

**Life-history, Morphometrics and Foliage Consumption of *Epicampoptera andersoni glauca* Hmps. (Lepidoptera: Drepanidae) on Robusta Coffee, *Coffea canephora* Pierre ex. Froehner (Rubiaceae), at Idi-Ayunre, Ibadan, Nigeria**

ANIKWE J.C. AND OKELANA, F.A.

Entomology Division, Cocoa Research Institute of Nigeria, P.M.B. 5244, Ibadan, Nigeria.

Niger. J. Entomol. 23:34 - 36 (2006)

**ABSTRACT** The life history of *Epicampoptera andersoni glauca* Hmps. on robusta coffee, *Coffea canephora* Pierre ex. Froehner, was investigated in the laboratory at 27±2°C and 70-80% RH. Larvae moulted four or five times irrespective of the sex. Development from egg to adult was completed in an average of 26.3 days when larvae passed through five instars and in 31.7 days when larvae passed through six instars. The mean growth ratio, determined from head capsule measurements, was 1.44. The sixth instar larva was the most voracious in feeding, consuming 86.45% of the leaf area offered per day.

### INTRODUCTION

The robusta coffee, *Coffea canephora* Pierre ex Froehner (Rubiaceae), is one of the widely cultivated coffee species in the middle belt and southern states of Nigeria. It accounts for about 94% of coffee export from Nigeria (Williams, 1989). It is a more vigorous and more productive cultivar than the arabica coffee (Coste, 1992). Presently, robusta coffee is gaining ground in the world market because of its high solubility and hence its use for the production of instant coffee (Le Pelley, 1978).

In Nigeria, coffee yield is not yet at its optimal level because of insect pest infestation and damage. Idowu (1971) reported on the various insect pests of coffee and their control. Okelana (1989) reported that two *Epicampoptera* spp. are a major pest of robusta coffee in Nigeria. One is *E. strandi* Bryk. sub sp. *glauca* and the other is *E. andersoni* Tams. sub sp. *glauca*. The former, commonly called the rat-tailed caterpillar or coffee leaf roller (Cambrony, 1992; Okelana, 1989), is the more destructive, occurring almost exclusively during the early rains (Mar. – Aug.) with a peak in July (Idowu, 1971). It causes enormous defoliation resulting in yield reduction (Okelana, 1985, 1989). *Epicampoptera* spp. are widespread in western and eastern Africa occurring mostly on coffee (Le Pelley, 1978).

Okelana (1985) studied the oviposition, hatching and parasitism of eggs of *E. strandi* during an outbreak on coppiced plots of *C. canephora* at the Cocoa Research Institute of Nigeria (CRIN) in 1982. Various natural enemies of the pest have been discovered and identified in CRIN. The eggs were parasitised by *Telenomus* sp. (Hymenoptera: Scelionidae) while the larval and the pupal stages were parasitised by *Charops* sp. (Hymenoptera: Ichneumonidae) and *Tachina* sp. (Diptera: Tachinidae), respectively (Idowu, 1971; Okelana,

1985, 1989). *Platythyrea modesta* Emery (Hymenoptera: Ponerinae) and *Spodromantis lineola* (Dictyoptera: Mantidae), among others, have been reported to prey on *E. andersoni*.

Hand picking and subsequent destruction of the larvae, as well as application of insecticides such as Thiodan 35 EC, Elocron 50 WP and Decis have been reported to give effective control of *Epicampoptera* spp. (Okelana, 1989).

The biology, ecology and distribution of *E. andersoni* have been studied extensively elsewhere (Le Pelley, 1978). In Nigeria, bio-ecological studies on *E. andersoni* on robusta coffee are scanty. Knowledge of the biology and ecology of *E. andersoni*, and its natural enemies are basic to the development of meaningful, effective and ecologically-sound pest management programme. This paper reports on the life history, morphometrics and foliage consumption of *E. andersoni* on *C. canephora*.

