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Morphometrical changes and description of eggs of *Rhynocoris albopilosus* Signoret (Heteroptera: Reduviidae) during their development

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The morphometric analysis of 78 eggs of *Rhynocoris albopilosus* Signoret, 1858 was carried out at laboratory (temperature 28 ± 2°C, photoperiod 12:12, relative humidity 65 ± 8%) using a stereoscopic microscope with graduation. Measurements were taken every two days, from laying to emergence. The results revealed that only the operculum and maximal widths show a significant change related to the development of the embryo. These changes were 0.47 to 0.52 mm for the operculum width and 0.59 to 0.65 mm for the maximal width. Because the embryo can be seen and described through the transparent chorion, these results make it possible to predict when nymphs will emerge.
Keywords: *Rhynocoris albopilosus*, egg incubation, embryo description.

L'analyse morphométrique de 78 œufs de *Rhynocoris albopilosus* a été réalisée au laboratoire (température 28 ± 2°C, photopériode 12 :12, humidité relative 65 ± 8%) à l'aide d'une loupe binoculaire avec graduation. Les mesures ont été effectuées chaque deux jours, de la ponte à l'émergence. Les résultats ont révélé que seules les largeurs de l'opercule et maximale connaissent un changement significatif lié au développement de l'embryon. Ces changements variaient entre 0.47 mm et 0.52 mm pour la largeur au niveau de l'opercule et entre 0.59 mm et 0.65 mm pour la largeur maximale. La description de l'embryon à travers le chorion transparent apparaît comme un élément important permettant de prévoir la période d'émergence des nymphes au cours de l'incubation.
Mots clés: *Rhynocoris albopilosus*, incubation des œufs, description de l'embryon.

1. INTRODUCTION

The heteropteran family Reduviidae comprises essential predators on insect pests of crops, playing a significant role in keeping pest populations in check (George and Ambrose, 2001; Sahayaraj *et al.*, 2003). The interest in Reduviidae as biological control agents has been highlighted by several authors (Odhiambo, 1959; Schaefer, 1988; George and Ambrose, 2001; Sahayaraj and Paulraj, 2001; Grundy and Maelzer, 2002; Claver and Ambrose, 2003; Claver *et al.*, 2003; Sahayaraj *et al.*, 2003; Sahayaraj and Raju, 2003). Since the beginning of the 20th century mass production of natural enemies has been considered as a means of improving biological control programmes (Van Lenteren, 2008).

Rhynocoris albopilosus Signoret (Heteroptera: Reduviidae: Harpactorinae) is known as the commune predator of *Dysdercus* in cotton fields in Centrafrica (Pierrard, 1972). James *et al.* (2003) have identified it among the major natural enemies of market gardening pests in Benin. In

Ivory Coast, *R. albopilosus* has been observed to attack some insect pests of vegetable crops in crop fields and, therefore, may be considered as an important natural enemy against the pests in keeping their populations low. Accordingly we have tried to establish mass production of *R. albopilosus* toward their practical application as biological control agents.

Odhiambo (1959), studying the life history of this species, reported that it deposits eggs in compact masses arranged in four or six long lines along the stem of the plant. No other information is available on the egg of *R. albopilosus*.
The knowledge of the life cycle of *R. albopilosus*, particularly reproduction factors and immature stages description is important for establishing mass production of the predator. This work aims to describe the eggs during their development in order to recognize any morphometrical signs of the timing of their hatching.

In this article, we examine whether there are morphometrical changes in *R. albopilosus* eggs from laying to hatching. Moreover, a description of various parts of the embryo, seen through the transparent eggshell, is given.

2. MATERIALS AND METHODS

Females of *R. albopilosus* that emerged the same day have been maintained each one with a male in a Petri dish (140 mm of diameter). They were reared under laboratory conditions (temperature 28 ± 2°C, photoperiod 12:12 and relative humidity 65 ± 8%) on *Tribolium castaneum* (Herbst) larvae. Seventy-eight eggs were collected, separated, and vertically fixed on filter paper at the bottom of a Petri dish (90 mm in diameter) with adhesive tape, in order to maintain the same orientation as when they were oviposited. The eggs were then kept under the same conditions as the females. Every two days after egg-laying, the following measurements were made on each egg: whole length: maximum length from the bottom of the egg to the apex of the operculum; body length: maximum length from the base of the egg to the border of the egg body and operculum; maximal width: greatest width at the egg body level; and operculum width: greatest width at the border of the egg body and operculum. The position of the eyes in formation from the base of the egg was taken into account in measurements from the fourth day after egg-laying. Ventral and dorsal faces of the eggs were defined according to the position of the embryo during their development. The observations were carried out using a stereoscopic microscope provided with graduation (WILD M3). The eggs were studied with an enlargement of 160.

