Braconidae); and *Eudeleboea* sp., and *Pristomerus* sp. (Hymenoptera, Ichneumonidae) were detected (Fig. 2A). The first genus is gregarious, while the others are solitary, but all are koinobiont endoparasitoids. The braconids emerged from the host early during the last larval stage, while ichneumonids emerged late in this stage as the host approached pupation.

This is the first report of *Dolichogenidea* sp., *Hypomicrogaster* sp., *Hymenochaonia* sp., and *Pristomerus* sp. as avocado borer parasitoids. *Chelonus* and *Eudeleboea* have already been associated with *S. catenifer* in Guiana (Cervantes et al. 1999), and *Apanteles* has been recorded in Venezuela (Boscán de Martínez & Godoy 1982). In Brazil, Hohmann & Meneguim (1993) reported parasitism of *S. catenifer* larvae by two unidentified braconids and one ichneumonid species. In another study, Hohmann et al. (2003) mentioned the collection of an ichneumonid, possibly in the genus *Eudeleboea*, and a braconid in the genus *Apanteles*.

Dolichogenidea sp. and *Chelonus* sp. were the first parasitoids to emerge from *S. catenifer* larvae, followed by *Apanteles* sp. and *Hypomicrogaster* sp., in the first cropping season (Fig. 3). In the second cropping season, *Dolichogenidea* sp. followed the same emergence pattern found during the first season, but the occurrence of *Apanteles* sp. and *Hypomicrogaster* sp. was delayed. *Apanteles* sp. was first recorded in April and *Dolichogenidea* sp. only in June (Fig. 3). The emergence of *Eudeleboea* sp. suggested an irregular behavior because specimens were collected in March and April in the 2001-2002 cropping season, and in September in the following year. *Pristomerus* sp. and *Hymenochaonia* sp. were recorded in the months of May and June, respectively (Fig. 3).

Dolichogenidea sp. and *Apanteles* sp. were collected throughout both cropping seasons, indicating they are present and are able to exploit hosts even when insecticides are applied (Fig. 3). The gregariousness of *Dolichogenidea* sp. and the exploitation of hosts early in the season may be advantageous to this species as a biological control agent of *S. catenifer.* Two other species were also abundant, *Apanteles* sp. and *Hypomicrogaster* sp., and are also good candidates for the implementation of biological control programs in avocado orchards.

Chelonus sp., *Hymenochaonia* sp. and *Pristomerus* sp. were not found in the second cropping season (Fig. 2B), which could be associated to a reduced host searching capacity as indicated by their low abundance in this season (3%, 2%, and 1%, respectively). Also, these species could have been either (1) displaced by the most abundant ones as the host population was dramatically reduced after adoption of a more intensive use of chemicals during the second crop season, or (2) they might have suffered more the side-effects of the chemicals utilized for the control of the avocado seed moth.

According to Elzen & King (1999), the use of insecticides is the main factor to be taken into account when natural enemy conservation is the goal. In the present study, we observed that the increased use of insecticides in the second cropping season could have contributed to decrease the number of parasitoid species (Fig. 2). How-

