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Developmental biology of *Aspavia armigera* (FABRICIUS, 1775) (Hemiptera: Pentatomidae) on rice (*Oryza sativa* L.) (Poaceae) and three other hosts in Nigeria

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ABSTRACT. The developmental biology of *Aspavia armigera* on four rice varieties ITA 301, ITA 305, ITA 307 and ITA 315 was studied under ambient conditions at the Plant Biology Laboratory, Olabisi Onabanjo University, Ago-Iwoye, Nigeria. Alternative host plants were also used in the experiment. The results showed that the development of *A. armigera* depended on its hosts. Oviposition periods were 41.7 days, 30.8 days, 22.6 days and 18.1 days on rice varieties ITA 301, ITA 305, ITA 307 and ITA 315, respectively. Fecundity ranged from 80.3 eggs on ITA 301, 79.6 eggs on ITA 307, 76.1 eggs on ITA 305 and 65.6 eggs on ITA 315. The differences in fecundity were not statistically significant. The eggs incubated for 4 to 6 days before hatching into nymphs on all the varieties. The longevity of mated and unmated males and mated females on the rice varieties were not statistically different, while unmated females lived significantly longer on ITA 305. There were five nymphal instars, which persisted for 16.8-19.5 days depending on the variety. The developmental period was significantly ($p<0.05$) delayed on ITA 315, and the mean growth ratio of head capsule measurements was 1.27. Oviposition periods ranged between 5 and 20 days on cowpea and 6 and 18 days on rice. A significantly higher number of eggs (fecundity) was laid by mated females of *A. armigera* fed on soybean than those fed on cowpea. Mean developmental periods were 25.7, 25.5, 21.4, and 20.3 days on soybean, amaranthus, rice and cowpea, respectively. Mated females lived for a significantly shorter period on cowpea (21.9 days) than on the other hosts.

KEY WORDS: host plant, oviposition, longevity, amaranthus, life cycle

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INTRODUCTION

Alydid and pentatomid bugs are mainly seed pests of rice worldwide (LITSINGER et al. 1986, FOSTER et al. 1989). The pentatomids are commonly referred to as shield bugs, among which are *Aspavia* STÅL, 1865 species and *Nezara viridula* (LINNAEUS, 1758). At least three different species of *Aspavia* exist on rice, the most abundant being *A. armigera* (FABRICIUS, 1775) and to a lesser extent *A. acuminata* MONTANDON, 1894. Adults and nymphs generally feed on the developing seeds and sometimes on the stem (IITA 1984). The colour of the adult *Aspavia* is brown with three yellow spots at the apices of the triangular scutellum. The dorsal surface of the prothoracic plate has a pointed projection (spine) on each side. The adult of *A. armigera* is about 8-9 mm long and 4-5 mm wide. The yellow spots are smaller than the bolder ones of *A. acuminata*. The size of the yellow spots generally differentiates one species of *Aspavia* from another (UMEH 1991). *Aspavia* is found in Africa (though not in all parts) in three climatic zones.

Only three species occur in East Africa and there are two more in West African countries (ALAM et al. 1983, JOHN et al. 1986). *Aspavia* infestation is very important in the production of rice and other grains. The feeding of both the adult and nymphs of *Aspavia* species, especially *A. armigera* at the dough stage, results in partially filled grains of low quality. Unprocessed panicles (paddy) usually have diffuse brown spots indicating areas of attack on the grains by the bugs. However, infested grains turn dirty brown to black during parboiling, thus affecting their aesthetic value. Therefore, attack on panicles at the milk and dough stages may be viewed as affecting the quality of the grains rather than yield loss (UMEH et al. 1991, BURDEOS & GABRIEL 1995).

On cowpea (*Vigna unguiculata* L. WALP.), *Aspavia armigera* caused a significant yield loss at 2 bugs per 10 plants and a total seed loss as a population of 16 bugs per 10 plants (PITAN et al. 2007). *Aspavia* species continue to be more important economically to rice production in Nigeria. Despite the importance of the pests in the production of rice and other crops, little information is available on the pest, especially its developmental biology on rice. This information is necessary during the planning stage of control programmes. Hence, the objective of the study was to elucidate the developmental biology of *A. armigera* on rice and other hosts.

