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Some Aspects of the Biology of *Conchyloctenia nigrosparsa* Boh. (Coleoptera: Chrysomelidae), a Sweet Potato Defoliator in southern Nigeria

J. K.U. EMEHUTE and W.O. ODIETE*

National Root Crops Research Institute, P.M.B. 7006, Umudike Umuahia, Imo State, Nigeria.
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ABSTRACT

The behaviour and the biology of *Conchyloctenia nigrosparsa* Boh. were investigated in sweet potato, *Ipomoea batatas* (L.) Lam; plots and in the laboratory. Adults and larvae fed voraciously on sweet potato leaves. Females required frequent copulation to sustain oviposition. Mating reduced adult life by 18-20 days, mated females outlived mated males by 6.0 days. A mated female laid 24.0 oothecae, each containing about 30.0 eggs. The stadium for 1st, 2nd, 3rd, 4th and 5th, instars was 2,2,2,3 and 4 days respectively. The developmental time from egg to adult emergence was 26-27 days when *C. nigrosparsa* was reared on *I. batatas, I repens* (L.), *I.cairica* (L.) and *I. involucrata* (Beauvois). The data also showed that the larval instars could be separated accurately by measuring the head capsules.

Fifteen to sixty percent of eggs of *C. nigrosparsa* were parasitised by *Tetrastichus* sp. *Hotea gambiae* Westw., *Afrius purpureus* Westw. and *Rhincoris bicolor* (F.) preyed actively on the immature stages of *C. nigrosparsa.*

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam. Convolvulaceae) is one of the root crops grown in many tropical countries, ranking seventh among all the other crops in total production (Plucknett, 1984). It has a short growth period of 4-5 months and requires an average of 1,020mm of rainfall annually. Under irrigation, it can be cropped twice yearly. The tuberous roots and the green leaves are rich in essential food materials such as carbohydrates, proteins, minerals and vitamins (French, 1955; Byers, 1961; Oyenuga, 1968; Madamba and San Pedro, 1976). Sweet potato is grown in many parts of Nigeria either sole or intercropped with yam, cassava or maize and serves as a suitable food substitute when yams, cassava or

*Present address: Department of Biological Sciences, University of Lagos, Akoka, Lagos, Nigeria.

cocoyams are not readily available. Its production in the tropics is limited by insect pests (Macdonald, 1963; Smee, 1965; Jerath, 1967; Baltazar, 1970) which damage both the aerial and subterranean parts.

Several insect species attack sweet potato in Nigeria (Jerath, 1967; Anon, 1971; Anota and Odebiyi, 1984) from planting through harvest, thus reducing the yield as well as limiting increased production of the crop. In recent years, it was observed that field plots of sweet potato could be seriously defoliated by *Conchyloctenia nigrosparsa.* Boh. resulting in poor quality foliage and possible yield losses. Based on the field observations, *C. nigrosparsa* could be a potential pest of sweet potato. Investigations on some aspects of its biology were therefore carried out as a first step towards formulating effective control strategy for the pest. The result of the investigations are reported in this paper.

MATERIALS AND METHODS

The behaviour of *C. nigrosparsa* was studied over a 12 month-period in two sweet potato plots each 50 x 30m located in Akoka and Ikorodu area of Lagos State of Nigeria. Adults (males and females) collected from the field plots were used to initiate laboratory culture out of which 30 pairs in separate perforated plastic boxes (18.5 x 12.6 x 7.2 cm) were used for life history studies. The experiment was conducted under fluctuating temperature and relative humidity of 24.7-30°C and 69.0-92.0% respectively at the Zoology Research Laboratory of the University of Lagos, Nigeria. Adults and immature stages were reared on fresh sweet potato leaves supplied every 3 days in plastic boxes. The life cycle of *C.nigrospa* was also investigatd on three wild specie *Ipomoea* in the laboratory. The relations between copulation and oviposition was tablished by carrying out simple linear gression analysis using 10 pairs *C.nigrosparsa* held in separate rearing tainers.

Measurement of the width of head sules of the larval instars was carried ou *nigrosparsa* retained cast exuviae for 1st-3rd instar larvae in tiers on a pai elongated, almost U-shaped anal pro tion. The 1st-4th exuviae together with anal projections were disposed of at the of the 4th instar larva. To obtain the h capsules of 1st-4th instars, cast exuviae w soaked in cold water to soften them and head capsules were then separated unde dissecting binocular microscope. For t [illegible] heads of mature larv [illegible] measured. Each head capsule w [illegible] on a light binocular microsco [illegible] measured at its widest point with the a of an eye-piece micrometer. One hundr and fifty head capsules (30 per instar) wer measured.