### MATERIALS AND METHODS

#### Life-history Studies

In May 2004, freshly laid eggs of *E. andersoni*, recognized by their creamy colour, were collected by detaching the leaves on which they were laid in the coffee germplasm of CRIN Headquarters, Idi-Ayunre, Ibadan (latitude 7° 30' N, longitude 3° 54' E, altitude of 200m above sea level). The annual rainfall average 2000mm and its distribution bimodal.

The eggs were transferred into covered plastic containers (13x8x6cm), bearing a 3cm diameter hole, covered by a fine nylon mesh (30 mesh/cm) on each of the four sides. They were incubated in ambient laboratory environment (27±2°C and 70-88% RH). The base of the container was lined with moistened cotton wool covered with filter paper. The leaf surface bearing the eggs faced upwards.

**Table 1. Body morphometrics, head capsule width (mm± SE), growth ratio and duration of development of *Epicampoptera andersoni* on *Coffea canephora*.**

Growth stage	Length (mm)	Width (mm)	Tail (mm)	Width of vertex <sup>a</sup> (mm)	Ratio	Growth Development time (days)
Egg	1.04±0.02	0.60±0.01	-	-	-	3.50±0.02
1 <sup>st</sup> instar larva	4.17±0.37	0.34±0.03	-	0.36±0.02f	-	2.35±0.11
2 <sup>nd</sup> instar larva	10.05±0.45	0.70±0.10	-	0.51±0.02e	1.42	2.90±0.07
3 <sup>rd</sup> instar larva	16.25±0.28	1.14±0.09	3.60	0.82±0.01d	1.61	3.00±0.00
4 <sup>th</sup> instar larva	28.50±1.06	3.75±0.27	12.10	1.15±0.02c	1.40	3.05±0.09
5 <sup>th</sup> instar larva	36.13±1.04	5.74±0.14	14.00	1.58±0.01b	1.37	4.00±0.25
6 <sup>th</sup> instar larva	38.45±1.10	6.23±0.10	17.20	2.18±0.02a	1.38	5.40±0.22
Pupa	22.65±0.07	6.04±0.16	-	-	-	7.50±0.19
Adult (Male)	22.83±0.12	4.55±0.03	-	-	-	-
(Female)	24.04±0.08	7.02±0.12	-	-	-	-
Mean growth ratio -	-	-	-	-	1.44	-

<sup>a</sup>Means in a column followed by the same letter are not significantly different ( $P>0.05$ ) according to Turkey's Honestly Significant Difference (HSD).

Soon after hatching, 40 larvae were separately transferred onto freshly cut coffee shoots dipped in water in a conical flask (250ml). The shoots, held in place firmly with the aid of cotton wool padding, were changed daily between 0700 and 0900hr; older larvae were given more shoots. The flask (with shoot and larvae) was placed in a rectangular white container to facilitate detection of the cast head capsules. Twenty of the larvae were examined everyday for morphological description. After each moult, cast head capsule width was measured. The growth ratio was determined for each larval instar by dividing the mean width of vertex of one instar with the one preceding it (Emehute and Odiete, 1991; Ewete, 1990).

A batch of 30 eggs was also reared to adults and the percentages of male and female moths that passed through five and six larval instars were computed. During development width of the vertex of each larval instar was measured. The data were subjected to one-way analysis of variance and significantly different means were separated using Turkey's Honestly Significant Difference ( $P<0.05$ ) (Gomez and Gomez, 1984).

#### Damage Assessment Studies

Ten one-day old larvae of *E. andersoni* were introduced separately onto freshly plucked robusta coffee leaves, which were scanned with a leaf area meter (Model C1 – 202) before and 24 hr after they were fed to the larvae. The area defoliated was expressed as a percentage of the whole leaf area.

## RESULT

### Life-history and Morphometrics

Table 1 shows developmental duration and morphometrics of *E. andersoni* reared on robusta coffee leaves. Moths laid eggs singly on both adaxial

and abaxial surfaces. Freshly laid eggs were oval, smooth and creamy, the colour changing with age to pinkish brown except where parasitized when the colour changed to black. The eggs on the average were 1.04 mm long by 0.60 mm wide. Incubation period averaged 3.50 days.

