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Bioecological aspects of *Hypocala andremona* (Cramer) (Lepidoptera: Noctuidae) on persimmon cultivars

Celso Luiz Hohmann[1*], Ana Maria Meneguim[1] and Lidiana Lovato[2]

[1]Entomologia, Área de Proteção de Plantas, Instituto Agronômico do Paraná, Rod. Celso Garcia Cid, Km 375, Cx. Postal 481, 86001-970, Londrina, Paraná, Brazil. [2]Instituto Federal de Educação, Ciência e Tecnologia de Roraima, Caracarai, Roraima, Brazil. Author for correspondence. E-mail: celuiz@iapar.br*

ABSTRACT. The biology of *Hypocala andremona* (Cramer) on persimmon (*Diospyrus kaki* L.) leaves of the cultivars Atago and Giombo was studied in laboratory (27 ± 1ºC, 65 ± 10% RH, 14 hours photo period) and egg distribution on plants of the cultivar Giombo in a commercial orchard, during the 2001/2002 crop season, in Londrina, Paraná state. The developmental period of larvae fed on 'Giombo' was longer (17.8 ± 0.17 days) in comparison to that of larvae fed on 'Atago' (15.8 ± 0.27 days). In contrast, the duration of the pupal stage of insects raised on 'Giombo' was lower (12.0 ± 0.29 days) than that of insects reared on 'Atago' (13.3 ± 0.17 days). The viabilities of larvae were 60.8 and 38.8% for insects reared on 'Giombo' and on 'Atago', respectively. Pupal viability was similar (ca. 93%) between treatments. The duration of the preoviposition and incubation periods of larvae fed on 'Atago' were 4.0 days and 2.1 days, respectively, the fecundity 524.7 eggs, egg viability 77% and adult longevity 12.9 days. No eggs were obtained when *H. andremona* larvae were reared on 'Giombo' in laboratory. Adults preferred to lay their eggs on leaves located at the top of the persimmon tree canopy.

Keywords: *Diospyrus* sp., biology, oviposition preference.

RESUMO. Aspectos bioecológicos de *Hypocala andremona* (Cramer) (Lepidoptera: Noctuidae) em cultivares de caquizeiro. A biologia de *Hypocala andremona* (Cramer) (Lepidoptera: Noctuidae) foi estudada em folhas das cultivares de caquizeiro (*Diospyrus kaki* L.) Atago e Giombo em laboratório (27 ± 1ºC, 65 ± 10% UR, 14h fotofase) e a distribuição de ovos em plantas da cultivar Giombo em pomar comercial, durante o período de 2001/2002, em Londrina, Estado do Paraná. O período de desenvolvimento das lagartas alimentadas com 'Giombo' foi maior (17,8 ± 0,17 dias) em relação às alimentadas com 'Atago' (15,8 ± 0,27 dias). Entretanto, a duração do estágio de pupa de insetos criados em 'Giombo' foi menor (12,0 ± 0,29 dias) do que as criadas em 'Atago' (13,3 ± 0,17 dias). As viabilidades das lagartas foram 60,8 e 38,8% para insetos alimentados em 'Giombo' e 'Atago', respectivamente. A viabilidade das pupas, no entanto, não foi influenciada pela cultivar; atingindo 93% em ambos os casos. Os períodos de preoviposição e incubação de lagartas alimentadas com 'Atago' foram 4,0 dias e 2,1 dias, respectivamente. A fecundidade foi de 524,7 ovos com viabilidade de 77% e a longevidade dos adultos foi de 12,9 dias. Não foram obtidas posturas de *H. andremona* criadas em laboratório sobre 'Giombo'. As mariposas de *H. andremona* preferiram ovipositar em folhas situadas na metade superior da copa do caquizeiro.

Palavras-chave: *Diospyrus* sp., biologia, preferência de oviposicão.

Introduction

Hypocala andremona (Cramer) (Lepidoptera: Noctuidae) infestations can result in economic losses to the persimmon, *Diospyrus kaki* L. This species has been reported from the neotropics (AMANTE, 1965; GALLO et al., 2002) up as far as Maine in the USA and Ontario in Canada (FORBES, 1954; HOLLAND, 1968 apud HALLMAN; KNIGHT JR., 1993). In Brazil, this insect is considered a key pest of persimmon and probably occurs in all regions where this fruit species is cultivated, predominantly in the southeastern and southern regions.