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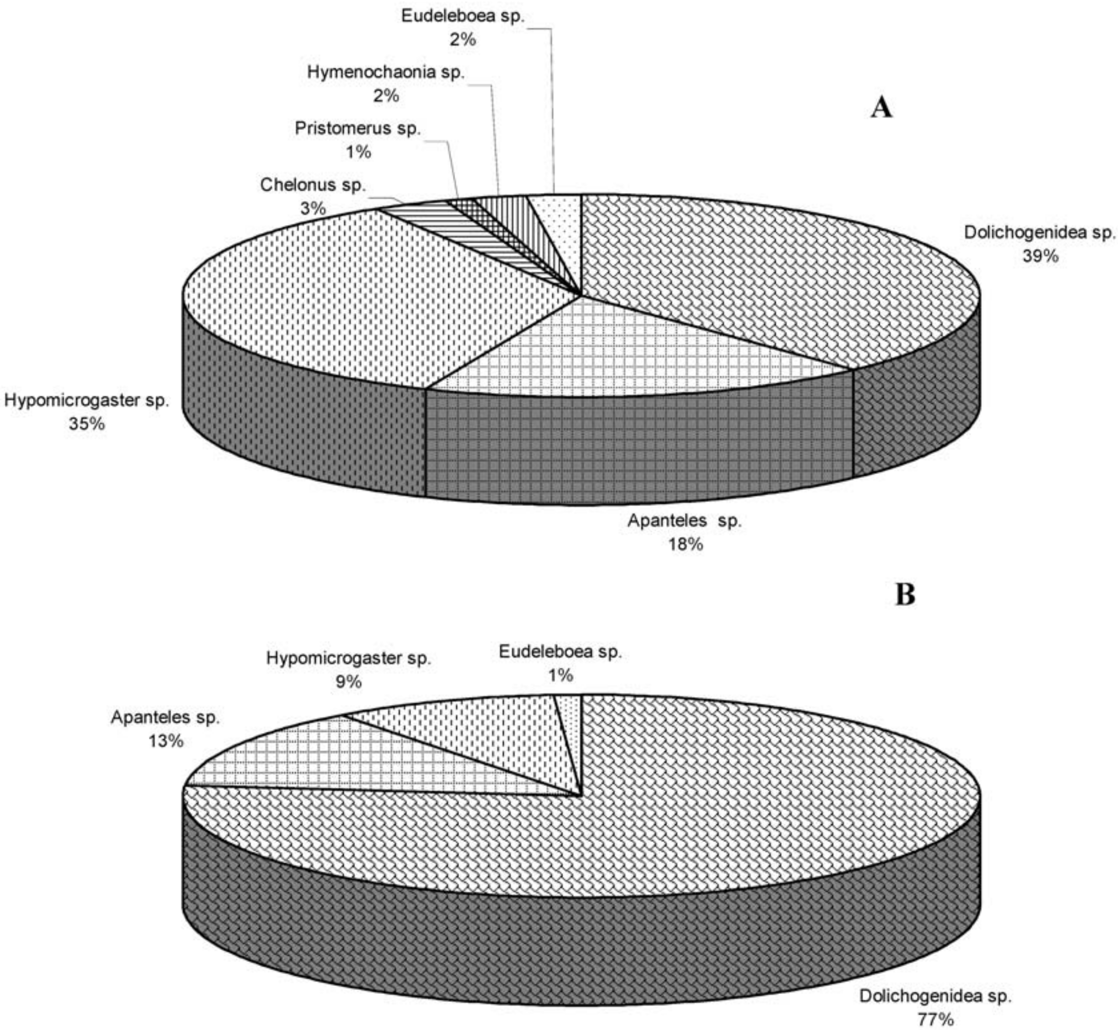

Fig. 2. Relative frequency of larval parasitoid species collected on cultivar Margarida avocado plants during the 2001-2002 production cycle (December-September) (A) and 2002-2003 production cycle (B). São Tomás de Aquino, MG.

ever, the greater number of insecticide applications did not decrease total parasitism (sum of parasitism of all species) in the second cropping season (2002-2003), which was near 47% in the month of August, higher than the 32% recorded in the 2001-2002 cropping season (Fig. 4). It can also be observed that the percentage of parasitism increases as *S. catenifer* population grows (Figs. 1 and 4), thus revealing a reciprocal density mechanism, where the population density of the mortality agent depends directly on the population density of the herbivore host (Huffaker & Messenger 1976).

Boscán de Martínez & Godoy (1982) related a *S. catenifer* parasitism in Venezuela of up to 30% by *Apanteles*. In the State of Paraná, Brazil, Hohmann & Meneguim (1993) observed parasitism of 9%, also caused by *Apanteles*. The present study verified that parasitism level was variable throughout the cropping seasons (Fig. 4). In addition, the comparison of results is difficult, since the authors quoted above did not mention the time during the season when their surveys were carried out.