Upon eclosion, the 1<sup>st</sup> instar larvae were black and actively motile. The larva averaged 4.17 mm in length, its vertex and body width were appropriately equal. From the 2<sup>nd</sup> – 6<sup>th</sup> instar, vertex width, was approximately  $\frac{1}{3}$  –  $\frac{3}{4}$  the width of the body (Table1). The 2<sup>nd</sup> instar was dark green and it was more than 2 x the length and width of the 1<sup>st</sup> instar. The swollen bulb on the dorsal part of the thorax had become distinct.

The 3<sup>rd</sup> instar was lighter than the 2<sup>nd</sup> instar and had faint yellow markings on green background.

The thorax was bulbous and shining green. Increases in length and width over the 2<sup>nd</sup> instar were 6.20 and 0.44 mm, respectively. A distinct tail 3.60 mm in length, emanate from the lower end of the abdomen.

The 4<sup>th</sup> instar was approximately 2 x the size of the 3<sup>rd</sup> instar; by the 5<sup>th</sup> instar color had changed to black and the size increased moderately over the 4<sup>th</sup> instar (length 1.3 x and width 1.5 x). The 6<sup>th</sup> instar was black measuring 32.4 mm in length and 6.2 mm in width. Just before pupation, the last instar rolled itself inside the leaf. The pupa was dark brown measuring 22.6 mm in length and 6.0 mm in width at the widest point of the pupal case. Emerged moths were dusty brown, the male being smaller than the female.

Developmental duration in the 1<sup>st</sup> – 4<sup>th</sup> larval instars was 2 – 3 days, the 5<sup>th</sup> and 6<sup>th</sup> larval instars and the pupa required longer duration, 4.0, 5.4 and 7.5 days, respectively.

The frequency of moulting, and consequently the number of larval instars, varied; some larvae passed through five instars before pupation whilst others passed through six instars. In the batch of 30 larvae reared, 33% of the females passed through six instars whereas 83% of the males passed through five instars.

The 1<sup>st</sup> instar larvae caused minimal damage as they just scrapped the upper epidermal layer of coffee leaves. Approximately 1.8% of the leaf area supplied to 1<sup>st</sup> instar larvae was consumed. In the 2<sup>nd</sup> instar, larvae started to eat the lamina from the edge and on the average consumed 3 x the area consumed by the 1<sup>st</sup> instar larvae (Table 2). From the 3<sup>rd</sup> instar on, larvae fed voraciously with the 5<sup>th</sup> and 6<sup>th</sup> instars consuming 84.4 – 86.4% of the leaf area supplied.

### DISCUSSION

*Epicampoptera andersoni* completed its development from egg to adult on leaf of robusta coffee in the laboratory in 26.3 days (for larvae passing through five instars) and 31.7 days (for larvae passing through six instars). The short developmental period coupled with its high fecundity, high foliage consumption, especially in the last instar, and total yield loss in an outbreak situation make the insect an economic pest which deserves immediate attention.

The head capsule measurements increased by an average factor of 1.44. This agreed with Dyar's law (Ewete, 1990; Emehute and Odiete, 1991; Wigglesworth, 1965). Measurement of head capsule width would make separation of larvae into instars more accurate than other morphometric parameters.

The 6<sup>th</sup> instar larva was the most destructive with 86.45% of leaf area consumed in a day by a larva. This corroborates the visual observations made by Okelana (1989) of the destructive capacity of the mature larvae and consequent impact especially during severe infestations. Since larvae were always found on the abaxial surface of coffee leaves, control with contact insecticides and/or components with antifeedant properties should be explored along with the natural enemies of this pest.

Table 2. Mean percentage leaf area consumed by larvae of *Epicampoptera andersoni*.

Larval instar	Leaf area consumed (cm <sup>2</sup> )		% of total leaf area
	Mean <sup>a</sup>	Range	
1 <sup>st</sup> instar	2.14	0.62-7.51	1.8
2 <sup>nd</sup> instar	12.15	7.98-13.02	5.4
3 <sup>rd</sup> instar	17.56	15.34-19.22	25.31
4 <sup>th</sup> instar	22.45	19.98-24.60	61.0
5 <sup>th</sup> instar	27.90	26.15-29.88	84.4
6 <sup>th</sup> instar	33.87	31.05-35.40	86.4

<sup>a</sup> Mean of 10 larvae

### ACKNOWLEDGEMENT

We are grateful to the Executive Director, Cocoa Research Institute of Nigeria, for the permission to publish this paper. Many thanks to Mr. M.A. Olayiwola and Mrs. M.A. Akande for their technical assistance.

