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Biological Cycle of Bug *Pseudotheraptus devastans* Distant (Heteroptera: Coreidae), the Coconut Pest in Côte d'Ivoire

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Abstract

***Pseudotheraptus devastans* Distant (Heteroptera: Coreidae), is an important coconut pest in Côte d'Ivoire. The stings from Nymph and adult cause not only the falling of immature nuts, but also their deformation. This triggers losses of production in the order can reach 80%. Little information is available about this pest. Those existing are limited to its ecology and damages caused in host-plants. The present investigation is aimed to study the life cycle of this pest. The experiment was carried out in a coconut field of the Marc Delorme Coconut Research Station (MDCRS). On these coconut palms, bunches between 3 and 4 months of age, enclosed in cage were used. Development duration from an egg to adult emergence averaged 28.26 days. The average incubation period was on average 6.63 days and fertility rate of eggs was 98.01%. Nymphal development period was 21.63 days. The sex-ratio is in favour of females which live 112.6 ± 13.45 days. These females laid on average 198.85 ± 36.05 eggs. The males lived on average 131.3 ± 17.7 days. The knowledge of these different parameters could allow the development of a control method based on the breaking of life cycle of this pest.**

Keywords

Coreid, Life Cycle, Rearing, Nymph, Coconut Pest

1. Introduction

The bug *Pseudotheraptus devastans* Distant (1917) belongs to the Class Insecta, Order Hemiptera, Suborder

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Heteroptera, Family Coreidae, Genus *Pseudotheraptus* and Species *devastans* [1]. This bug is a serious coconut pest (*Cocos nucifera* L.) in Côte d'Ivoire. The yielding losses can reach 80% [2] [3]. Nymphs and adults attack the youngest nuts under 7 months old. Their stings trigger the premature falling of the young nuts aged from 2 to 3 months [4] or severe deformations of the future old nuts. Two reasons explain this premature falling. Firstly, during feeding, the stylet caused damages to tissues of the plant. Secondly, the saliva of bug contains toxin which have lytic action on the cellular components of coconut [5] [6]. *P. devastans* have been specifically implicated as virus vectors. However, penetration of the stylet into plant tissue facilitates entry of various other pathogenic microorganisms such as fungi [7]. *P. devastans* feeding lesions have been associated transmission of the fungal diseases of cassava (anthracnose cassava) [5] [8], (candlestick disease) [9]. In light of the damage caused, several initiatives of control were proposed. The chemical control, although efficient, can be very harmful. Indeed, human health and environmental balance can be affected. Likewise, insects can develop resistances [10] [11]. Studies geared towards identification of ecologically healthy methods may prove more effective. Nonetheless, they require the knowledge more detailed of the bug biology. Almost all of the information on *Pseudotheraptus devastans*, results from works led in Côte d'Ivoire and in Republic of the Congo on the pest ecology and damages caused to the host plants [2] [4] [5] [9]. The work carried out aimed to study the biological cycle of *P. devastans* for further control purposes.

2. Materials and Methods

2.1. Location

The study was conducted on station at the Coconut Research Station of CNRA (National Center of Agronomic Research) is located at Port-Bouët (5˚15'N and 3˚55'W) in Abidjan in the southern part of Côte d'Ivoire. The International Coconut Genebank for Africa and Indian Ocean is hosted by this station. The studies in the field took place from January to December, 2014 at an average temperature and a relative humidity of 26.39˚C and 87.85% respectively with 2078 mm annual rainfall.

2.2. Mass Rearing

The first operation consisted to collect nymphs of *Pseudotheraptus devastans* from infested coconut bunches. Collected nymphs are putting on new healthy bunches with nut aged from 3 to 4 months in trapezoid cages measuring 65 × 48 × 33 cm. the cage covered all the nut. These nymphs were monitored until adults' emergence.

2.3. Development Cycle and Some Biological Parameters of *Pseudotheraptus devastans*

Twenty pairs (females and males) of newly emerged adults are formed and put each in a new cage on a new coconut bunch. These cages are daily observed. Every egg laid was dated, marked and observed until its hatching. The date of hatching was recorded. At hatching, newly emerged first instar reared two by two in a cage containing a new old coconut bunch aged from 3 to 4 months for their food until adults' emergence. To facilitate the location of nymphs in the course of observations, bunches must contained spaced nuts. Each nymph was daily monitored for molting. This was confirmed by the presence of exuviae at successive stages. From the first laying, the number of eggs laid by each female was scored until the death of this female. The total number of eggs laid by female was counted and the mean of laid eggs was calculated. The following parameters were determined (the duration of adults life, the duration of incubation, the duration of nymphal stages):

- the duration of incubation is the period stretching out from the laying to hatching of eggs.
- the duration of nymphal stages is the period between one instar and the next instar.
- the duration of adults life is the time between emergence date and death date.