Although *H. andremona* larvae may cause significant leaf defoliation, the most severe injuries occur when the insect attacks the floral structures and fruits. Damage in floral buds may lead to their abortion and in fruits causes direct (fruit drop) and esthetic losses (GALLO et al., 2002; HALLMAN; KNIGHT JR., 1993; MARTINS; PEREIRA, 1989).

Information on the biology of *H. andremona* is rare and is restricted to the works conducted by Hallman and Knight Jr. (1993), using one accession of *D. kaki*, in the USA, and that of Bavaresco et al. (2005) using the cultivar Fuyu, in Brazil. As cultivar characteristics may differently affect insect life-history parameters, it is important to determine whether the biology of *H. andremona* is influenced when reared on different cultivars.

In the present work, we study *H. andremona* development in two persimmon cultivars, Giombo and Atago, and egg distribution on the persimmon trees of the cultivar Giombo, as a way to contribute for the development of an environmentally sound management program for this insect.

Material and methods

The biology of *Hypocala andremona* on the cultivars Giombo and Atago was determined in the Laboratório de Entomologia of the the Instituto Agronômico do Paraná - IAPAR, Londrina, Paraná State (27 ± 1ºC, 65 ± 10% RH, 14h photofase). 'Giombo' is commercially cultivated in the State of Paraná and Atago is a cultivar that is part of IAPAR's germplasm collection. The study was started with larvae whose parental generation developed on persimmon plants (cultivar Giombo) cultivated in the IAPAR Experimental Station, in Londrina until adulthood.

Soon after the eggs hatched, 135 and 74 neonate larvae were individually placed inside transparent plastic cages (7.0 x 3.5 cm) and fed with leaves, which were replaced daily, of the cultivars Atago or Giombo, respectively, until they pupated. The pupae were then sexed and transferred to clean plastic cages (as described above) containing moistened filter paper, and weighed the following day.

The study started on two different dates, i.e., within a 6-day period interval due to insufficient number of individuals. However, the methodology and environmental conditions were identical in both cases. Observations were made daily to determine larval and pupal developmental period, their viability and sex ratio (females/males + females). As the adults emerged, two males and one female were maintained inside transparent plastic cylinders (30 x 14 cm) (n = 17), having persimmon tree branches as egg laying substrate, and a 10% honey solution as food. Soon after oviposition, the eggs were placed on moistened filter paper inside petri dishes, where they remained until larval eclosion. The reproductive parameters evaluated were preoviposition and incubation periods, fecundity, egg viability and adult longevity. Only moths whose larvae were reared on 'Atago' laid eggs.

In order to more efficiently monitor *H. andremona* and to apply control measures, the most preferred persimmon plant stratum for oviposition was determined. To accomplish this, two branches, one from the upper half and another from the lower half from an individual plant, in ten plants, cv. Giombo, were randomly collected biweekly in a commercial orchard in Londrina, Paraná State, from November 2001 to January 2002. In laboratory, the leaves were detached from the branches and the eggs counted.

The data were analyzed either using Student's t-test (development and pupae weight) or chi-square test (viability and sex ratio).

Results and discussion

The duration of the six *H. andremona* larval and pupal stages, as well as larval viability, were significantly influenced by cultivar. Larvae fed on 'Atago' developed faster than larvae fed on 'Giombo' (t-test = 5.92, n = 73, $p < 0.01$) (Table 1). Larvae in this study developed faster compared to a 22.3 and 23.3-day period (male/female) on 'Fuyu' (BAVARESCO et al., 2005) and to a 30-day period on an accession of *D. kaki* (HALLMAN; KNIGHT, 1993). In contrast, the duration of the pupal stage was shorter when the insects were reared on 'Giombo' (t-test = 3.90, n = 66, $p < 0.01$) (Table 1). The duration of the pupal stage period was in agreement with that reported by Bavaresco et al. (2005) and Hallman and Knight Jr. (1993). The viability of the larvae fed on 'Giombo' was higher than that of larvae fed on 'Atago' ($\chi^2_{[1]} = 9.49$, $p < 0.005$, n = 190) (Table 1). Pupal viability was similar between treatments. Hallman and Knight Jr. (1993) reported 41 and 100% of viability for larvae, reared on an accession of *D. kaki,* and pupae respectively, whereas Bavaresco et al. (2005) reported 23.5 and 87.2%, respectively for insects reared on 'Fuyu'.