3. RESULTS

Nine days after laying, 74 eggs hatched. The examination of the four eggs that did not hatch revealed that they did not present any sign of an embryonic development. These eggs were probably not fertilized. Unlike the body length of the egg, which was almost constant, the total length and the opercula and maximal widths, as well as the position of the eyes in formation, varied significantly from the fourth day after the laying (Table 1).

Table 1: Means (± Standard Error) of the lengths and widths of eggs, and the position of eyes of *Rhynocoris albopilosus* during incubation

Periods	Whole length in mm	Body length in mm	Maximal width in mm	Operculum width in mm	Eyes position in mm
OD	1,77 ± 0,01 a*	1,49 ± 0,01 a	0,59 ± 0,00 a	0,47 ± 0,00 a	-
2 DAO	1,76 ± 0,01 a	1,49 ± 0,00 a	0,59 ± 0,00 a	0,47 ± 0,00 a	-
4 DAO	1,80 ± 0,01 b	1,50 ± 0,00 a	0,63 ± 0,00 b	0,50 ± 0,00 b	1,17 ± 0,01 a
6 DAO	1,80 ± 0,01 b	1,50 ± 0,01 a	0,65 ± 0,00 c	0,52 ± 0,00 c	1,34 ± 0,01 b
8 DAO	1,79 ± 0,01 b	1,50 ± 0,00 a	0,63 ± 0,00 b	0,52 ± 0,00 d	1,38 ± 0,01 c

* The values of the same column followed by the same letter do not differ significantly with P = 0.05 (ANOVA I and Test LSD of Fisher), n = 78.
DAO: Day After Oviposition; OD: Oviposition Day

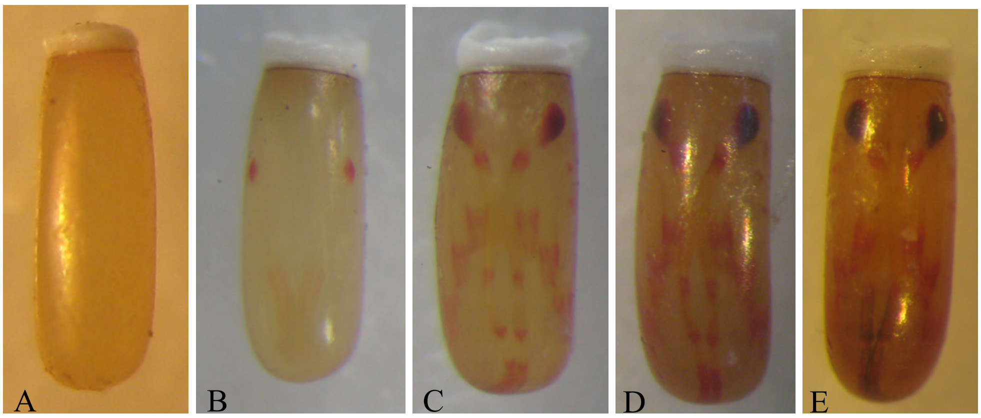

Figure 1: Evolution of *Rhynocoris albopilosus* embryo structures seen through the chorion in successive days after oviposition (ventral view): A: 2 days; B: 4 days; C: 6 days; D: 8 days; E: 9 days

Description of eggs
The embryo of *Rhynocoris albopilosus* was described during the egg development, through the transparent chorion (Figure 1).

Development as a whole. Opercula white from oviposition to hatching. Egg yellowish to light brown at time of laying, turned into orange or reddish during development. Ventral face darker than dorsal one.

Day of oviposition to two days after oviposition (Fig. 1A)**.** Egg body yellowish to light brown, without particular markings.

Three days after oviposition. Egg body ventrally with two small, spherical, symmetrical red spots; spots located at same level at the base of eggs.