2.4. Data Analysis

Means and standard deviation related to mean were computed for the durations of the different life stages. These were, namely eggs incubation, different nymph instars, adult survival age as well as and fecundity such as the number of eggs laid by each female in its lifetime. The survival of nymph instars calculated as the percentage of individuals at a specific stage that progress to the next stage. In the same way, the fertility rate and sex ratio,

namely the proportion of female adults, were computed.

3. Results and Discussion

3.1. Life Cycle

Detailed description of all stages is provided by [2]. Indeed, Adult are coloured brown-red except on the ventral face of abdomen where it is pale green, the membrane of the hind wings is black and the antennae are filiforme and almost long as the body. The nymph appearance and colour is similar to those of the adult. The antennae are long, with 2 and 3 flattened. Depending on the instar, there are 2 to 4 blackish-brown, rounded protuberances on the dorsal face of the abdomen. Eggs are lentiform and their colour changes from pale yellow to red-brown with age.

In the present study, life cycle of *Pseudotheraptus devastans* Distant (1917) was analyzed and it showed three stages of development, namely the egg, nymph and adult. Observations showed that it's a hemimetabolous development as 89 families component the suborder of Heteroptera [12]. Indeed from the hatching until adult emergence, we observed successively 5 exuviaes, consequences in the various sloughs, which are the proof of the passage from a stage to another (**Figure 1**).

Different authors working with other coreids also found these same results. Indeed, all these works showed three big stages (egg stage, nymph stage characterized by five instars and the adult stage) in the development of coreids such as *Corizus hyalinus*, *C. sidae*, C. *lateralis* [13] *Pseudotheraptus wayi* [7] [14]-[17], *Acanthocephala terminalis*, *Anasa tritis*, *Archimerus alternatus*, *Catorhintha mendica* et *Euthochtha galeator* [18] [19]. **Figure 1** shows the egg incubation period and the durations of the five stadia of nymph stage.

The eggs incubation period was 6.63 ± 0.61 days. This duration is similar to that of *Clavigralla scutellaris* (6.63 ± 0.74 jours) [20]. Durations of the five nymphal instars were 2.23 ± 0.43, 4.36 ± 0.71, 4.2 ± 0.7, 4.4 ± 0.77 and 6.43 ± 0.85 days, respectively and are almost as well even as those of *C. scutellaris* (2.50 ± 0.51, 3.81 ± 0.77, 3.19 ± 0.68, 3.46 ± 0.40, and 5.96 ± 0.84 days) [20]. For the eggs and nymphs, the variability of the values measured with regard to the average varied from 9% to 19%.

The duration of the first instar was the shortest while that of the last instar was the longest. This fact is also observed at several coreids species such as *Mozena obtusa* [21], *C. scutellaris* [20], *Corecoris dentiventris* [22], *P. wayi* [14] [17]. Anatomical, morphological and physiological transformations undergo and acquire by fifth instar before adult stage would explain the longer duration of this instar.

According to [22], the differentiation of the internal reproductive organs and the completion of the wings development occurs at this instar. The average cumulative nymphal development time in days was 21.63 ± 1.47. The total duration of the immature stages of *P. devastans* (21.63 ± 1.47 days) is close to that obtained by [23] who reported that the immature stages of Coreidae border on 21 days. Total developmental duration (egg to adult emergence) averaged 28.26 ± 1.55 days (**Figure 2**).

This duration is included in the same time interval (21 - 40 days) by the nearby species *P. wayi* [14]. The instars survival rates during rearing were 83.33%, 64.61%, 90.47%, 78.94%, 86.66% respectively (**Figure 3**). The

Figure 1. Durations of incubation and the immature stages of *Pseudotheraptus devastans.*