### REFERENCES

- Cambrony, H.R. 1992. *Coffee Growing*. The Tropical Agriculturalist. CTA and Macmillan Press Ltd., London, 119pp
- Coste, R. 1992. *Coffee, The Plant and the Products*. The Macmillan Press Ltd., UK, 328pp.
- Emehute, J.K.U. and Odiete, W.O. 1991. Some aspects of the biology of *Conchyloctenia nigriparsa* Boh. (Coleoptera: Chrysomelidae), a sweet potato defoliator in Southern Nigeria. *Nigerian Journal of Entomology* 12:25-34.
- Ewete, F.K. 1990. The immature stages and chaetotaxy of *Acraea terpischore* L. (Lepidoptera: Nymphalidae). *Journal of African Zoology* 104:191-199.
- Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*, 2<sup>nd</sup> ed., John Wiley & Sons Inc., New York, 680pp.
- Idowu, O.L. 1971. Report on work done on coffee Entomology as a Research Officer-in-Training (1968-1971) at Cocoa Research Institute of Nigeria, Ibadan. 24pp.
- Lepelley, R. H. 1978. *Pests of Coffee*. Longmans, Green and Co. Ltd., 590 pp
- Okelana, F.A. 1985. Oviposition pattern, hatching and parasitism of eggs of *Epicampoptera strandi* Bryk. Sub. sp. *glauca* Hmps. (Lepidoptera: Drepanidae) on coffee in Nigeria. *Café, Cacao, Thé* 24 (4): 273-276.
- Okelana, F.A. 1989. Bio-ecology and control of insect pests of coffee. In: *Progress in Tree Crop Research*, 2<sup>nd</sup> ed., Cocoa Research Institute of Nigeria, Ibadan, Nigeria, pp. 152 – 165.
- Williams, J.A. 1989. Coffee breeding in Nigeria, In: *Progress in Tree Crop Research*, 2<sup>nd</sup> ed. Cocoa Research Institute of Nigeria, Ibadan, Nigeria. pp.127-140.
- Wigglesworth, V.B. 1965. *The Principles of Insect Physiology*, 6<sup>th</sup> ed., Methuen, London. 741pp.

## AUTHOR'S GUIDE

**Publication Policy**

The Nigerian Journal of Entomology is published annually by the Entomological Society of Nigeria. Original research on any aspect of entomology and related arthropods are accepted and peer-reviewed for publication as a Full Length, a Short Communication or a Review Article. Contributors are expected to pay Two Thousand Naira (₦2,000.00) per manuscript as handling charges while submitting and pay Seven Thousand Five Hundred Naira (₦7,500.00) if their papers are accepted for publication. Both rates are subject to review.

**Manuscript**

Premium is placed on high standard of technical content and communication in English. Manuscript should be typewritten (Times New Roman, Font 12 points) double-spaced on A4 (30cm × 21cm) paper with 3.5cm margin on the left, 3.0cm margins at the top and bottom of the page.

**Title**

Title should be explicit and concise showing type of study, organism(s) involved and the location study. Scientific names in the title should be accompanied by the order and family to which the organisms belong, e.g., *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae). Key words to be used for indexing should be provided and arranged alphabetically below the abstract.

**Authorship**

Author's name and address should follow title with the surname coming first. Current address if different from institution where work was carried out should be given as a footnote. The corresponding author should be indicated by superscript asterisk on the last initial.

**Running Title**

Author(s) should provide a shortened version of the title below the abstract.

