Annals of the Entomological Society of America, 109(3), 2016, 335–342
doi: 10.1093/aesa/sav120
Advance Access Publication Date: 14 December 2015
Research article

Arthropod Biology

Study on the Biology of *Calidea* spp. (Heteroptera: Scutelleridae), an Insect Pest of *Jatropha curcas* in South-Sudanian Zone of Burkina Faso

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Received 20 August 2015; Accepted 12 November 2015

Abstract

Jatropha curcas Linné is a nonedible oleaginous plant in the family Euphorbiaceae. Its seeds provide oil for industrial use, such as biofuels, and contribute to the livelihoods of small-scale farmers in rural areas. *J. curcas* is attacked by many insect pests, including *Calidea* spp., a heteropteran pest of its fruit and flowers. This insect was surveyed from May 2013 to January 2014 in the Sissili province of southern Burkina Faso. *Calidea* spp. were collected from *J. curcas* plantations within a radius of 15 km around the Léo township and bred in the laboratory under similar conditions. The mean ratio of fertility was 20.3% and the mean fecundity was 132 eggs. The biological cycle of the insect is composed of one egg stadium, five larval instars, and one adult stadium. Egg incubation took 6.2–8.3 d, and the five larval instars lasted between 27.1 and 30.1 d. The average life span of *Calidea* spp. adults was 114.6 d for females and 98.1 d for males. The female had an average size of 17.6 mm against 16.6 mm for the male. These findings are the first reported on this insect pest in Burkina Faso.

Key words: biology, *Calidea*, *Jatropha curcas*, burkina faso

Jatropha curcas Linné is a nonedible and perennial oleaginous plant of the family Euphorbiaceae, 3–5 m in height (Henning and Ramorafora 2005). The origin of *J. curcas* is in Mexico and Central America, and might have been introduced into Africa in the 16th century by Portuguese sailors, from Cape Verde and from Guinea Bissau. Then, the plant spread throughout Africa and into Asia (Domergue and Pirot 2008). The *Jatropha* genus contains ∼170 known species (Heller 1996), of which four species are known: *J. curcas*, *J. gossypiifolia* L., *J. podagrica* H., and *J. integerrima* J. (Ouédraogo 2000). However, *J. curcas* species is the most widely spread and most exploited.

Nowadays there is a promotion of *J. curcas* seeds that produce oil that can be used as biofuel. Planting *J. curcas* aims at diversifying agricultural production and at increasing the income of Burkina Faso growers, contributing to poverty alleviation in rural areas (Laude 2009). Besides its potential for production of biofuel, Jatropha also presents many other advantages, such as the increase of women's activities (production of soap), poverty reduction (marketing of by-products including seed cake and glycerine), and the promotion of forest products (using oil cakes as organic fertilizer). *J. curcas* maintains soil fertility by controlling erosion, and it reduces greenhouse gas emissions by the carbon sequestration. Nonetheless, just like most trees, *J. curcas* is exposed to attacks by many insect pests, despite its toxicity. Its oil is known to have insecticide properties (Solsoloy 1993). The most frequently observed insect pests on *J. curcas* are bugs of the *Pachycoris* (Heteroptera: Scutelleridae) group, which are widely spread in Mexico, Brazil, and Nicaragua (Grimm and Maes 1997). These bugs cause major damage to fruit, malformation of seeds, and a reduction in oil content. Madagascar locusts, lady beetles, bugs, scale insects, and caterpillars also attack *J. curcas* (Üllenberg 2008). Bugs such as *Calidea* spp. and *Nezara viridula* (L.) destroy the fruit of *J. curcas* (Heller 1996). Besides, their attacks can provoke the premature development of seeds and their malformation.

Calidea spp. are polyphagous insects of the Scutelleridae family (Heteroptera). They are insect pests of cotton in Tanzania and of sorghum and sunflower in South Africa (Nielsen 2010). According to the same source, it is becoming a new threat to the marketing of Jatropha in Malaysia. The insect's presence in a cotton field is often very short, and it attacks only the bolls that are not yet open (Braun 1997). *Calidea* spp. are known in *J. curcas* plantations in Guinea-Bissau where they are responsible for severe damage to seed production and the quality of the oil (Nielsen 2010). The larvae and the adults attack the fruit and flowers of *J. curcas*, by piercing the young seeds and causing the depreciation of their commercial value.

In Burkina Faso, *Calidea* spp. are reported to be one of the most frequent insect pests found in 60% of *J. curcas* plantations (Rouamba 2011). It mostly attacks inflorescences, flowers, fruit, and seeds. The attacked parts of the fruit often present reddish brown spots where females deposit eggs but seldom on the underside face of the leaf. The knowledge of the biology of these insects is necessary for the development of efficient control measures.

Materials and Methods

Breeding Site

The study of *Calidea* spp. was conducted between 1 May 2013 and 31 January 2014 at the entomology laboratory of the Fondation Fasobiocarburant in Léo in the Sissili province, in southern Burkina Faso (11° 5' N, 2° 6' W), with a mean temperature of 27°C and 66% relative humidity (RH), at an altitude of 360 masl (DPSA 2013).

It is a zone of agriculture and livestock, with woody plants such as *Mangifera indica*, *Anacardium occidentalis*, *Vitellaria paradoxa*, *Parkia biglobosa*, *J. curcas*, and *Tamarindus indica*.

One hundred-and-thirty-five pairs of *Calidea* spp., almost all of them while copulating, were collected in different *J. curcas* plantations, in the Sissili province, and allowed to breed by feeding them with *J. curcas* fruit.