To assess egg parasitism in *C. nigrospa sa,* oothecae (egg-pods) were randomly co lected forthnightly at- 4,6,8 and 10 week after planting (w.a.p). A total of 200 oothe cae (100 per location) were collected fron the field plots and each was held for obser vation in a Petri-dish. Data were taken or the number of parasites emerging from each ootheca, number of unemerged parasites by dissecting and the number of unparasitised host eggs. Observations were

made on other entomophagous species noting particularly the stage(s) of *C. nigrosparsa* attacked through feeding experiments. Indentification of insect specimens was by the Commonwealth Institute of Entomology (C.I.E.) London.

RESULTS

Habits

C.nigrosparsa is diurnal, easily observed between 8.00 and 10.00 in the morning and 4.30 and 6.30 in the evening (Nigerian time). The adults preferred cool and bright weather but hid under fallen vegetation and/or in soil cracks with increase in solar radiation. Adults did not fly often but when they did, they covered more than a distance of 50m before landing. Mating took place on the upper leaf surfaces but the females deposited and glued their oothecae on the lower leaf surfaces. Whereas 1st-3rd instar larvae perforated sweet potato leaves, the 4th and 5th instar larvae and the adults chewed the leaf blades (Plate 1).

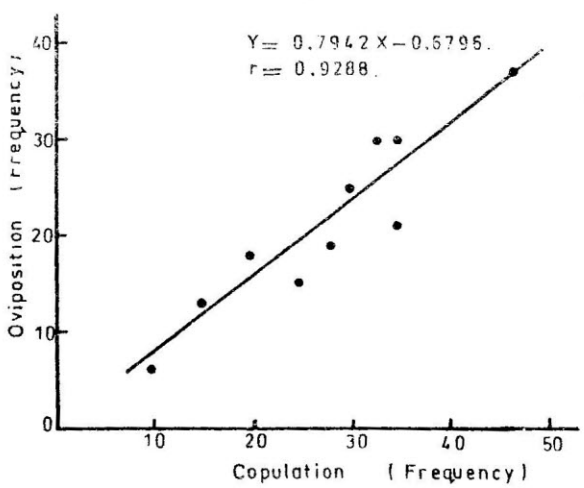

Fig. 1: Relationship between copulation and oviposition in C. nigrosparsa.

LIFE HISTORY

Copulation and oviposition

Pre-occupation, pre-oviposition and oviposition periods were 9.40, 15.90 and 45.70 days respectively (Table 1). Copulation was performed from time to time until a few days to death. Copulation was frequent and each lasted 30.5 ± 2.91 mins. A mated female laid an average of 24.0 oothecae. Each ootheca (Plate 2) measured 5.5 x 5.2 mm, was whitish, spongy and fairly cylindrical and contained about 30.0 ± 5.4 eggs. There was a positive and significant correlation between the frequencies of copulation and oviposition (P = 0.01) (Fig.1) Unmated females occasionally laid eggs which were unviable.

Plate 1: Foliar damage by 5th instar larva of C. nigrosparsa

Table 1. Oviposition parameters, fecundity and longevity of adult *C. nigrosparsa* with number in parenthesis.

Adult Characteristics	Mean period (days) ± S.E.	Mean No. of eggs laid/ female ± S.E.
Pre-occupation	9.40±0.09 (35)	-
Pre-oviposition	15.90±0.11 (35)	-
Oviposition	45.70±3.09 (30)	-
Fecundity	-	716±67.0 (30)
Longevity		
Mated male	44.5±5 (20)	-
Mated Female	50.8±3.8 (20)	-

Preimaginal stages:

Table 2 summarises the duration in days of the stages of C.nigrosparsa reared on sweet potato leaves in the laboratory. There were five larval instars and the developmental period from egg to adult emergence was 26 days for both sexes. The eggs were arranged in compartments within each ootheca. Each egg was cream-coloured, elongated, oval in shape and measured 1.44 x 0.58mm (Table 3). The size of ootheca and the number of eggs it contained diminished with the age of the ovipositing females. Incubation period was 7.4 days (Table 2).

Table 3 shows the measurements of the various life stages of *C.nigrosparsa*. The larval instars showed progressive increases in size as reflected in the measurements of the body and the head capsule. The mature 5th instar larva measured 9.6 x 4.9 mm and was outstanding in terms of size and damage to sweet potato leaves. It was dirty-ash coloured, dorso-ventrally flattened and possessed 16 pairs of lateral spines, of dorsal spines and 9 pairs of spi The paired spiracles were situat posite 4th and 9th-16th spines, t gest and smallest spiracles associated with the 4th and 16th s respectively (Fig. 2). After 4 da mature larva ceased feeding and ventrally on sweet potato leaves o where it became a whitish sed prepupa and within 24h later be dark-brown pupa.