MATERIALS AND METHODS

Experiment 1: Biology of *Aspavia armigera* on four rice varieties

Four rice varieties (ITA 301, ITA 305, ITA 307 and ITA 315), supplied by Africa Rice Ibadan, were sown in pots at the Plant Biology Laboratory, Olabisi Onabanjo University, Ago-Iwoye. Four pots (20 cm diameter) were filled with sieved top soil and seeded with each rice variety. Six seeds were dibbled per pot and after germination were thinned down to two seedlings. The pots were watered twice daily during the dry season, once every other day during the rainy season and as necessary. The potted rice plants were allowed to develop until panicle formation. Fresh soft panicles of these rice varieties were obtained from the plants as foods for the insects.

Insect culture and rearing cages

Adults of *Aspavia* were collected from rice fields around Ago-Iwoye, Ogun State, Nigeria, and the sexes of the insects were determined by comparing their external genitalia. A pair, male and female, was enclosed in each of ten plastic cages of dimensions (14 x 9 x 6 cm) with a lid. They were supplied with fresh panicles of ITA 301, ITA 305, ITA 307 and ITA 315 every other day. These soft panicle stalks were inserted into moistened cotton wool already plugged into a glass vial in the cages to preserve their freshness and to provide water for the insect. *A. armigera* adults were left in the cages to oviposit. Fresh eggs were collected from these cages every morning and placed in plastic Petri dishes, each with a lid and lined with moistened Whatman No. 9 filter paper. The Petri dishes were labelled to indicate the date of egg collection and hatching as well as the rice variety from which eggs were collected. Eggs were incubated at ambient laboratory temperature 24-27°C and relative humidity 88-92%. The neonate nymphs used in the subsequent experiments were obtained from the culture.

Observations on egg viability, nymphal development, growth index, sex ratio and longevity of *A. armigera* on four rice varieties

Sixty nymphs of *A. armigera* that hatched from the incubated eggs were reared singly in separate cages on each of the four rice varieties. The developmental periods of each nymphal instar was monitored daily by looking for exuviae, a clear indication of moulting (EWETE & OLAGBAJU 1990). Fresh soft panicles and water were supplied every day and the cages kept clean by removing the secretions and faeces inside them. Dead nymphs were replaced with newly hatched ones. The developmental period (nymph-adult) was recorded. Observations were made on nymphal survival at each stage and the sex ratio. The growth index was determined using CATINDIG et al. (1993):

$$\text{Growth index} = \frac{\text{Larval survival (\%)}}{\text{Larval growth period (days)}}$$

Adults that emerged from this study were paired immediately to study the lifespan of mated *A. armigera*. Similarly, the longevity of 10 unmated males and females of *A. armigera* on each rice variety was studied.

Observations of pre-mating, mating, pre-oviposition, oviposition periods, egg viability and fecundity of *Aspavia armigera*

A pair of teneral adults (1 male + 1 female) removed from the insect culture was placed in each of the 15 plastic cages described earlier. They were supplied with soft panicles of each of the four rice varieties (ITA 301, ITA 305, ITA 307 and ITA 315), which served as treatments in a completely randomized design. Each treatment was applied 15 times. Observations were made on pre-mating, mating, pre-oviposition, oviposition periods and fecundity of the mated females in each of the plastic cages on each rice variety. Dead insects were replaced with teneral adults of the appropriate sex (to ensure continuous mating). The eggs collected from the cages were allowed to incubate in separate Petri dishes and their viability was recorded. Similar experimental procedures were carried out and observations made on 10 unmated females on each rice variety.

Morphometrics of the developmental stages of *Aspavia armigera*

Thirty eggs sampled from the *A. armigera* egg batches and twenty nymphs from each of the developmental stages were killed with ethyl acetate one day prior to the next moulting and preserved in 70% ethanol for 24 hours. Similarly, ten male and female adults were killed in the same way as the nymphs and their body length, width of abdomen and head capsule (vertex) measured. All measurements were made under a drawing microscope (x 160) fitted with a graticule in its eye piece. Each immature stage was described.

Experiment 2: Biology of *Aspavia armigera* on its alternative hosts: soybean, cowpea, amaranthus

The same procedures for Experiment 1 on rice were followed except that different food sources were provided: soybean (TGX 1448-2E), cowpea (IT 86D-71%), amaranthus (NH84/493), and rice (ITA 315) as control. Tender pods of soybean (R-5 stage), cowpea, soft panicles of rice and flower heads of amaranthus were supplied to nymphs of *A. armigera* in separate cages. The same observations of the developmental biology of *A. armigera* as in Experiment I were made and recorded.