The occurrence of *Perilampus* sp. (Hymenoptera: Perilampidae) as a hyperparasitoid of *Dolichogenidea* sp. was also observed. The interaction between hyperparasitoid and primary parasitoid may often reduce the population of the latter and negatively interfere with the population reduction of the herbivore. In this case, even though 7% parasitism was recorded, it is believed that this hyperparasitoid would not interfere with the control of *S. catenifer*, since it was recorded only in

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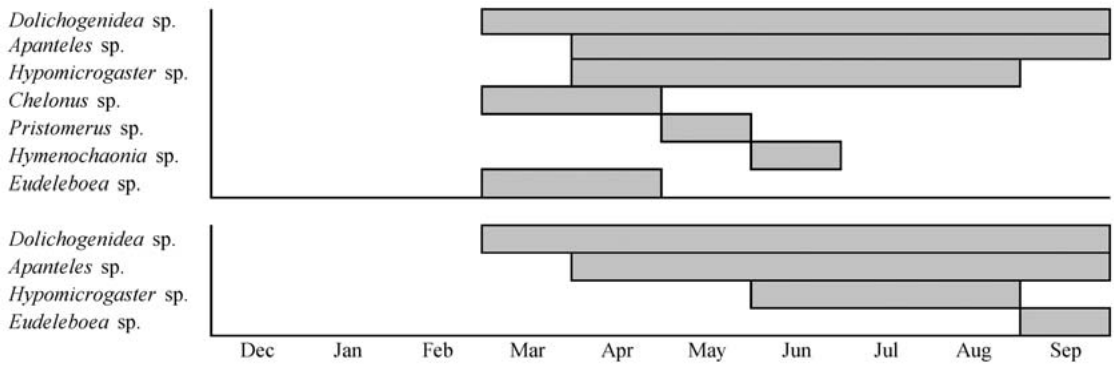

Fig. 3. Distribution of *Stenoma catenifer* larval parasitoid species, collected in a cultivar Margarida avocado orchard along a production cycle (December-September), in the 2001-2002 (A) and 2002-2003 (B) cropping seasons. São Tomás de Aquino, MG.

the month of August, the moment at which fruit harvest had begun, not resulting in a numeric reduction of *Dolichogenidea* sp.

Our study suggests that these larval parasitoids may play an important role in *S. catenifer* population dynamics, and that these parasitoids should be conserved as much as possible as they may make a significant contribution toward the integrated management of the pest. Our study also points for the necessity of a better look on the host—parasitoid population dynamics as parasitism rates were very similar even when host population was reduced 6-fold, indicating augmentative biological approaches could be required for successful control of the avocado seed moth at higher host densities. Finally, as to efficiently develop parasitoid conservation strategies or to implement an augmentative biological control program, further studies on the structure of the parasitoid community associated to this moth and the identification of selective chemicals should be conducted.

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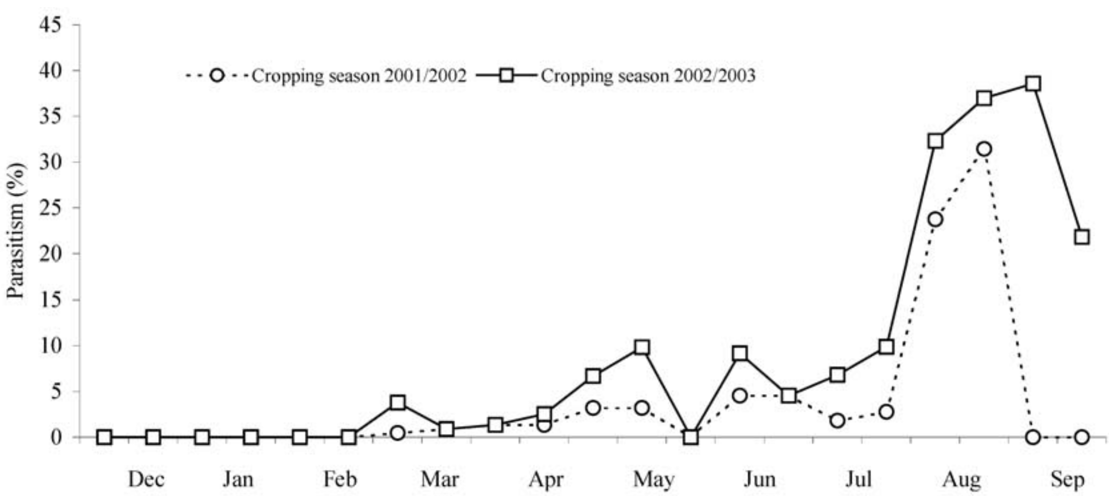