Adult

Although the sexes are the same in males were smaller in size, measuring 5.60 mm, than the females which me 10.40 x 6.20 (Table 3). Both sexes pos dark-brown spots on the elytra (Plate the abdomen of the female was lig colour on the ventral side than the ab of the male. Adult longevity was limi food, sex and mating. Starved adul

Table 2. Mean developmental period (in days) of various life stages and mean life-cycle (egg-adult emergence) of *C.nigrosparsa* reared on sweet potato and other wild potato species; numbers in parenthesis.

Host plant	Stage	Mean duration (days)±S.E.	Mean life cycle (days)±S.E.
Ipomoea batatas	Egg	7.40±0.09 (30)	26.0±0.50 (30)
	Larvae		
	1st Instar	2.0±0.0 (30)	
	2nd insar	2.0±0.0 (30)	
	3rd instar	2.0±0.0 (30)	
	4th instar	3.0±0.0 (30)	
	5th instar	4.0±0.0 (30)	
	Prepupa	1.0±0.0 (25)	
	Pupa	4.4±0.09 (20)	
I. repens		-	27.0±0.10 (20)
I. cairica		-	26.4±0.70 (25)
I. involucrata		-	26.5±0.40 (19)

within 2-4 days after emergence (n = 15/sex). Well-fed mated adults lived 44.5 and 50.8 days for males and females, respectively (Table 1); the females outlived the males by 6 days. Mating reduced adult life span by 18-20 days in both sexes; unmated males lived longer than unmated females by 5-7 days (n = 20/sex).

Alternative host plants

C.nigrosparsa successfully fed and completed its life cycle on three wild *Ipomoea* species namely *I.repens, I.cairica* and *I.involucrata*. Its means life cycle on sweet potato and on the three wild *Ipomoea* species did not differ statistically at 5% level under the laboratory conditions (Table 2).

Natural enemies

Egg parasitism by an eulophid parasitoi *Tetrastichus* spp. (Plate 3), ranged from 1: 35% at Ikorodu and 40-60% at Akok (Table 4). Two pentatomid predator *Hotea gambiae* Westw. (Plate 4), *Afrius pu pureus* Westw. and a reduviid, *Rhincor bicolor* (F.), preyed on the immature stag of *C.nigrosparsa*. Adults of *C.nigrospar* were not preyed upon or parasitised by a of the identified natural enemies. Targets predation were the 4th and 5th larval insta and the pupa with the pentatomids killi an average of 5.7 of the former stages a 8-10 of the latter stage per day (Table 5)

Table 3. Measurement of the various developmental stages of *C. nigrosparsa* reared o sweet potato leaves

Stage of development	Number (n)	Length $\bar{x} \pm$ S.E. (mm)-	Width $\bar{x} \pm$ S.E. (mm)	Head capsule width (mm) ±S.E.	Growth ratio
Oothe	30	5.50 ±0.30	5.20 ± 0.20	-	-
Egg	300	1.44 ± 0.01	0.58 ± 0.02	-	-
Larva					
1st instar	30	2.20 ± 0.10	1.4 ± 0.30	0.43 ±0.01 (0.38 - 0.47)	
					1.40
2nd instar	30	3.80 ± 0.10	1.90 ± 0.20	0.60 ±0.01 (0.56 - 0.64)	
					1.38
3rd instar	30	5.20 ± 0.20	2.60 ± 0.40	0.83 ±0.01 0.75 - 0.90)	
					1.39
4th instar	30	7.10±0.30	3.60±0.50	1.15±0.02 (1.05 - 1.22)	
					1.37
5th instar	30	9.60 ± 0.20	4.90 ± 0.10	1.57 ± 0.02 (1.39 - 1.76)	
Adult					
Male	40	8.60 ± + 0.10	5.60 ± 0.30	-	-
Female	20	10.40 ± 0.60	7.80 ± 0.40	-	-

The relationship between copulation and oviposition showed that *C.nigrosparsa* required multiple mating in order to sustain oviposition. Similar relationship had been reported for *Prodenia litura* (Fab.) (Nurul Islam and Ali, 1978). The earlier death of the unmated individuals could be attributed their reproductive activities resulting expenditure of energy as had been rep

Plate 2: C. nigrosparsa female ovipositing an ootheca.

other insect species (Chauthani and Misra, 1966; Usua, 1970; Aina, 1972). Chapman (1971) reported that unmated females of *Schistocerca* lived longer than the mated females which produced more viable eggs.

