The lesser cotton leafworm, *Anomis impasta* (Guenée) (Lepidoptera, Noctuidae), in cotton

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ABSTRACT. The lesser cotton leafworm, *Anomis impasta* (Guenée) (Lepidoptera, Noctuidae) in cotton. *Anomis impasta* (Guenée) is a species that shows remarkable morphological and behavioral similarities with the cotton leafworm *Alabama argillacea* (Hübner). During two growing cotton seasons, *A. impasta* was observed feeding on leaves and flower bracts of cotton and monitored. Furthermore, a study was conducted under laboratory conditions to generate biological information about this species with larvae feeding cotton squares and leaves. Larvae fed on cotton squares exhibited delayed development (18.5 ± 0.18 days) and lower pupal weight (140.8 ± 2.26 mg) compared to larvae fed on cotton leaves (14.0 ± 0.07 days and 169.3 ± 2.06 mg). Thus, one generation cycle of *A. impasta* was obtained by feeding the larvae with cotton leaves. The mean (minimum-maximum) values for the duration of eggs, larvae and pupae were: 3.0 (3–4), 14.8 (14–18), and 9.7 (7–14) days, respectively. The viability of the eggs, larvae, and pupae were 43.7, 98.3, and 94.7%, respectively. Females lived on average 25.2 days (ranging from 15 to 37 days) and produced 869 eggs (from 4 to 1,866 eggs). The successful development and reproduction of *A. impasta* on cotton, especially, on the cotton leaves, suggest the potential of this species to reach a pest status in cotton. The similarities with *A. argillacea*, as discussed in this study, can be one of the reasons for low reference to *A. impasta* in the field. Therefore, the information provided here will allow researchers and growers to distinguish these two cotton defoliators.

KEYWORDS. Biology; cotton pest; intercropping; Noctuidae.

RESUMO. O curuquerê, *Anomis impasta* (Guenée) (Lepidoptera, Noctuidae) em algodoeiro. *Anomis impasta* (Guenée) é uma espécie que apresenta morfologia e comportamento muito similar ao curuquerê-do-algodoeiro, *Alabama argillacea* (Hübner). Durante duas safras de algodão, foi monitorada a alimentação de *A. impasta* em folhas e brácteas da cultura. Assim, este estudo foi conduzido para gerar informações biológicas sobre a espécie. As larvas foram criadas em folhas de algodão e botões florais (brácteas + botão floral), partes em que as lagartas foram comumente encontradas em campo. Larvas criadas com botão floral apresentaram maior período larval (18,5 ± 0,18 dias) e menor peso pupal (140,8 ± 2,26 mg) em comparação às larvas criadas apenas com folhas (14,0 ± 0,07 dias e 169,3 ± 2,06 mg). Assim, uma geração de *A. impasta* foi obtida alimentando-se as larvas com folhas de algodão. A média (variação) de duração para a fase de ovo, larva e pupa foi de 3,0 (3 a 4), 14,8 (14 a 18) e 9,7 (7 a 14) dias, respectivamente. A viabilidade para ovos, larva e pupa foi de 43,7; 98,3 e 94,7%, respectivamente. As fêmeas viveram em média 25,2 dias (15 a 37) e produziram 869 ovos (4 a 1866). O desenvolvimento e reprodução de *A. impasta* em algodoeiro, em especial quando as lagartas desenvolvem-se sobre folhas, fornecem indícios do seu potencial em atingir condição de praga na cultura. A semelhança com a espécie *A. argillacea*, como apresentado neste estudo, pode ser uma das razões de sua baixa constatação de *A. impasta* em campo. Portanto, acredita-se que as informações geradas com este estudo auxiliem pesquisadores e produtores na identificação dessas duas espécies desfolhadoras do algodoeiro.

PALAVRAS-CHAVE. Biologia; Noctuidae; policultivo; pragas do algodoeiro.