The insects were kept in conditions closed to those of the surrounding environment (30°C temperature, 69% RH, and a photoperiod of 12:12 [L:D] h). The laboratory was well-ventilated thanks to large windows. At the beginning of each month, 15 couples of *Calidea* spp. were collected and bred in the laboratory under the same conditions and on the same day. Each copulating pair was put inside an empty bottle that had three thin vent holes in the lid. The material was a plastic type, same type same brand and transparent. Pairs were allowed to breed in the laboratory in a transparent plastic box of 50 by 40 cm^2, with wet cotton replaced every 2 d to keep the relative humidity high. Each box only contained a breeding pair, and it had grilled opening (15 by 10 cm^2) on each one of its sides and on its roof to allow aeration covered with muslin fabric with a very thin mesh. Cotton was soaked in water and placed at the bottom of each box to increase the moisture necessary for the development of the insect. Larvae and adults of *Calidea* spp. were fed with flowers and fruit of *J. curcas* replaced as needed. Boxes were maintained at 30°C and a photoperiod of 12:12 (L:D) h.

The parameters recorded are shown in Table 1.

Measurements were also carried out of various developmental stadia of the insect, some morphological characters of *Calidea* spp. male and female adults, including measurements of the head, pronotum, abdomen, rostrum, and antenna.

The F_1 population was maintained and fed on the same diet as their parents. Adults were counted and placed in separate breeding boxes and they were observed till they died. Twenty *Calidea* spp. of each developmental stadium were used to measure length and width of body, 20 other adults of each sex for length and width of body, head, pronotum, abdomen, rostrum and antenna, and 20 other adults of each sex were bred, but without any plant material in order to assess the life span of adults deprived of food.

When a *Calidea* spp. female deposited eggs, these were transferred to a new box to avoid having eggs being attacked by *Calidea* spp. adults (larvae and adults are cannibals of *Calidea* spp. eggs).

The mean ratio of *Calidea* spp. mortality for each developmental stadium was calculated as:

- Mean fecundity = Total number of eggs deposited by adult females / Total number of adult females

Table 1. Biological parameters recorded

Parameters recorded
Number of ovipositions per female
Time interval between the ovipositions
Total duration of ovipositions
Duration of an oviposition
The form and color of eggs
Layout of the egg masses
The various colorations of eggs before hatching
Duration of egg incubation
Number of larvae
The survival ratio of individuals of the same stadium
Number of developmental stadia
Duration of the developmental cycle
Duration of each developmental stadium
Mortality ratios
Fertility
Sex ratio
Number of copulations and time of copulation
Duration between emergence at the adult stadium and egg deposition
Life span of male and female adults
Life span of adults that are not fed
Fecundity

- Mean mortality ratio at each stadium= $\frac{\text{Number of individuals that died at each stadium}}{\text{Total number of eggs deposited}} \times 100$
- Mean female fertility = $\frac{\text{Total number of adult individuals}}{\text{Total number of eggs deposited}}$
- Sex-ratio = $\frac{\text{Total number of male individuals begotten from a couple}}{\text{Total number of female individuals begotten from a couple}}$

Statistical Analysis

The data were analyzed using Statview (SAS Institute Inc.) version. 5.0.0.0 Software. The means were separated by Fischer's protected least significant difference (PLSD) test at 5% level. The experimental arrangement was a Fischer's block of 15 applications corresponding to the *Calidea* spp. couples being bred, and 9 replications corresponding to the different months in which the breeding was implemented.

Results

Description of *Calidea* spp.

Adult Stadium

Calidea spp. is a heterometabole presenting seven developmental stadia: one egg stadium, five larval instars, and one adult stadium. The adult is iridescent green blue; its mouthpieces are of the piercing–sucking type. The female and the male present the same ornamentations and the same coloration. On average, the females are 17.6 mm long and 8.2 mm wide, whereas on average the males are 16.6 mm long and 7.3 mm wide.

The head of the adult male is conical, wide at the level of the ocellus and narrowed near the rostrum. It has two black longitudinal barrings and two large and red globulous ocelluses. The antennas with five articles are long, black, and measure on average 7.0 mm long and 0.4 mm wide. The femoral bones are red, the tibias are light blue on the outer part and black on the inner side, and the tarsus, formed by three articles, are black. The hind wings are membranous whereas the fore wings are hard and corneous. The pronotum has red edges, and in its basal part, two little black vertical maculas separated by a thin black line; in its hind part it has three black transverse spots united together in the shape of a crown. The two lateral angles of the pronotum are red, slightly rounded and less prominent. The hind base of the pronotum is as wide as the fore edge of the scutellum. The scutellum is bronze-copper-green blue with a yellow foundation; it is quite developed and wide, reaching the tip of the abdomen. It has three pairs of black spots longitudinally positioned on either side of a light weight black saddle presenting the aspect of a pennate leaf. The adaxial face of the insect is red, with three pairs of black spots on the middle of the abdomen. On the lateral face of the abdomen there are little dark blue spots on a golden foundation, slightly united, in the form of a reversed pyramid. The mouth pieces are of the piercing–sucking type, and constitute a rostrum with three articles. On average, the rostrum measures 7.3 mm long and 0.5 mm wide. When at rest, that rostrum is directed rearwards and is positioned against the ventral face, between the hindquarter of the legs; at feeding time, the rostrum of the insect takes a vertical position, perpendicular to the axis of the body.

Regarding the female, on average, its abdomen measures 9.2 mm long and 8.2 mm wide. The head measures on average 3.0 mm long and 3.4 mm wide. Its pronotum is 5.0 mm long and 8.3 mm wide. Its rostrum measures on average 7.4 mm long and 0.5 mm wide. The antennas are 7.0 mm long and 0.4 mm wide.