The width of the head capsules of the larval instars increased in a regular geometric progression by a factor of 1.38 in line with Dyar's 'Law' (Wigglesworth, 1965). The larval instars can therefore be separated accurately by measurement of the larval head capsules.

The fact that *C.nigrosparsa* can develop just as fast on sweet potato as on the wild species suggests that the elimination of wild species of *Ipomoea* in areas where sweet potato is grown is desirable in order to deprive *C.nigrosparsa* of sources of food, shelter, oviposition and development during the off-season of sweet potato. This would lead to a reduction in the population of *C.nigrosparsa* in sweet potato plots.

The presence of active natural enemies of *C.nigrosparsa* calls for caution in the use of insecticides against insect pests of sweet potato in order to ensure the safety of these bio-agents and other beneficials in the ecosystem. The foliage feeding habit of *C.nigrosparsa* suggests a possible direct negative effect on the quality and quantity of sweet potato and an indirect negative effect on

Table 4. Parasitisation rates of eggs of *C. nigrosparsa* by *Tetrastichus sp.* in two locations in Lagos Nigeria with numbers of oothecae in parentheses.

Location	Sampling time (W.a.p.)	Total eggs	No. of eggs parasitised	Parasitisation (%)
Akoka	4	560 (20)	225	40.2
	6	775 (25)	341	44.0
	8	870 (30)	478	54.9
	10.	700 (25)	423	60.4
Ikorodu	4	435 (15)	65	14.9
	6	840.(30)	210	25.0
	8	960 (30)	340	35.4
	10	675 (25)	236	35.3

Table 5. Predation rates* of *H.gambiae* and *A.purpureus* on the 4th and 5th larval instars and the pupa of *C.nigrosparsa.*

	4th and 5th larval instars		Pupa	
Predator sp.	No.supplied per day	No. killed per day	No.supplied per day	No. killed per day
H.gambiae	20	14	30	20
A.purpureus	20	10	30	16

*Mean for 10 pairs (male & female) of 5 observations.

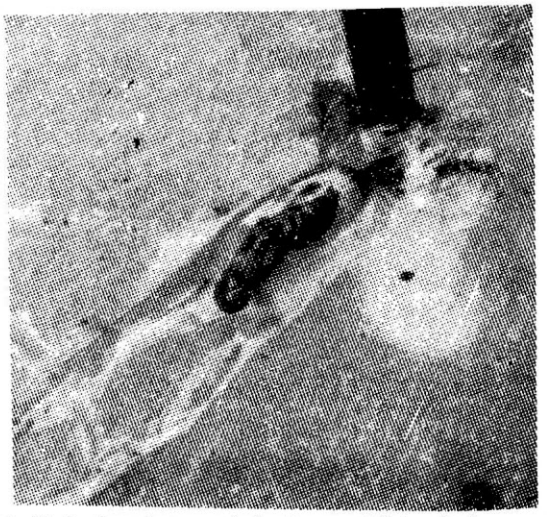

Plate 3: A developmental stage of Tetrastichus sp. within partly opened chorion of C. nigrosparsa egg

Plate 4: H. gambiae (adult) feeding on 5th instar larva of C. nigrosparsa

the tuber due to reduced photosynthesis and photosynthetic sinks. Future study should investigate the pest damage in relation to vegetable and tuber yields for the assessment of the pest status of *C.nigrosparsa* in sweet potato agro-ecosystem.

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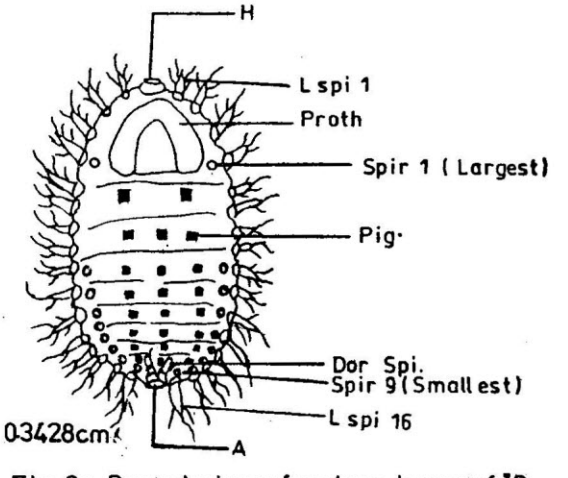

Fig·2: Dorsal view of mature larva of C. nigrosparsa.
H-Head LSpi-Lateral spine 1
Proth-Prothorax Spir 1-Spiracle 1
Pig-Pigment Dor Spi-Dorsal spine
Spir 9-Spiracle 9 LSpi 16-Lateral spine 16
A - Anus

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