Regardless of the cropping systems, local conditions, and the cultivated variety, cotton plants can be infested by several insect and mite species. Among the defoliator insects, the American cotton leafworm, *Alabama argillacea* (Hübner) (Lepidoptera, Noctuidae), is of common occurrence across all cotton growing areas in Brazil. Recently, *Anomis impasta* (Guenée) (= *Anomis doctorium*), has been collected in experimental cotton fields localized in Remigio (PB), Paudalho and Surubim (PE), and in grower areas placed at Frei Miguelinho (PE). This noctuid species is remarkably similar to *A. argillacea* concerning the egg morphology, early larval instars, pupal stage and feeding behavior. The only published record of the occurrence of *A. impasta* in Brazil was made by Guenée using specimens from Bonito, Pernambuco (Dyar 1913). Given the resemblance, both morphological and behavioral, with a common and well known cotton pest, *A. argillacea*, the occurrence of *A. impasta* in our cotton fields, at least in the Semiarid region, might have been masked. In fact, Lima (1949) already mentioned the similarity of *Anomis texana* (Riley) with *A. argillacea*, and that the former species was an important pest of cotton in Peru.

Cotton has moved considerably across Brazil over the past two decades. Large areas of cotton were located in the Arid and Semiarid regions of the Northeast until 1980's. During

the mid 1980's, the crop moved from those areas to the meridional part of Brazil, concentrating on Paraná and São Paulo States. In the late 1990's, large areas of cotton were established in the Cerrado's biome spreading out around the West, Central and Northeast regions of Brazil, stretching out, later on, toward the Northwest and North regions areas (Fontes *et al.* 2006; Freire 2007). This change in the distribution of the cotton growing areas has exposed the crop to a diversified arthropod fauna (Torres 2008). In addition to the usual herbivores commonly associated with the crop, new species of insects have been reported damaging cotton. The adoption of new varieties and cropping systems such as non-tillage and doubling cropping, the cultivation of large areas next to other major crops, and the intensive use of pesticides, can be cited as the possible causes for secondary pests outbreaks, and may account for the emergence of new cotton pests (Diez-Rodriguez & Omoto 2001; Torres 2008; Nagoshi 2009; Barros *et al.* 2010a; b).

Despite the tendency of increasing areas cultivated with cotton within Brazil, the semiarid region has been reducing the cultivation of cotton over the past decades. In addition, it seems that the way of cultivating cotton has not changed much over the years, mainly while comparing these areas with those grown in the Cerrado's Biome. In the Semiarid of Northeast, cotton is cultivated by small growers, where the predominant techniques adopted are extractives, *e.g.*, very limited inputs are used for fertilization or pest management purposes (Barros & Torres 2010). Therefore, studies on the entomofauna of cotton in the Semiarid of northeast Brazil are scarce. Considering the recent past, only species of mealybugs have been reported to cause loss in cotton production in the Semiarid that was not common in the previous pest records (Bastos *et al*. 2007; Torres *et al.* 2011). Lately, this species has been also reported in the Cerrado's areas of Bahia, Goiás, and Mato Grosso (J. B. Torres), major areas of cotton production in Brazil.

The genus *Anomis* comprehends 201 species and subspecies (Zipecodezoo 2010) with several species using Malvaceae (*e.g.* cotton and okra) and Solanaceae (*e.g.* tomato) as hosts (CABI 2010). *Anomis flava* (Fabr.) and *Anomis fulvida* Guenée have been reported as pest of cotton in Australia, Philippines, India, and Madagascar (Bishop *et al*. 1978; Ferino *et al*. 1981; Kuklinski 2000), while *Anomis texana* (Riley) is a pest of cotton in various countries of the American continent including Chile, Guatemala, Mexico, Peru, and United States (Lima 1949). Lima (1949) while describing *A. argillacea* stressed the high degree of similarities found between *A. texana* and *A. argillacea* and stated that *A. texana* is an important pest of cotton in Peru. According to Deutscher *et al.* (1999), unsprayed cotton fields in Australia have as much as 80% of defoliation under infestation of *A. flava*. However, infestations are uncommon in fields where sprays are applied to control bollworms. Furthermore, *Anomis sabulifera* (Guenée) has been an important pest of jute in India, requiring intensive control efforts (Tripathi & Ram 1972; Hat & Basak 2000; Yadav 2010). In Brazil, *Anomis illita* Guenée was cited occurring in Itaperuna, RJ, feeding upon *Urena lobata* (Malvaceae) (Lima 1949).

Considering the lack of information on *A. impasta* and the potential problems that may arise from the attack and misidentification of this insect in cotton plants, this study aimed to report the dynamics of *A. impasta* infesting cotton from a Semiarid area of Brazil. In addition, this contribution also aims to generate data on the biology of this species feeding on cotton.