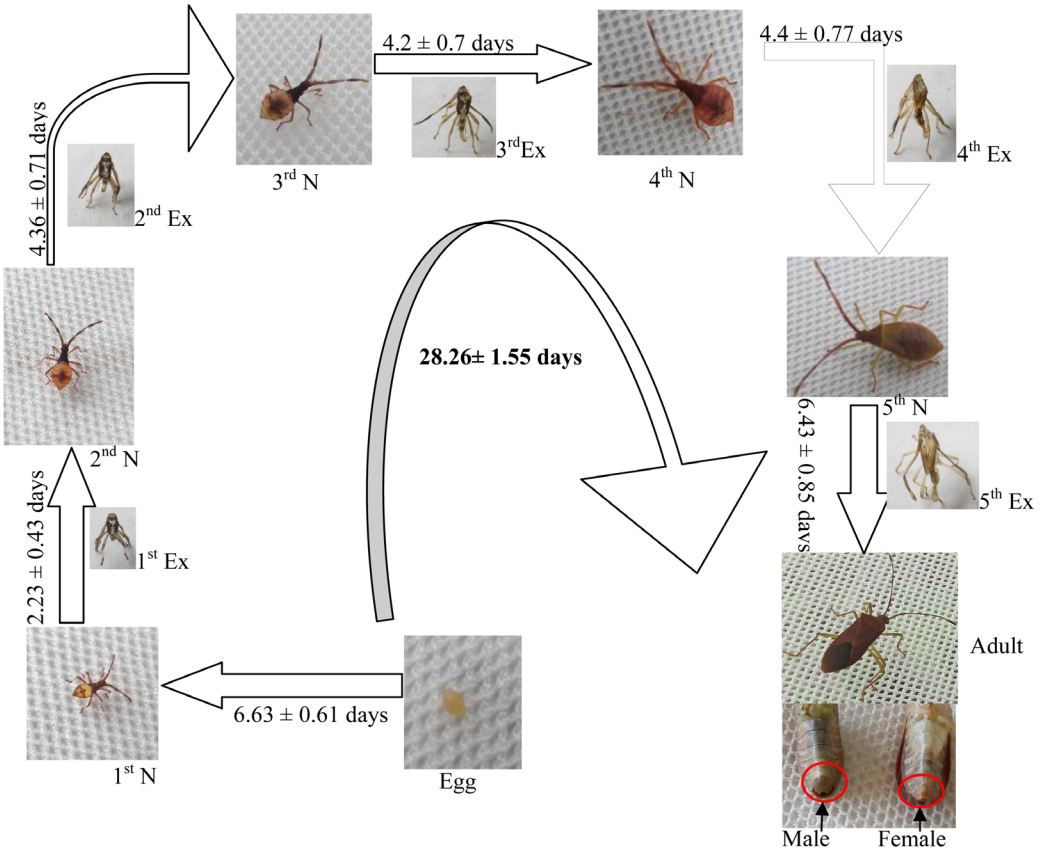

Figure 2. Development cycle of *Pseudotheraptus devastans.* N: Nymph; Ex: Exuviae.

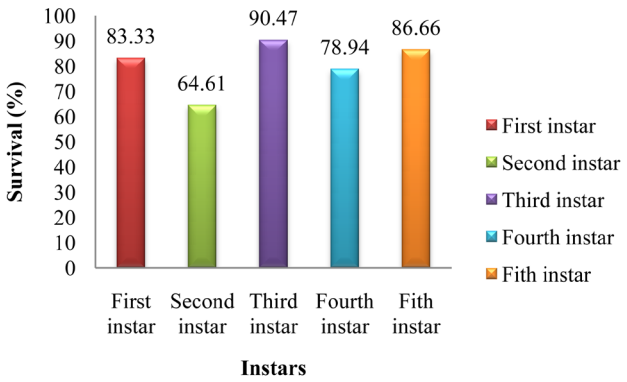

Figure 3. Survival of immature stages of *Pseudotheraptus devastans.*

Lowest nymphal survival occurred during the second instar. This observation seems to be the rule to several coreids [21] [22] [24] and has to be a critical feeding phase. It could be explained considering that in this instar actual feeding activity begins, implying in the need to metabolize for the first time toxic or non-nutritive compounds (allelochemics) contained in the food.

3.2. Biological Parameters

On average *P. devastans* female laid 198.85 ± 36.05 eggs. These average laying is higher than that of *P. Wayi* (74 - 100 eggs) [13] and lower than that of *Mozena obtusa* (510 eggs) [21]. The egg viability observed for *P. devastans* was 98.01%. This a rate almost similar to that of *C. dentiventris* (99.63%) [22] and of *Leptoglossus mem-*

branaceus (100%) [25]. Egg viability for some coreids such as *Leptoglossus gonagra* (93.4%) [26] and *Veneza stigma* (91.66%) [27], although that being lower than that of *P. devastans*, are however very high. From 198 eggs laid on average per female, 49 adults emerged whose 23 males and 26 females originating a sex-ratio of 0.88. *P. devastans* sex-ratio is so in favour of females as *Leptoglossus zonatus* [28] and *C. dentiventris* [22]. In other Coreids, a sex ratio favoring males was registered as in *L. gonagra* [26] and *Crinocerus sanctus* [29]. Adults live for 4 month or more as well as at *Pomponatius typicus* [30]. Adult longevity was longer in males (131.3 ± 17.7 days) than females (112.6 ± 13.45 days) [11] [15]. But at *M. obtusa* the female's life is longer than that of males [18].

4. Conclusion

This study has allowed knowing duration of all development stages of the life cycle of *P. devastans*. Three main steps were observed during life cycle of *Pseudotheraptus devastans*. These steps are: egg stage, nymph stage characterized by five slougs and adult stage. This shows that *P. devastans* is hemimetabolous. The development duration from an egg to adult emergence averaged 28.26 ± 1.55 days, with an incubation period of 6.63 days and nymphal development period of 21.63 days. Males with 131.3 ± 17.7 days live longer than females with 112.6 ± 13.45 days. The high eggs-laying (198.85 ± 36.05 eggs), the very high rate of egg viability (98.01%) and the sex-ratio in favour of the females are potential of reproduction indicators of this species. The acquisition of all these elements added to the fact that all the stages of development except eggs, are infesting, require news approaches and the implementations of methods of more adequate and more efficient control.

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