Regarding the male, its abdomen is slightly narrowed, and on average, it measures 8.6 mm long and 7.1 mm wide. On average, the head measures 3.0 mm long and 3.3 mm wide. Its pronotum is 4.6 mm long and 7.7 mm wide. On average, its rostrum measures 7.1 mm long and 0.5 mm wide. The antennas are 7.0 mm long and 0.4 mm wide.

Egg Stadium

The eggs are ovoid, ivory white, and measure about 1.3 mm long. The female often deposits grouped eggs on *J. curcas* fruit and at times on the inner face of its leaves. They are often deposited in several linked rows of five to eight eggs forming an irregular polygon. During egg deposition, the female deposits white excremental liquid between each pair of eggs. The *J. curcas* fruit is the most preferred site of egg deposition for the *Calidea* spp. female. It is probably favorable to the development of any larvae that will hatch.

From ivory white at the time of egg deposition, the eggs turn yellow, and then become red before hatching. The chorions remain strongly tied on the support, even after the larvae are hatched.

Larval Instars

The developmental cycle of *Calidea* spp. has five larval stages. These include—

First Larval Instar. The first larval instar is usually slightly globulous, reddish, with a brown spot stretched on the thorax and transversal black spots in form of hooks on the abdomen. The legs and antennas are black. The first larval instar on average measures 1.5 mm long and 1.3 mm wide; the larvae usually remain agglutinated around or near the empty chorions without feeding themselves for 72 hours, up to the second instar when they scatter in search of food. In the laboratory, the first and second larval instars of *Calidea* spp. tolerated nutritional deprivation up to the third instar.

Second and Third Larval Instars. Morphologically, the second and third instars are similar. They have a stretched form, dark blue on an iridescent green-blue foundation on the thorax; the abdomen has three elongated and horizontal black dashes; a cornicle extends the abdomen; nonetheless, it is easy to differentiate them through their sizes. The second larval instars are darker blue and on average they measure 2.6 mm long and 1.6 mm wide. The third larval instars have a slightly light green coloration; they are more voluminous than the second larval instar and measure 4.0 mm long and 3.0 mm wide.

At these two stadia, the larvae are often very mobile, mostly when there are no flowers or fruit near them. They move in search of food. From the second larval instar, take the adult coloration, but they have no wings. They present an identical way of living (attacking fruit, flowers, and *Calidea* spp. eggs).

Fourth and Fifth Larval Instars. The fourth and fifth larval instars are morphologically very close to each other. They have an elongated form but are slightly inflexed, and iridescent green-blue in color, with black spots. They differ from each other by their morphometric measurements. The fourth larval instar measures on average 6.2 mm long and 4.0 mm wide, whereas the larvae of the fifth instar are on average 9.2 mm long and 6.5 mm wide. The fourth larval instar presents on its back an arciform alar bud that has a dark blue coloration on the top and is red toward the bottom. With fifth larval instar, the scutellum is light green on a slightly bright yellow foundation and the primordium is strongly pronounced and totally red.

The larvae and the adults feed on the fruit and flowers of *J. curcas*, and can cause malformation of seeds and abortion of flowers. Throughout all the five larval instars, *Calidea* spp. behave in a generally gregarian manner, but the insect becomes solitary as it goes through the stadia, and the actual dispersal starts only after an imaginal molt.

Mean of Mortality Rate of *Calidea* spp. in the Laboratory per Stadium

The larval mortality rate of *Calidea* spp. that was observed in the laboratory was 79.8%, whereas the rate of emergence at adult stadium was 20.3%. The analysis of the mean rate of *Calidea* spp. that died in the laboratory during the various developmental stages reveals a significant difference ($F = 1531$; df = 6; $P < 0.0001$) between the developmental stages, except between the egg stadium and the first larval instar. The lowest mean mortality rate observed in the laboratory was registered at the egg stadium (1.8% aborted eggs) whereas the highest mean mortality rate was observed in the second larval instar (36%; Fig. 1).

Sex Ratio

The ANOVA ($F = 0.26$; df = 8; $P < 0.9$) on sex ratio revealed no significant difference between the applications. Thus, the mean sex ratio of *Calidea* spp. in the laboratory was 1.01 corresponding to a ratio of 1:1.

Mean Number of Copulations

An ANOVA ($F = 0.4$; df = 8; $P < 0.9$) was performed on the number of copulations. We found no significant difference between the various breeding periods of the insect in the laboratory. The mean number of copulation was 2.2. The highest number of copulations was 2.4, observed in the month of October 2013 whereas the lowest was 2.0, registered in the month of January 2014.

Mean Duration of Copulation

The mean duration of copulation of *Calidea* spp. in the laboratory was 13 h and 5 min. The longest copulation duration was 14 h 16 min, observed in the month of August 2013 whereas the shortest one was 12 h, registered in the month of December 2013. The ANOVA on the mean duration of copulation in the laboratory