MATERIAL AND METHODS

Field description and sampling procedure. The occurrence of *A. impasta* was noticed during two cotton seasons, 2008 and 2009, in field plots set up in Remigio, PB, 08°01'46.5"S and 34°57'28.7"W. The occurrence and population densities of the species were verified and monitored simultaneously to an experiment in which the influence of intercropping local crops including cotton (*Gossypium hirsutum* cv. BRS Rubi), cowpea (*Vigna unguiculata* L. (Walp.)), corn (*Zea mays* L.), peanut (*Arachis hypogaea* L.), and sesame (*Sesamum indicum* L.) was under investigation. The planting dates were the 10th and 30th May in 2008 and 2009, respectively. The experiment was set up as a randomized block design with four plots (replications) and three treatments: cotton cultivated in monoculture (i); local grower design consisting of cotton cultivated intercropped with cowpea and corn (ii); and a system consisting of cotton intercropped with sesame and peanut (iii). The intercropping system adopted consisted of three different crops cultivated simultaneously. The intercropping design adopted was that used by local growers, which consisted of three lines of each crop. Each experimental plot consisted of 18 crop lines with six lines for each crop species. Each line was 16m long. Three lines of sorghum surrounded the whole experimental field as a way to separate/isolate each experimental plot. Besides randomizing the plots within the whole experimental area, the group of three lines of each plant species was also randomized within the each plot. The row and within row spacing adopted followed the local growers' practice: cotton (1.1x0.4 m), corn (1.0x1.0 m), sesame (0.8x0.8 m), cowpea and peanut (0.5x0.5 m). Thinning and weed control were carried out by hand. No external inputs were adopted such as pesticides or fertilizers.

A. impasta was sampled by randomly inspecting 10 cotton plants per plot. For each plant, the whole plant was inspected for larvae and pre-pupae. Since only the larvae and pre-pupae could be safely differentiated in the field, we did not use eggs and pupae in this study. Neonate larvae, when not clearly separated apart from *A. argillacea* in the field, were collected and reared up to the second or third instar allowing a correct identification. Samplings were carried out at 10 to 12 days intervals, from June 25 to October 11 in 2008 and from June 12 to October 16 in 2009, with 10 sampling dates. The total number of larvae found in a cotton plant was averaged from the 10 plants evaluated per plot on

each sampling date to produce the mean value of replication (plot) per treatment. In addition to the species occurrence report, the abundance of *A. impasta* larvae per treatment was submitted to one-way repeated measure analysis of variance, using the sampling dates within plots as the repeated measures (*between subjects*) and the treatments and abundance over time as the factors under analysis (*within subjects*). These analyses were carried out using PROC MIXED of SAS (SAS Institute 2001).

Development of *A. impasta* fed with cotton squares or leaves. A colony of *A. impasta* was set up at the Biological Control Laboratory of the Universidade Federal Rural de Pernambuco (UFRPE) from larvae and pupae collected in cotton fields cultivated with the variety BRS Rubi and in the experimental plots, both located in Remigio, PB, Brazil (08°01'46.5"S and 34°57'28.7"W).

The insects were kept at 26 ± 2°C, 60–80% relative humidity, and 12 h photophase following the methods used to rear de American cotton leafworm, *A. argillacea.* Briefly, larvae were reared up to pupal stage, and then they were dislodged from the leaves and transferred to adult cages. Adult cage consisted of a cylindrical PVC tube (17cm width and 22 cm tall), placed over a plastic plate of 20cm diameter lined with paper towel. The top of the cages was closed with organdie fabric fixed with an elastic ribbon. Adults were fed with 10% honey solutions (honey: water) applied to moistened cotton pads inserted inside plastic caps and placed in the bottom of the cages. Cotton terminals were offered as egg laying substrate. Cotton terminals were cut from the plant, placed in water, and cut again to prevent cavitations. Each stem was placed into a 100 mL water filled vial. To maintain the stock colony, eggs laid on the plant terminals were collected together with the whole structure every day, when the terminals were also replaced for a new one. To set up the biological observations, plant terminals were offered in the evening and replaced in the morning. This guarantees that the eggs used in the experiment were less than 12h-old. Thereafter, leaves containing the eggs were transferred to Petri dishes until larval emergence. The Petri dishes containing the eggs were stored in climatic chamber regulated to 25°C and 12h of photophase. The study was initiated with eggs of the third generation of the colony in the laboratory. Newly hatched larvae were fed fresh cotton leaves harvested from cotton variety Acala 90.