Table 1. Duration (days) and viability (%) of larvae and pupae, pupal weight (mg) and sex ratio of *H. andremona* reared on two persimmon cultivar leaves. Londrina, Paraná State. (27 ± 1ºC, 65 ± 10% RH, 14h photofase).

	Larvae		Pupae			
Cultivar	Duration[1]	Viability[2]	Duration[1]	Viability[2]	Weight[1]	Sex Ratio[2]
Giombo	17.8 ± 0.17 a	60.8a	12.0 ± 0.29 a	93[ns]	484.0 ± 15.10[ns]	0.45[ns]
Atago	15.8 ± 0.27 b	38.8 b	13.3 ± 0.17 b	93[ns]	464.0 ± 15.08[ns]	0.53[ns]

Means followed by different letters in the column differ by Student's t-test ($p < 0.01$) [1] or by the chi-square test[2].

There was no significant effect of the cultivar on pupal weight (*t*-test = 1.74, n = 80, p > 0.05) (Table 1). Pupal weight of larvae raised on 'Giombo' or 'Atago' was ca. 30% higher in comparison with that of insects reared either on 'Fuyu' (BAVARESCO et al., 2005) or on a *D. kaki* accession (HALLMAN; KNIGHT JR., 1993).

The preoviposition and incubation periods of larvae raised on 'Atago' were 4.0 ± 0.64 days and 2.1 ± 0.04 days, respectively; the fecundity were 524.7 ± 108.91 eggs and the viability of the eggs 77%. Adult longevity was approximately 12.9 ± 0.67 days. Except for fecundity, which was lower (410.1 ± 49.47 eggs) for insects raised on 'Fuyu' (BAVARESCO et al., 2005) compared to those reared on 'Atago', the remaining parameters were similar between these two persimmon cultivars. No eggs were obtained from *H. andremona* moths whose larvae were reared on 'Giombo' leaves in laboratory. Apparently, there was no reason for this type of behavior to happen, since the larvae used to start the study were collected on 'Giombo' leaves in the field. Moreover, there were no methodological differences in the way the insects from broth groups ('Giombo' or 'Atago') were reared.

Hypocala andremona adults preferred to lay their eggs on leaves located at the top of the persimmon tree canopy. Seventy three percent of the 536 eggs collected during the 2001/2002-crop season on 'Giombo' were laid on the higher plant stratum. This result is an indicative that the top of the plant is the most favorable plant stratum to efficiently detect early insect infestation and consequently to apply control measures.

Although the literature has reported *H. andremona* damage in floral buds and in fruits (GALLO et al., 2002; HALLMAN; KNIGHT JR., 1993; MARTINS; PEREIRA, 1989), no injury was found on the reproductive structures in the current study.

The differences in biological parameters between *H. andremona* reared on 'Giombo' or 'Atago' are solely due to cultivar differences, since the two groups of larvae were reared under identical environmental conditions. However, the differences in biological attributes, when comparisons are made between insects reared on the cultivars Giombo or Atago and those reared on Fuyu (BAVARESCO et al., 2005) or on *D. kaki* accession (HALLMAN; KNIGHT, 1993) may have resulted from both, cultivars and environmental conditions, which were different. The longer larval developmental stage for larvae fed on Fuyu (BAVARESCO et al., 2005) and on *D. kaki* accession (HALLMAN; KNIGHT JR., 1993) probably resulted from the temperature differences, which were 1°C and 3°C lower than those used in the current study.

Conclusion

Developmental time of larvae and pupae, and pupal viability and weight are similar between the cultivars Atago and Giombo; larval viability on 'Giombo' is higher than that on 'Atago'.

Hypocala andremona lays the majority of their eggs on the upper stratum of the persimmon plant canopy.

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