**Text**

Text should be organized into Abstract, Introduction, Materials and Methods, Results, Discussion or Results and Discussion, Acknowledgements, References. The Abstract should be explicit and informative encapsulating objective of study, methodology, findings and conclusions/recommendations. The Introduction should contain an updated review of literature to give essential background information and objectives of research as well as make evident incremental contribution being made to knowledge. Materials and Methods should be described explicitly, except when well known procedures have been followed or modified, to enable others interpret the results or duplicate the work. In the case of a modified procedure the requisite publication should be cited and the modification described. Results should be presented without duplicating data that can be seen in Table(s) or Figure(s). Discussion should explain rather than be repetitive of results, relate findings to previous knowledge, and focus on implication and consequences of results.

**Tables** Should be self-explanatory, well composed, typed one to a page and numbered consecutively using Arabic numerals. Tabular footnotes should be indicated with

superscript alphabets explained in separate paragraphs at the bottom of the table. Data presented must have been subjected to appropriate statistical analysis.

**Illustrations**

Illustrations should be twice the final size required and made with black ink on white cardboard paper. Symbols such as 'x', 'y', 'z' should be avoided. Legends should be typed below the illustrations. Photographs should be on gloss print with good contrast of black and white. Coloured photographs will attract additional charges.

**Units and Numbers**

SI units should be used and the unit system symbol separated from the value preceding it, e.g., 15 m. Arabic numerals should be used for: (a) quantities of items <10, (b) quantitative measurements in text and tables, e.g. 7.0 cm and (c) for numbers preceded by a capitalized noun, e.g., Table 9.

**Nomenclature**

Authors should comply with the International Code of Zoological Nomenclature. Species name should be given in full (followed by author's name) in the title, abstract and when first mentioned in the text. Subsequently, the generic name should be abbreviated.

**Name of Pesticide**

The trade name of a pesticide should precede by its internationally accepted common name and the common name used subsequently.

**REFERENCES**

Reference and citations should follow the name and year system; where there is more than one co-author, the senior author's name should be followed by *et al.* before the year of publication. Alphabets should be appended to year of publication when more than one paper is published in the same year by the same author(s).

Examples: Oke (1985); Ekesi (2005a, b); Okperake and Dike (2005); Dungum *et al.* (2005); (Aigbodion and Anyiwe, 2001; Molta *et al.*, 1996; Petu and Umeozor, 1987).

References cited in the text must be listed in alphabetical order of the sole or senior author. The different types of citation are

- Ekesi, S. 2005. Ash from cooking fires synergizes efficacy of the entomopathogenic fungus, *Metarhizium anisopliae* against four major stored product insect pests. Nigerian Journal of Entomology 22: 64-75.
- Hill, D.S 1983. Agricultural Insect Pests of the Tropics and Their Control, 2<sup>nd</sup> ed, Cambridge University Press, London. 746 pp.
- Jackai, L.E. N., Singh, S. R., Raheja A. K. and Wiedijic, F. 1985. Recent trends in the control of cowpea, *V. unguiculata* (L.) Walp, pests in Africa. In: Cowpea Research Production and Utilization (Singh, S.R. and Rachie, K. C. eds.), pp. 233 -243. John Wiley and Sons, Chichester, U.K.

**Proof**

Galley proofs are sent to authors for correction of printer's errors only. Any alteration by authors at this stage could

lead to additional page charges. Corrected proofs are to be returned to the Editor-in-Chief within 2 weeks.

**Reprint**

Five copies of the reprint of each article are supplied to the sole or senior author.

**Submission of Manuscripts**

Three copies of all manuscripts to be considered for publication should be addressed to:

Professor E. O. Ogunwolu  
(Editor -in- Charge, NJE)  
Department of Crop and Environmental Protection.  
E-mail: delbank\_ogunwolu@yahoo.com

University of Agriculture, P.M.B. 2373, Makurdi.

Authors must affirm that the work has not been published and the manuscript is not undergoing simultaneous processing for publication in another journal.

The revised manuscript (three copies) must be accompanied by an electronic version on diskette in Microsoft Word as well as accompanied by the reviewed manuscript (s).

Author(s) take (s) full responsibility for statements, views, opinions and data contained in paper published. Mention of proprietary products in NJE does not connote endorsement by Entomological Society of Nigeria.