During field sampling procedures, young larvae were observed while feeding on cotton leaves. Large larvae and pre-pupae were located between bracts and flowers or boll and damaged both flower bracts and bolls. Based on these field observations, two treatments were set up: larvae feeding on whole flower square (bracts and bud); and larvae feeding only on fully expanded leaves from the plant terminals. The cotton variety used was Acala 90.

The performance of *A. impasta* larvae feeding on squares and expanded cotton leaves from plant terminals was evaluated based on the duration and survival of larval and pupal stages and the weight of 24h-old pupae. To obtain these parameters, newly hatched larvae (< 12h-old) were transferred to plastic containers of 80mL-volume (Cral Artigos para Laboratório Ltda). Tiny perforations were made throughout the container caps using a no. 1 entomological pin to allow ventilation inside the containers. The observations initiated with 90 neonate larvae per treatment. A rate of three larvae per rearing containers was maintained during the first three days of the larval stage. Each container represented a replication. After three days, the food was replaced and the surviving larvae were individually reared. Observations on the development and survival were daily performed together with food replacement and cage cleaning operations. Developmental times and survival of larvae and pupae, and weight of pupae were tested for normality (Kolmogorov D: normal test) and homogeneity of variance (Bartlett's test), and square root (x + 0.5) or arsine square root (survival/100) transformed every time the data failed to fulfill one of the ANOVA's assumptions. However, untransformed means are presented. One-way analysis of variance (ANOVA) was performed using the PROC GLM of SAS (SAS Institute 2001), and the results from the F-test were used to infer about the means of treatments.

Development and reproduction of *A. impasta*. Based on previous experimental results, the best performance of the larva and pupa of *A. impasta* was obtained with the larvae feeding on cotton leaves. Thus, this part of the study aimed at evaluating the development and reproduction of *A. impasta* while feeding on cotton leaves of the variety Acala 90.

Cotton leaves were overnight exposed to the moths as an egg laying site. Then, leaves containing eggs less than 12h-old were cut into pieces containing three eggs each. Forty replications consisting of three eggs each were monitored. The pieces of leaves containing the eggs were stored in plastic containers of 80mL with finely perforated lids to allow ventilation inside the containers. The containers holding the eggs were maintained in climatic chamber regulated to 25 ± 1°C, 12h of photophase and relative humidity varying from 60 to 70% until the emergence of the larvae. After larval emergence, 60 larvae were individually reared per container to evaluate the developmental period and survival. The food offered to the larvae was pieces of cotton leaves picked from the upper portion of cotton plants of the variety Acala 90. Food replacement took place at daily intervals starting with larval emergence and extending until pupation. During diet's replacement the containers were cleaned, eliminating feces and remaining pieces of food. The presence of head capsule was used to determine the day of the molt, and later to determine the number of instars that the larvae went through. Some larvae were reared separately under the same conditions to allow registration of the larval stages through measurements and pictures. Measurements were made using a micrometer scale (0.01 mm), attached to the ocular of a light microscope (10–40, Motic™, São Paulo, Brazil).

By recording the day of pupation, it was possible to determine the duration of each larval instar and the viability of the each instar. The body size of pupae based on their weight

was taken on 24h-old pupa. The pupae were reared in the same rearing containers of the larvae until adult's emergence. Two days prior to adult's emergence, one male and one female pupae were transferred to adult rearing cages that consisted of PVC tubes of 10cm diameter and 17cm tall. Twenty adults (= replications) were monitored daily to evaluate egg production and longevity of females. Cotton pads moistened in 10% honey solution (honey: water) fixed inside plastic caps were placed in the bottom of the cages for adults feeding. To enhance oviposition and to facilitate egg counting, young cotton leaves were harvested, had its petiole inside vials containing water, and offered as substrate for the female to lay eggs. Cotton leaves were replaced daily and the cages also had the wall inspected for eggs. After counting the eggs laid on the cotton leaves using a bench 10x-magnification lent, the cotton leaves containing the eggs were maintained in Petri dishes sealed with PVC film until larva emergence. Egg viability was determined based on the number of hatching larvae. Further, the age of first oviposition, period of egg production and female longevity were also determined. The female adult size based on wingspan (the largest distance between the two wings ends) was also taken from those females that exhibited no damage on the wings at day of death (n = 7 males and 6 females). The data were then averaged and presented with minimum and maximum value range.