Four days after oviposition (Fig. 1B)**.** Dorsum of egg body weakly but distinctly concave at both sides. In addition to two red spots, apex of chorion and two indistinct antennal articles at level of lower half of chorion redder.

Five days after oviposition. Almost same as at fourth day after oviposition, but apex of chorion and antennal articles redder.

Six days after oviposition (Fig. 1C). Red spots still spherical, but truncated at inner margin (toward operculum), with black triangular stain; this truncation giving slight concave to superior margin. One side of triangular stain confused with almost central third of truncated part of red spot; top opposed to that side of triangular stain included in red spot, close to lower edge. Antennae placed side by side in median part of ventral face, extending to base of chorion, then up laterally to almost two-thirds length of chorion; first articles contacted with each other at middle in ventral view, yellowish for the most part, with base and apex reddish; other segments slightly reddish and visible on ventral face in lower half of chorion.

Seven days after oviposition. Black stain now spherical, occupying about two-thirds above red spots. All antennal articles yellowish with reddish base.

Eight days after oviposition (Fig. 1D)**.** Chorion with lacy structure at level of dorsal face; egg body dorsally with dark squirmed structure in basal half; squirmed structure with several lobes in lateral view; dorsal face somewhat invaginated, reducing maximal width for certain eggs. Red spots (the developing eyes) reduced to a marginal crescent in ventral view; black strain now round, occupying three-quarters of eye. Antennal articles and legs oxblood apically and yellowish medially, except fourth antennal article red with yellowish apex; fourth antennal articles close together, leaving lower quarter of ventral face of chorion and extend up laterally until a little more than three-quarters of chorion's length, from base.

Nine days after oviposition (Fig. 1E)**.** Squirmed structure observed on previous day at dorsal face now darker; in ventral view, segmentation noticeably clear now; abdominal segments also distinctly visible, occupying almost lower half of chorion, with abdominal apex located at base of chorion. Second, third and base of fourth articles of antennae slightly dark; apex of fourth article reddish. Hatching begins at this stage.

4. DISCUSSION

The egg incubation period observed in *Rhynocoris albopilosus* was shorter than that obtained by Odhiambo (1959).

The change in the whole length of the egg during incubation cannot be accounted for by the change in the operculum height, because the body length remained constant. The deployment and the folding back of the veil present at the operculum level (Cobben and Henstra, 1968) might explain the total length changes. The maximal widths at the fourth day and the eighth day after egg-laying did not differ significantly, perhaps because of the light depression noted on the dorsal face of the eighth-day egg.

During their work on eggs of *Rhodnius proxilus* (Reduviidae: Triatominae), Chaves *et al.* (2003) observed that only the maximal width of eggs varied significantly during their development. However, the eggs of *Rhynocoris albopilosus* varied not only in the maximal width but in the operculum width as well. The studies of Cobben (1968) showed the great homogeneity of Reduviidae during embryonic development. In general, the germinal band develops from the inferior pole towards the superior one, laterally on the surface of the vitella (yolk). Once the appendices start to develop, the embryo migrates (always on the surface of the vitella) so that the head is in the up position. In our study, the significant increase of the distance between the base of the egg and the position of the eyes in formation, from the fourth day to the eighth day could be explained by the migration of the embryo. Similarly, the head of the embryo moves more and more towards the operculum as the emergence period approaches. At hatching, the nymph pushes the operculum upward (Salkeld, 1972). These movements of the embryo could cause the change of the operculum width.

There is no moment of rotation of the embryo in Reduvioidea (unlike in the Pentatomomorpha) (Moulet, 2002). This was checked in *R. albopilosus*; and indeed, the site of the embryo's eyes on the dorsal face did not change, from their first appearance on the third day until hatching.

According to Odhiambo (1959), the newly laid eggs of *R. albopilosus* appear light brown, but later become much darker. The change of the color of eggs during their development is probably related to the development of the embryo and the transparency of the shell. In most Reduviidae the chorion is unicolored and transparent, and through it the color of the vitelline mass can be seen; this may change frequently as maturation proceeds (Villiers, 1948).

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References

Chaves L.F.P. Ramoni-Perazzi E. Lizano & Añez N. (2003). Morphometrical changes in eggs of *Rhodnius proxilus* (Heteroptera: Reduviidae) during development. *Entomotropica* **18,** p. 83-88.