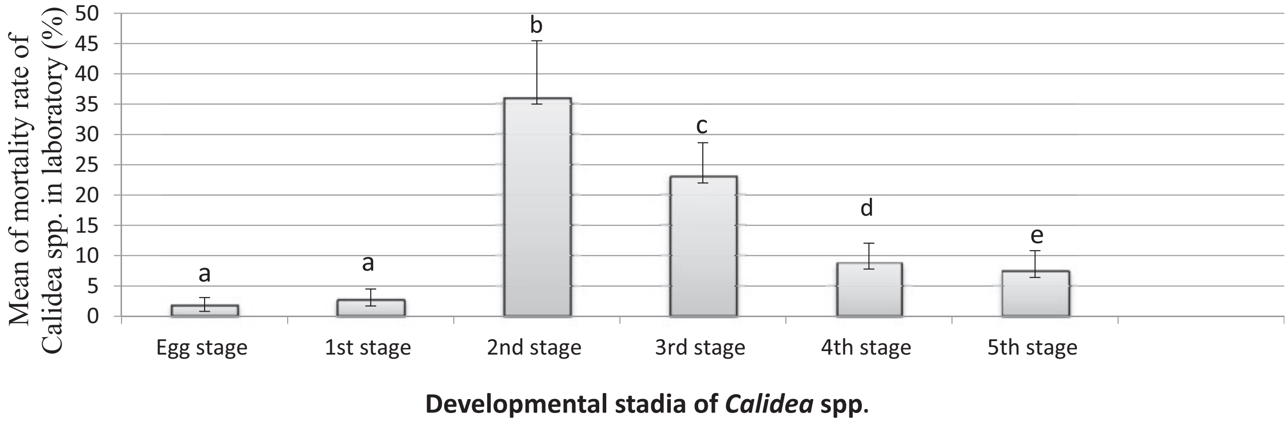

Fig. 1. Mortality ratio of *Calidea* spp. according to insect developmental stadia.

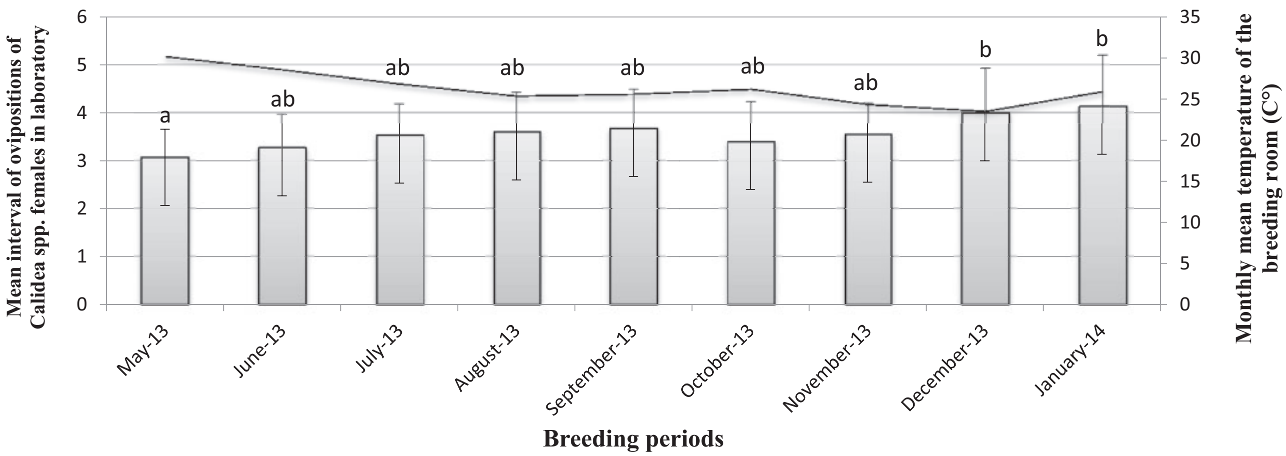

Fig. 2. Mean oviposition interval of *Calidea* spp. females with respect to month and breeding room temperature.

showed a significant difference ($F = 3.1$; df = 8; $P < 0.003$) between the months (Fig. 2).

Mean Duration of Preoviposition

The mean duration of preoviposition (period separating the emergence of the adult female and the first oviposition) of *Calidea* spp. in the laboratory was 10.5 d. No significant difference between the applications was revealed by the ANOVA ($F = 0.8$; df = 8; $P < 0.5$). The shortest duration was 10.3 d, observed in the month of May 2013, whereas the longest was 11.0 d, registered in the month of January 2014.

Mean Number of Ovipositions in Laboratory

We did not find any significant difference ($F = 0.6$; df = 8; $P < 0.7$) between the applications with regard to the number of ovipositions of *Calidea* spp. females in the laboratory. However, the mean of the number of ovipositions of *Calidea* spp. female was 3.

Mean Interval Between Ovipositions

The ANOVA on the mean interval between ovipositions of *Calidea* spp. females in the laboratory revealed a significant difference ($F = 2.63$; df = 8; $P < 0.01$) between the applications. The mean interval between ovipositions of the *Calidea* spp. females in the laboratory was 3.6 d. The smallest mean interval, the closest between the ovipositions, was 3 d, observed in the month of May 2013, whereas the most distant one was 4.1 d, registered in the month of January 2014 (Fig. 3).

Mean Duration of Ovipositions

The ANOVA on the mean of ovipositions' duration for the *Calidea* spp. females in the laboratory indicates no significant difference ($F = 0.6$; df = 8; $P < 0.7$) between the applications. The mean duration of ovipositions of the *Calidea* spp. female in the laboratory was 10.4 d. The longest duration was 11 d, observed in the month of January 2014, whereas the shortest duration of ovipositions was 10 d, registered in the months of May and June 2013.

Mean Fecundity

No significant difference ($F = 0.3$; df = 8; $P < 0.9$) was found between the various applications regarding the mean of *Calidea* spp. fecundity. The mean number of eggs deposited per female of *Calidea* spp. in the laboratory was 132. The maximal mean of fecundity was 138 eggs, registered in the month of May 2013, whereas the minimal mean was 126 eggs, registered in the month of January 2013.