RESULTS AND DISCUSSION

Occurrence of *A. impasta* in cotton. The lesser cotton leafworm, *A. impasta*, was present in all three experimental locations during the two years of study. The distances from these experimental locations (Paudalho and Surubim, PE; and Remigio, PB) to the grower field in Frei Miguelinho, PE, varied from 126 to 230Km.

Intercropping cotton with any of the tested crops did not shape the infestation of *A. impasta* larvae in cotton during the seasons of 2008 ($F_{2, 18} = 2.11$, $P = 0.2023$) and 2009 ($F_{2, 18} = 1.00$, $P = 0.4210$) (Fig. 1). The seasonal means of *A. impasta* larvae per cotton plant across the 10 sampling dates in 2008 were 0.56 ± 0.09, 0.34 ± 0.06 and 0.41 ± 0.05 for cotton monoculture, cotton intercropped with cowpea and corn, and cotton intercropped with peanut and sesame, respectively. The density of larvae per plant in 2009 was quite similar to the density found in the previous year: 0.46 ± 0.08, 0.52 ± 0.08, and 0.47 ± 0.08 larvae per plant of cotton monoculture, cotton intercropped with cowpea and corn, and cotton intercropped with peanut, respectively. The average number of larvae per plant, however, varied throughout the cotton growing season of 2008 ($F_{9, 27} = 13.43$, $P < 0.0001$) and 2009 ($F_{9, 27} = 23.60$, $P < 0.0001$). During 2008, the highest densities of larvae per cotton plant were found in the evaluations carried out on September 3 and 13. In 2009, the greatest densities of larvae per plant were found in the evaluations made at July 20 and August 2 (Fig. 1). Although the high occurrence of larvae took place during mid-late season over a100 days-old crop, larvae of *A. impasta* was found earlier (second and first evaluations of 2008 and 2009, respectively), when the crop was around 30-days old. In 2008 and 2009, the mean densities were over 1.0 and 1.5 larvae per plant, during the periods of higher occurrence. Despite the observed infestation, severe plant defoliation was not observed. According to Ferino (1981), 5 to 6 mature larvae of *A. flava* per plant were required to cause defoliation of approximately 60%. These authors also reported that *A. flava* larvae were heavily parasitized and preyed upon in the field, which probably occurred in our fields considering that no pesticides were used at any time and the high diversity of predators observed (data not showed here).

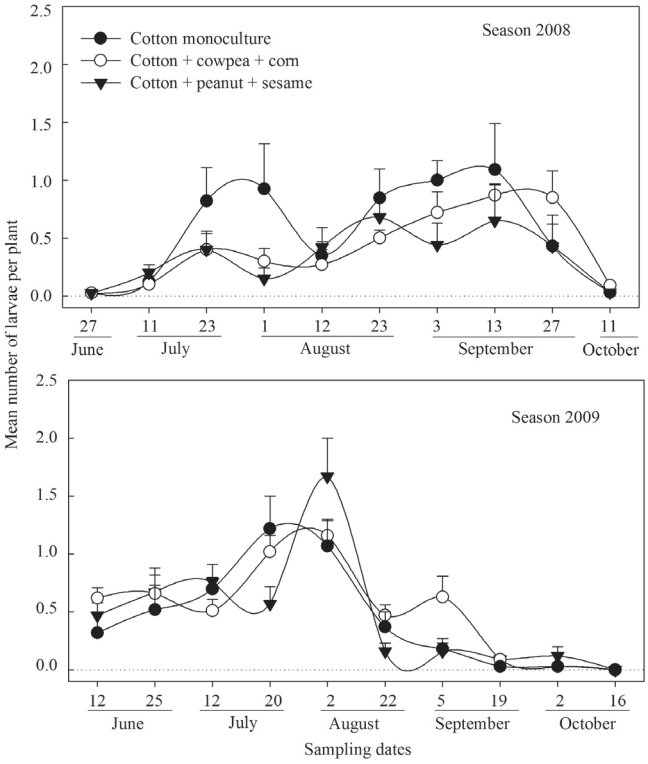

Fig. 1. Seasonal means (+SE) of *Anomis impasta* larvae per plant of cotton (variety BRS Rubi). Remigio, PB. Seasons 2008 and 2009.