Claver M.A. & Ambrose D.P. (2003). Suppression of *Helicoverpa armigera* (Hübner), *Nezara viridula* (L.) and *Riptortus clavatus* Thunberg infesting pigeonpea by the reduviid predator *Rhynocoris fuscipes* (Fabricius) in field cages. *Entomologia Croatica* **7,** p. 85-88.

Claver M.A., Ravichandran B., Khan M.M. & Ambrose D.P. (2003). Impact of cypermethrin on the functional response, predatory and mating behaviour of a non-target potential biological control agent *Acanthaspis pedestris* (Stal) (Het., Reduviidae). *Journal of Applied Entomology* **127,** p. 18-22.

Cobben R.H. (1968). Evolutionary trends in Heteroptera. Part I: Eggs, architecture of the shell, gross embryology and eclosion. *Agriculture Research Report*, Wageningen, 474 p.

Cobben R.H. & Henstra S. (1968). The egg of an assassin bug (*Rhinocoris* sp.) from Ivory Coast. *Joel News 6B*.

George P.J.E. & Ambrose D.P. (2001). Polymorphic adaptive insecticidal resistance in *Rhynocoris marginatus* (Fab.) (Het., Reduviidae) a non-target biocontrol agent. *Journal of Applied Entomology* **125,** p. 207-209.

Grundy P.R. & Maelzer D.A. (2002). Factors affecting the establishment and dispersal of nymphs of *Pristhesancus plagipennis* Walker (Hemiptera: Reduviidae) when released onto soybean, cotton and sunflower crops. *Australian Journal of Entomology* **41,** p. 272-278.

James B., P. Neuenschwander, G. Goergen, M. Toko, F. Beed & D. Coyne (2003). Peri-urban vegetable pest biodiversity diagnosed. *Project B: Developing plant health management options*. Ibadan, IITA: 15-16.

Moulet P. (2002). *Systématique, biologie, écologie et éthologie des Reduviidae (Heteroptera); Systématique et bio-écologie des Coreoidea (Heteroptera) du Ventoux (Sud-Est France)*. Thèse de doctorat, Université d'Avignon et des Pays de Vaucluse, Avignon, 202 p.

Odhiambo T.R. (1959). An account of parental care in *Rhinocoris albopilosus* Signoret (Hemiptera-Heteroptera: Reduviidae), with notes on its life history. *Proceedings of the Royal Entomology Society of London (a)*, p. 175-185.

Pierrard G. (1972). *Le contrôle de* Dysdercus völkeri *Schmidt défini par l'acquisition de connaissances de la biologie de l'insecte et de ses dégâts.* Thèse de doctorat. Faculté des Sciences Agronomiques de l'Etat de Gembloux, Zoologie et Entomologie Tropicales, Gembloux, 135 p.

Sahayaraj K., Delma J.C.R. & Martin P. (2003). Biological control potential of aphidophagous reduviid predator *Rhynocoris marginatus*. *International Arachis Newletter* **23,** p. 29-30.

Sahayaraj K. & Paulraj G.M. (2001). Rearing and life table of reduviid predator *Rhynocoris marginatus* Fab. (Het., Reduviidae) on *Spodoptera litura* Fab. (Lep., Noctuidae). *Journal of Applied Entomology* **125,** 321-325.

Sahayaraj K. & Raju G. (2003). Pest and natural enemy complex of groundnut in Tuticorin and Tirunelveli district of Tamil Nadu, India. *International Arachis Newletter* **23,** 25-29.

Salkeld E.H. (1972). The chorionic architecture of *Zelus exsanguis* (Hemiptera: Reduviidae). *Canadian Entomology* **104,** p. 433-442.

Schaefer C.W. (1988). *Reduviidae (Hemiptera: Heteroptera) as agents of biological control. In:* Bicovas, K.S. Ananthasubramanian, A. Venkatesan and S. Sivaraman (eds.), Loyola College, Madras 1. p. 27-33.

Van Lenteren J.C. (2008). Internet Book of Biological Control. www.IOBC-Global.org, Wageningen, The Netherlands. Consulté le 10/03/2008. 135 p.

Villiers A. (1948). *Faune de l'empire française*. IX. Hémiptères Reduviidae de l'Afrique noire. Office de la Recherche Scientifique Coloniale, Editions du Museum, Paris. 488 p.

(18 ref.)