Mean Fertility of *Calidea* Spp

An ANOVA was performed on the mean fertility of *Calidea* spp. in the laboratory, and no statistical difference was noticed between the various breeding periods ($F = 1.1$; df = 8; $P < 0.3$). Thus, the mean fertility of the insect in the laboratory was 27. The maximal mean

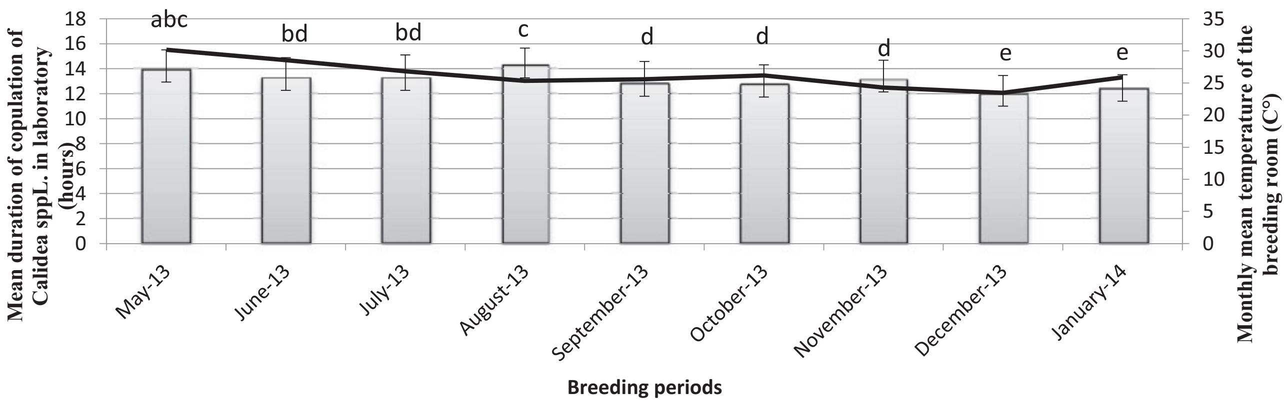

Fig. 3. Mean duration of copulation of *Calidea* spp. with respect to temperature and month.

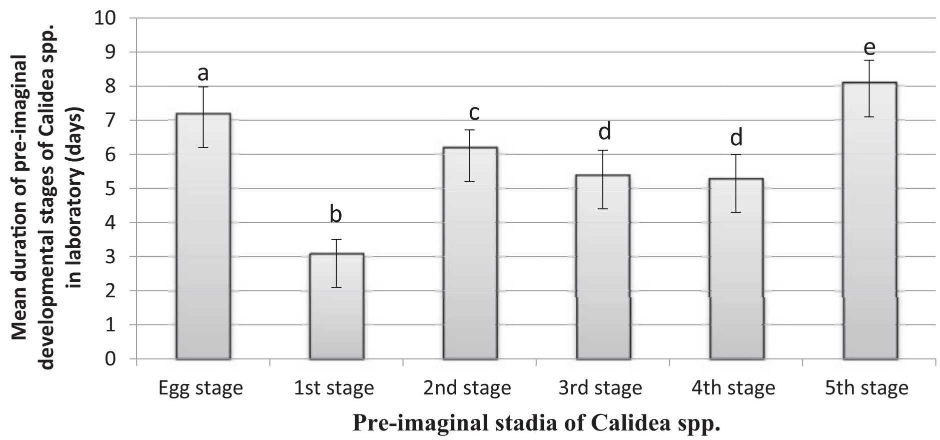

Fig. 4. Mean duration of pre-imaginal developmental stadia of *Calidea* spp. in the laboratory.

fertility was 29 adults, observed in the month of June 2013 whereas the minimal was 25 adults, registered in the month of January 2014.

Mean Duration of Preimaginal Developmental Stadia of *Calidea* spp.

The ANOVA on the mean duration of preimaginal developmental stadia of *Calidea* spp. in the laboratory indicated a significant difference ($F = 1337$; df = 5; $P < 0.0001$) between the stages. Nonetheless, no significant difference was observed between the mean duration of the development of third and fourth stages larvae (Fig. 4).

Mean Duration of Egg Incubation

A statistical analysis was carried out on the duration of egg incubation during the various breeding periods of the insect, and we found evidence of a significant difference between the various months ($F = 21.73$; df = 8; $P < 0.0001$). The mean duration of *Calidea* spp. egg incubation in the laboratory was 7.2 d. The shortest incubation duration was 6.2 d, observed in the month of May 2013 (Fig. 5), whereas the longest was 8.3 d, registered in the month of January 2014.

Mean Duration of the Development of First Larval Instar

The ANOVA regarding this variable revealed a significant difference ($F = 6.1$; df = 8; $P < 0.0001$) between May and December 2013 and also between May 2013 and January 2014. The mean duration of the development of *Calidea* spp. first larval instar in the laboratory was 3.1 d. The shortest mean was 3.0 d, observed in the month of May 2013 (Fig. 6), whereas the longest one was 4.1 d, registered in the month of January 2014.

Mean Duration of the Development of Second Larval Instar

The ANOVA ($F = 1.4$; df = 8; $P < 0.1$) of the duration of the development of second larval instar showed no statistically significant difference between the different breeding periods. Nonetheless, the shortest mean of development of that stage of the insect was 5.7 d, observed in the month of May 2013, whereas the longest mean duration was 6.5 d, registered in the month of December 2013. The mean duration of the development of *Calidea* spp. second larval instar registered in the laboratory was 6.2 d.

Mean Duration of the Development of Third Larval Instar

An ANOVA was performed on the duration of the development of third larval instar at different breeding periods, and we found no significant difference ($F = 0.5$; df = 8; $P < 0.8$) between the applications regarding that variable. We found that the shortest mean duration of development of that instar was 5.3 d, observed in the month of May 2013, whereas the longest mean duration was 5.9 d, registered in the month of January 2014. The mean duration of the development of *Calidea* spp. third larval instar registered in the laboratory was 5.4 d.