Eggs and neonate larvae of *A. impasta* were treated as *A. argillacea* at beginning of this study, since these two species share similar characteristics at these stages (Fig. 2). However, later instar larvae of *A. impasta* exhibited behavior of lodging in the fruiting structures between the bracts and the flower squares, flowers and bolls. At that stage, *A. argillacea* stays predominantly on the leaves scattered throughout the plant canopy. In addition, the morphology is notably different from *A. argillacea* for older larvae.

Development of *A. impasta* fed cotton squares or leaves. Larvae of *A. impasta* fed with cotton squares (bracts + buds) delayed development on average for 4.5 days (18.5 ± 0.18 days) compared to larvae fed with cotton leaves (14.0 ± 0.07 days) ($F_{1, 70} = 719.20$, $P < 0.0001$). Furthermore, larvae fed

with cotton leaves produced larger pupae (169.3 ± 2.06 mg) compared to pupae originated from larvae fed with flower squares (140.8 ± 2.26 mg) ($F_{1, 70} = 65.03$, $P < 0.0001$). In fact, larvae did not injure flower squares, where only scars were observed. The larvae fed mostly on the flower bracts when offered only flower squares and bracts.

Development and reproduction of *A. impasta*. The eggs of *A. impasta* are light blue-green when first laid, becoming brownish-yellow close to hatching. The eggs are almost spherical with a slightly flattened top with an average of 0.69 mm in diameter (n = 15 eggs) (Fig. 2). Like most noctuids, the egg has a series of ridges projected upwards, hardly noticeable at the top near the micropyle (Torres & Ruberson 2006). In the field, the eggs are laid individually, scattered over the plant leaves, bracts and pinhead structures. Under laboratory conditions (on rearing cages) cluster of eggs were observed, especially on the pinhead structures.

Larvae of first, second and third instars are slender and with greenish-yellow coloration (Fig. 2). They feed by scraping the leaves of the plant terminals and bracts, similarly to the common American cotton leafworm. As the third and fourth instar larvae increase in size, and start to have dark spots at the

Fig. 2. Developmental stages of *Anomis impasta* – eggs, first (I) and second instar larva (II). Green (V.a), reddish-purple (V.b), and dark fifth instar larvae (V.c); green (VI.a) and reddish-purple (VI.b) sixth instar prepupa larvae. Pupa and adult female (J.B. Torres). Tips of entomological pin no. 000 indicate size of eggs, first and second instar larvae.

base of the setae. These spots form two rows of setae on the dorsum with two pairs of setae per body segment. The spots are more evident in fourth instar larvae and also in fifth instar larvae from green populations. Coloration of the larvae might change dramatically, from fifth to sixth instar (Fig. 2). Larvae in the fifth instar can be differentiated into two populations with predominance of green or black coloration in the dorsum as observed for several species of noctuids. In our study, all fifth instar larvae observed in the field were green-colored. However, under laboratory conditions, color changed to dark-brown in the dorsum at fifth instar and reddish-purple at sixth instar (Fig. 2). In this laboratory study, only 29.8% of the larvae (17 out of 57 larvae) retained the green coloration in the fifth instar, while the remaining larvae changed color to dark-brown or reddish-purple. Furthermore, 100% of those larvae molting within a sixth instar exhibited the reddish-purple coloration, similar to all prepupae found out in the field. Despite the color, both green and dark-brown fifth and sixth instar larvae exhibited a characteristic pattern of inverted white bands around the setae (Fig. 2 V.a to VI.a). There are several hypotheses related to the polymorphism variation in noctuid larvae (Applebaum & Heifetz 1999). The density-dependent phase, in which individuals reared at high densities become heavily melanized during the later larval instars, is one hypothesis commonly reported. The high-density phase is also associated with differences in behavior and developmental time (Simmonds & Blaney 1986). Larvae reared in isolation typically exhibit green coloration. This might explains the predominance of the green population of *A. impasta* surveyed in the field, while they were predominantly dark in crowded rearing laboratory conditions. Additional hypotheses also suggests that individuals reared solitarily might have melanized cuticles and might be related to hormonal activities as sex pheromone production (Matsumoto *et al*. 1990), diet (Fescemyer & Erlandson 1993), defense against parasitism (Kunimi & Yamada 1990), and diseases (Wilson *et al.* 2001). Diet affects the degree of dark body color of gregarious *Anticarsia gemmatalis* Hübner larvae, but it does not influence green coloration in solitarious individuals (Fescemyer & Erlandson 1993). Therefore, several hypotheses substantiate the polymorphism observed in the noctuid larvae. However, the double polymorphism exhibited by *A. impasta* mature larvae (Fig. 2 V–VI) that includes changes from green to dark and green to reddish-purple is uncommon and should be explored for an explanation.