Fig. 4. Total parasitism of *Stenoma catenifer* caterpillars collected in a cultivar Margarida avocado orchard along a production cycle (December-September), in the 2001-2002 (A) and 2002-2003 (B) cropping seasons. São Tomás de Aquino, MG.

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References Cited

Boscán De Martinez N., and F. J. Godoy. 1983. *Apanteles* sp. (Hymenoptera: Braconidae) parasito del taladrador del aguacate *Stenoma catenifer* Walsingham (Lepidoptera: Stenomidae) en Venezuela. Agron. Trop. 32: 205-208.

Cervantes, P. C., C. H. C. Lyal, and V. K. Browns. 1999. The Stenomatidae moth *Stenoma catenifer* Walsingham: a pre-dispersal seed predator of greenheart (*Chlorocardium rodiei* (Schomb.) Rohwer, Richter & Van der Werff) in Guyana. J. Nat. Hist. 33: 531-542.

Elzen, G. W., and E. G. King. 1999. Periodic release and manipulation of natural enemies. pp. 253-270 *In* T. S. Bellows and T. W. Fisher [eds.], Handbook of Biological Control. London: Academic Press.

Fornazieri, M., R. Piffer, C. P. Teixeira, and M. O. Athayde. 1994. Controle da broca do fruto do abacateiro (*Stenoma catenifer* Wals.) na região serrana do estado do Espírito Santo. Comunicado técnico 2p.

Hohmann, C. L., and A. M. Meneguim. 1993. Observações preliminares sobre a ocorrência da broca do abacate, *Stenoma catenifer* Wals. no estado do Paraná. An. Soc. Entomol. Brasil 22: 417-419.

Hohmann, C. L., W. J. Santos, and A. M. Meneguim. 2000. Avaliação de técnicas de manejo para o controle da broca-do-abacate, *Stenoma catenifer* (Wals.) (Lepidoptera: Oecophoridae). Rev. Bras. Frutic. 22: 359-363.

Hohmann, C. L., A. M. Meneguim, E. A. Andrade, T. G. Novaes, and C. Zandoná. 2003. The avocado fruit borer *Stenoma catenifer* (Wals.) (Lepidoptera: Elachistidae): egg and damage distribution and parasitism. Rev. Bras. Frutic. 25: 432-435.

Huffaker, M., and P. S. Messenger [eds.]. 1976. Theory and practice of biological control. Academic Press, New York. 788 pp.

Maceda, A., C. L. Hohmann, and H. R. Santos. 2003. Temperature effects on *Trichogramma pretiosum* Riley and *Trichogrammatoidea annulata* De Santis. Braz. Arch. Biol. Technol. 46: 27-32.

Nava, D. E., and J. R. P. Parra. 2003. Seleção de linhagens de *Trichogramma* e *Trichogrammatoidea* para o controle da broca-do-abacate. In SIMPÓSIO DE CONTROLE BIOLÓGICO, 8., São Pedro, 2003. Resumos. São Pedro: SEB, 2003. p.127.

Nava, D. E., and J. R. P. Parra. 2005. Biologia de *Stenoma catenifer* Walsingham (Lepidoptera: Elachistidae) em dieta natural e artificial e estabelecimento de um sistema de criação. Neotrop. Entomol. 34. (in press)

Teixeira, C. G. 1992. [Ed]. Cultura, pp. 1-57 *In* Instituto de Technologia de Alimentos, (ITAL) Abacate. ICEA-Gráfica et Editora Ltda., Campinas, Brazil.

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