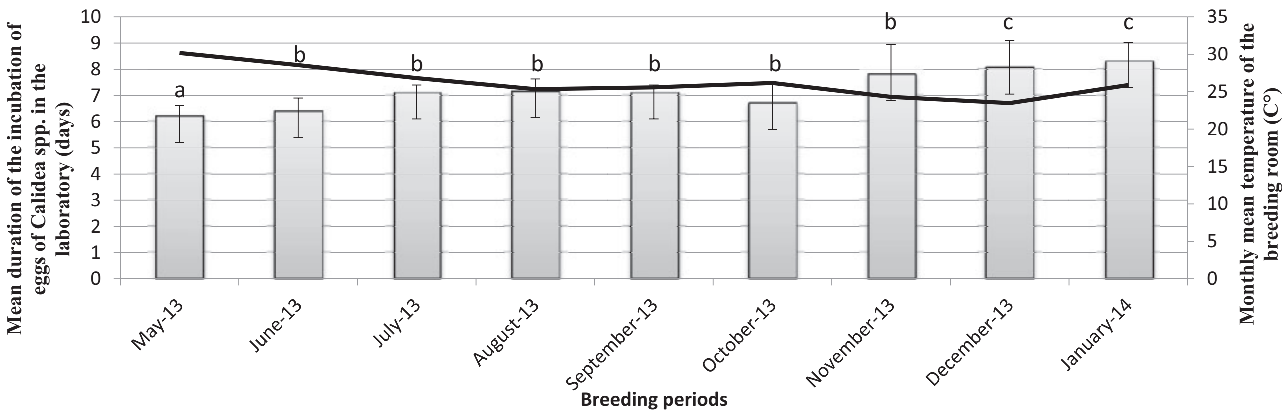

Fig. 5. Mean duration of *Calidea* spp. egg incubation in the laboratory with respect to temperature and month.

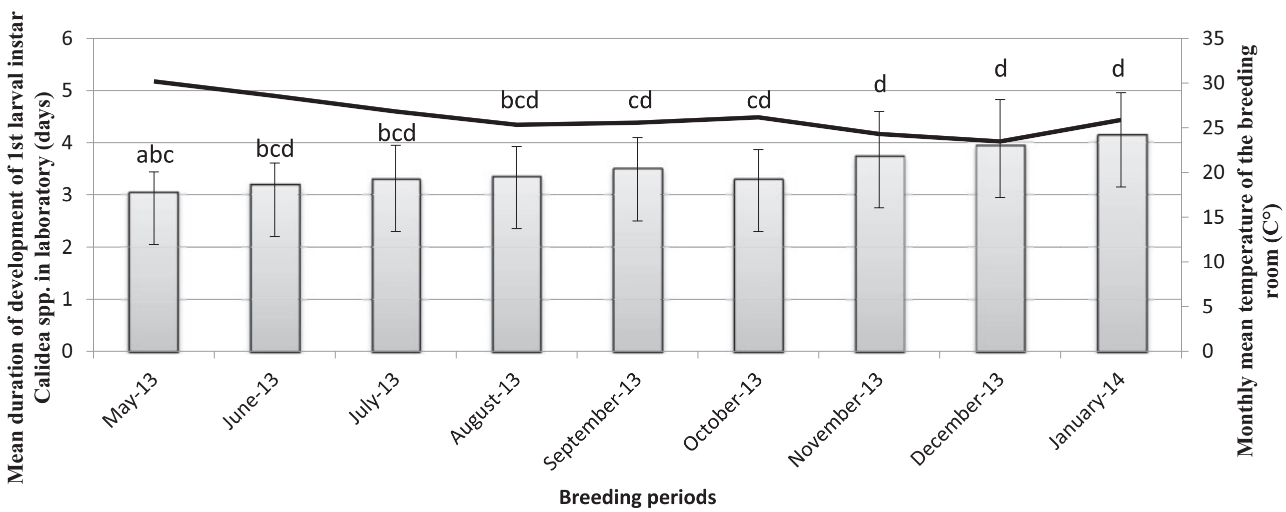

Fig. 6. Mean duration of the development of *Calidea* spp. 1st larval instar in the laboratory with respect to temperature and month.

Mean Duration of the Development of Fourth Larval Instar

The ANOVA on the duration of the development of *Calidea* spp. fourth larval instar revealed no significant difference ($F = 1.3$; df = 8; $P < 0.2$) between the breeding periods. Nonetheless, the shortest mean duration of development was 5.2 d, observed in the month of May 2013, whereas the longest mean duration was 6 d, registered in the month of January 2014. The mean duration of the development of *Calidea* spp. fourth larval instar registered in the laboratory was 5.3 d.

Mean Duration of the Fifth Larval Instar

The ANOVA on the duration of the development of *Calidea* spp. fifth larval instar revealed no significant difference ($F = 2.2$; df = 8; $P < 0.2$) between the breeding periods. Nonetheless, the shortest mean duration of development was 7.6 d, observed in the month of May 2013, whereas the longest mean duration was 8.5 d, registered in the month of January 2014. The mean duration of the development of *Calidea* spp. fifth larval instar registered in the laboratory was 8.1 d.

Mean Duration of the Larval Stadia of *Calidea* spp.