The larvae grow, on average, from 3mm to 24mm from first to the sixth instar. A gain of about 5.67 mm is obtained just from the fifth to the sixth instar (Table I). The pupa of *A. impasta* is quite similar to that of *A. argillacea* (Fig. 2). They are found in sparse cocoon between bracts and bolls or in curled up leaves. There was no statistical difference in size between male and female pupae (Table I). Adult males and females are also of similar size with wingspan ranging from 30 to 34 mm (Table I). Adult forewings are pale whitish brown to darker pale with one pair of darker spots sparse on each wing (Fig. 2). Hind wings are light pale with white borders.

The complete life cycle of *A. impasta* fed cotton leaves of the variety Acala 90 comprised an average of 27.5 days (95% confidence interval ranging from 26 to 31 days) (Table II). Larval development occurred predominantly through five instars, but 30% of the larvae exhibited an extra sixth instar under rearing conditions. The larval viability was 98.3%. The average weight of 24h-old pupae was 189.3mg (ranging from 164.1 to 221.8 mg) for female pupae and 188.3mg (ranging from 128.4 to 215.9 mg) for male pupae. The adult emergence was 94.7% with 53% of female adults. Female adults lived on average 25.2 days (from 15 to 37 days).

Table II. Mean duration (minimum-maximum) of the developmental stages of *Anomis impasta* fed with cotton leaves of the variety Acala 90. Temp.: 25 ± 1°C, photophase 12h, and R.H. of 65–80%.

Eggs	Larvae / instars						Pupae	Egg to adult
	I	II	III	IV	V	VI		
3.0 (3–4)	3.1 (3–4)	1.3 (1–2)	2.6 (2–3)	2.1 (2–3)	2.1 (2–3)	5.0 (2–6)	9.7 (7–14)	27.5 (26–31)

From the 20 paired females used to evaluate adult survival and reproduction, three females did not lay eggs. From the remaining 17 females, seven females did not produce viable eggs. Considering all females monitored, it was yielded an average of 577.2 eggs per female (from 0 to 1,866 eggs) with 25.7% of the eggs hatching (from 0 to 78.8%). The average egg production among the females laying viable eggs (n = 10 females) was 869 eggs per female (from 4 to 1,866 eggs) with 43.7% of egg hatching (from 3.2 to 78.8%). This large variability in egg production and egg viability, including females not laying eggs, can be a result of the various factors that the insects are subjected when brought from the wild to controlled conditions, including food quality, rearing techniques and laboratory conditions. Besides the record made by Dyar (1913) for *A. impasta* in Brazil, no data is available for this species regarding its distribution, behavioral traits, development, or reproduction. Thus, our study provides the first data reported for this species. We hope that this would provide the bases for further studies. In addition,

Table I. Mean size (mm) (minimum-maximum) of *Anomis impasta* developmental stages fed with cotton leaves of the variety Acala 90. Temp.: 25 ± 1°C, photophase 12 h, and R.H. of 65-80%.

Eggs	Larvae						Pupae		Adults	
	I	II	III	IV	V	VI	Female	Male	Female	Male
0.69 (0.65–0.75)	3.53 (3–4)	4.77 (4.5–5)	7.64 (7–8)	9.50 (8.5–11)	16.50 (15–19)	22.17 (20–24)	14.8 (14–16)	15.1 (14–17)	32.7 (32–34)	32.8 (30–34)

information about co-specific species, such as *A. flava* and *A. texana,* is scarce, even when they happen to be of economic importance as it is the case for the two previously mentioned, which gives extra relevance to our findings.

Based on the lack of data for *A. impasta* in Brazil, two hypotheses can be raised: First, *A. impasta* has sporadic occurrence due to the close host range to cotton, in which cultivated area has reduced significantly in the Semiarid. The monophagy condition is a reasonable explanation considering that most species of the group feed on malvaceous plants. Second, the occurrence of the species is masked due to traits that are shared with *A. argillacea,* a more important species. Therefore, this species goes unnoticed when occurring in the cotton fields with the population been kept under control by the application of the insecticides aimed at controlling other species, as it was found in Australia for *A. flava* and bollworms (Deutscher *et al*. 1999).

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