A significant difference ($F = 453$; df = 8; $P < 0.0001$) was found between the breeding period of the month of May 2013 and that of the January 2014 (Fig. 7) when data on the larval stadium of *Calidea* spp. were submitted to ANOVA. Thus, the shortest duration was 27.05 d in the month of May 2013, whereas the longest one was 30.1 d in the month of January 2014. The mean duration of the insect's five larval instars observed in the laboratory was 28.1 d. The first instar was the shortest with a mean of 3.1 d and the fifth larval instar was the longest with a mean of 8.1 d.

Mean Duration of the Development of *Calidea* Spp.

The ANOVA on the duration of the developmental cycle of *Calidea* spp. (from egg to adult) in the laboratory revealed a significant difference ($F = 112$; df = 8; $P < 0.001$) between the breeding period of the month of May 2013 and that of the month of January 2014. Thus, the shortest mean duration of the developmental cycle was 33.1 d, observed in the month of May 2013 (Fig. 8), whereas the longest one was 38.4 d, registered in the month of January 2014. The mean duration of the developmental cycle in the laboratory was 35.3 d.

Mean Life Span of *Calidea* spp. Adults

The ANOVA on the mean life span of *Calidea* spp. adults brought to evidence a significant difference ($F = 187$; df = 3; $P < 0.0001$) between the females and males that were regularly fed with *J. curcas*, fruits, and also between these and the males and females deprived of all types of food. The *Calidea* spp. female lives in the laboratory up

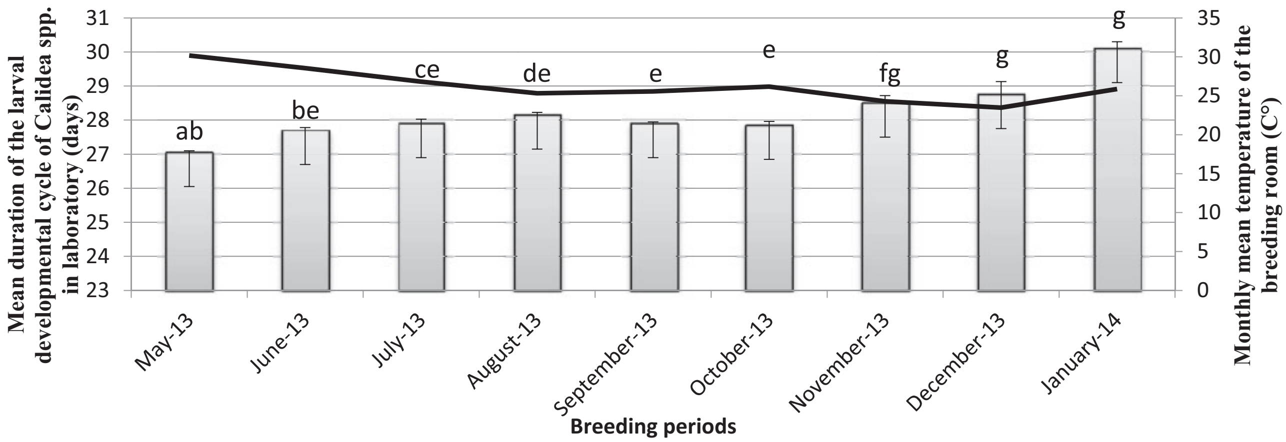

Fig. 7. Mean duration of the larval developmental cycle of *Calidea* spp. in the laboratory with respect to temperature and month.

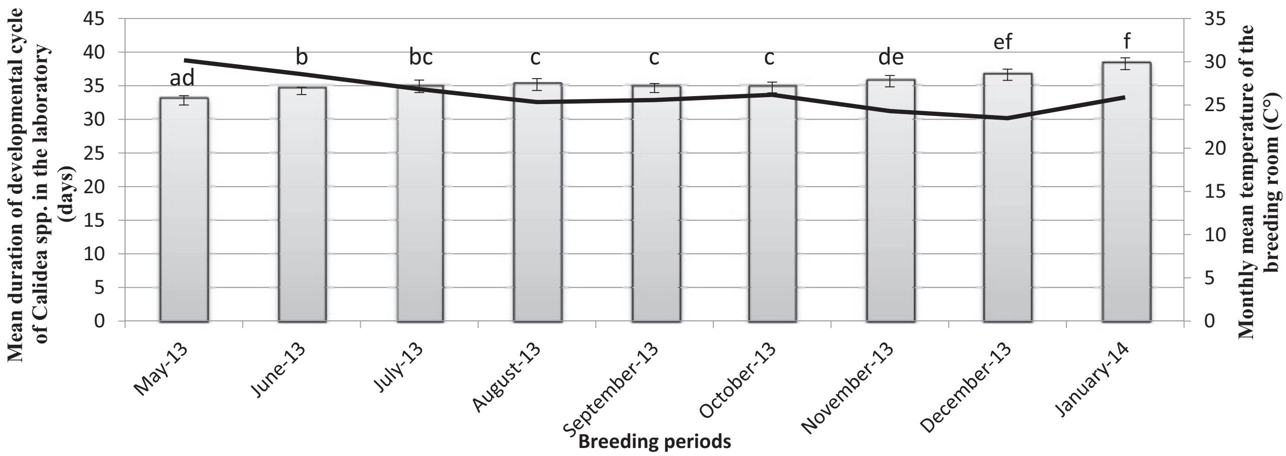

Fig. 8. Mean duration of the developmental cycle of *Calidea* spp. in the laboratory with respect to temperature and month.

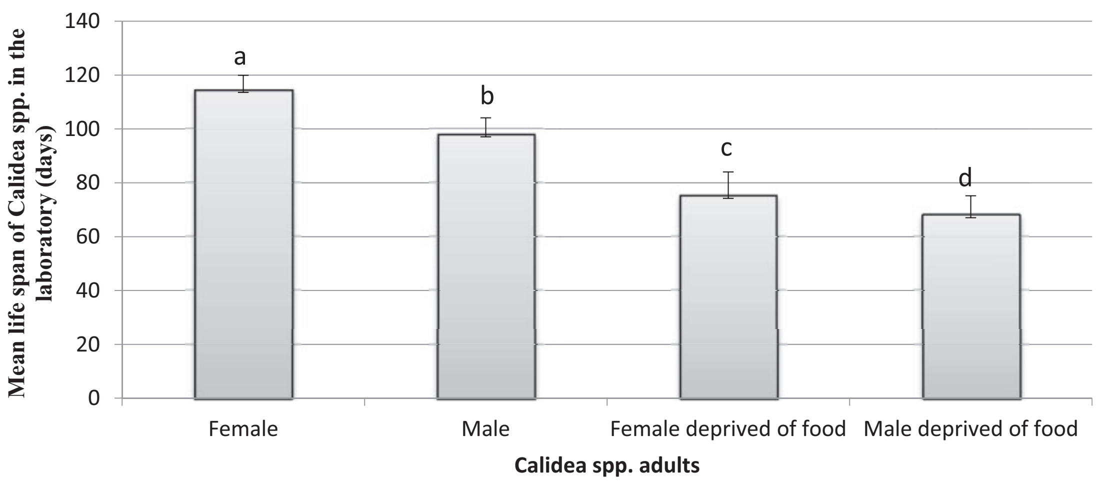

Fig. 9. Mean life span of *Calidea* spp. adults in the laboratory when they are fed or deprived of food.

to 114.5 d (Fig. 9) whereas the male insect lives a mean of 98.0 d. When the *Calidea* spp. female was deprived of all types of food, it could live a mean of 75.2 d, whereas under the same conditions, the male could live a mean of 68 d.

Discussion

The results of this laboratory study, conducted at Léo in Burkina Faso, seem comparable to those reported by other authors. Actually, Kaufmann (1966) reported that in Ghana, *Calidea* spp. females in the laboratory deposit batches of 23–48 eggs (a mean of 30) usually on the flower and at times on the stems of the host plant, *Jatropha podagrica* Hooker (an Euphorbiacea of the same genus as *J. curcas*) and at a mean interval of 5.3 d. The fecundity of the female was between 150 to 200 eggs, and the duration of their incubation was 5–6 d, for a full developmental cycle of about 60 d. The life span of *Calidea* spp. adults was about 1.5 mo for the male, and 2 mo for the female. Grimm and Somarriba (1998) report that in Nicaragua, *Pachycoris klugii* (Heteroptera: Scutelleridae) has an egg survival ratio in the laboratory of 94.7%, larval mortality of 21.6%, fecundity of 72 eggs, for a mean of 2.4 egg depositions per female. According to the same source, the cumulated duration of larval instars was 32.5 d, the mean duration of egg incubation was between 7 and 8 d, and the mean duration of the life span of the adults was 105.6 d for the female and 71.4 d for the male from imaginal molting. Grimm and Somarriba (1999) also reported that in Nicaragua, the mortality ratio in the laboratory of *Leptoglossus zonatus* (Heteroptera: Coreidae) larvae was 59.7% and the highest ratio was 35.8%, observed in the second larval instar. According to the same authors, eggs' incubation duration was 8.4 d, that of the larval instars was 25.6 d, the first instar being the shortest (a mean of 2.5 d) and the fifth one being the longest (a mean of 6.8 d). The life span of the insect was 83.6 d for the adult male and 87.4 d for the female. Panizzi (1989) reported that in laboratory conditions (temperature, $25 \pm 1°C$; RH, $65 \pm 5\%$; and a photoperiod of 14:10 [L:D] h), the mortality of the second to fifth larval instars of *L. zonatus* was 41.5%. Cocquempot (2004) also reported on the green bug *Nezara viridula* (L.) (Hemiptera: Pentatomidae), showing that it was a major polyphagous insect pest of various crops including *J. curcas*, and could live 9–10 mo.

Teetes et al. (1983) report that *Calidea* spp. deposits batches of 40 eggs, of spherical form, with 1 mm diameter in the folds of sorghum leaves. The life cycle of the insect lasts between 23 and 56 d, depending on the temperature. Cocquempot (2004) reports on *Nezara viridula* (Hemiptera: Pentatomidae) that the duration of development is directly related to temperature, being ∼58 d at 20°C, 34 d at 25°C, and 23 d at 30°C. The life span varies from 9 to 10 mo. Poutouli et al. (2011) report that the *Calidea dregii* adult, a species that is close to the one we reported in this article, can reach 13–16 mm long.

From all of the above, we can conclude that our observations are concordant with the results of authors who have worked on *Calidea* spp. or on similar species of the order Heteroptera.

Despite the matching of these results, a slight difference seems to be observed in parameters such as the duration of development cycle and the life span of adults. This variance could be due to variation of temperature (the temperature in Burkina Faso would be higher than in Ghana), the host plant, or to breeding conditions, as our study was close to field conditions, whereas in Nicaragua breeding was done in a controlled environment.

Acknowledgments

We thank Mr Yacouba Nignan, research assistant in the Fondation Fasobiocarburant, for his help in the field. This project was funded by the Agence Française de Développement (AFD) through a grant of the Fonds Français pour l'Environnement (FFEM) and cofunded by the Fondation Fasobiocarburant. The implementation of the project was coordinated by l'Agence de Développement de la Coopération Internationale dans les domaines de l'Agriculture, de l'alimentation et des espaces ruraux.

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