RESULTS

Experiment 1: Biology of *Aspavia armigera* on four rice varieties

Egg viability, nymphal development, growth index, sex ratio and longevity of Aspavia armigera on rice varieties

Nymphs of *A. armigera* were successfully reared to adults on the four rice varieties. The first neonate nymphs appeared not to feed and had average developmental periods ranging from 2.3 days on ITA 301 to 3.0 days on ITA 315. The fifth instar had the longest developmental period on the four varieties. However, the fourth and the fifth instar stages took a significantly longer period to develop on ITA 315 relative to the other varieties. The mean total nymphal developmental period was significantly shorter on ITA 301 (16.8 days) and longer (significantly delayed) on ITA 315 (19.5 days) than on the other varieties (Table 1). The highest percentage of viable eggs (92%) was recorded when mated females were fed on rice variety ITA 301, while the lowest (85%) was recorded on ITA 315. The highest percentage nymphal survival (96%) was recorded on ITA 305 and ITA 307, and 94% on ITA 302, which were statistically superior to the 86% recorded on ITA 315 (Table 2). Unmated males lived significantly longer on ITA 315, while unmated females lived longer on ITA 305 compared to the other varieties, which were not statistically different from one another. However, the longevities of the mated males and females did not vary significantly ($p<0.05$) among the four rice varieties tested (Table 3).

Table 1. Mean duration (days ± S.E) of *Aspavia armigera* nymphal development on four rice varieties.

Developmental period	Rice variety			
	ITA 301	**ITA 305**	**ITA 307**	**ITA 315**
Instar I	2.8±0.29a (2-5)	2.6±0.22a (2-4)	2.3±0.15a (2-3)	3.0±0a (3)
Instar II	2.8±0.13a (2-3)	3.4±0.27a (2-5)	3.1±0.18a (2-4)	3.8±0.13a (3-4)
Instar III	3.1±0.18a (3-4)	2.8±0.13a (2-3)	3.1±0.18a (2-4)	3.2±0.13a (3-4)
Instar IV	3.4±0.16a (3-4)	3.4±0.38a (2-6)	3.2±0.13a (5-6)	6.0±0.26b (5-6)
Instar V	5.0±0.21a (4-6)	5.2±0.21a (4-6)	5.2±0.13a (5-6)	6.0±0.26b (5-6)
Mean developmental period	17.1±0.21a (16-19)	17.40±0.13a (16-19)	16.8±0.13a (16-17)	19.5±0.17b (18-21)

C.V = 3.5%; S.E = 0.2.
Means followed by the same letter in a row are not significantly different at the 5% level using DMRT.
The numbers in parentheses indicate the range.

Pre-mating, mating, pre-oviposition, oviposition periods, egg viability and fecundity of Aspavia armigera

A. armigera pre-mating, mating, pre-oviposition and oviposition periods were significantly longer on ITA 315 compared to the other varieties, which were statistically similar (Table 4). Copulation between adults of *A. armigera* was usually initiated by the

Table 2. Egg viability, mean survival, growth index and sex ratio of *Aspavia armigera* reared on four rice varieties.

Parameter	Rice variety			
	ITA 301	**ITA 305**	**ITA 307**	**ITA 315**
Egg viability (%)	92	89	90	85
Instar I, survival (%)	90	80	80	30
Instar II , survival (%)	80	100	100	100
Instar III, survival (%)	100	100	100	100
Instar IV, survival (%)	100	100	100	100
Instar V, survival (%)	100	100	100	100
Mean survival %	94.0a	96.0a	96.0a	86.0b
Growth index*	4.09	4.6	3.6	1.54
Sex ratio (m:f)	1:1.1	1:1.4	1:1.1	1:1.2

Means followed by the same letter in a row are not significantly different at the 5% level using DMRT. Average sex ratio = 1:1.2.

Table 3. Mean longevity (days ±S.E.) of unmated and mated adult *Aspavia armigera* reared on rice varieties.

Rice variety	Male longevity {days)			
	Male		Female	
	Unmated	**Mated**	**Unmated**	**Mated**
ITA 301	32.8±4.5a (9-45)	30.1±3.5a (14-35)	36.5±3.0b (23-55)	46.1±5.1a (19-71)
ITA 305	30.8±4.7a (11-57)	34.4±4.3a (10-52)	56.3±5.1a (23-72)	36.0±3.0a (17-49)
ITA 307	43.0±4.9a (18-63)	29.0±4.1a (9-50)	44.7±3.0b (26-59)	42.0±3.1a (26-53)
ITA 315	51.5±6.9b (10-67)	31.7±4.7a (7-56)	38.2±3.8b (9-54)	33.1±4.4a (14-51)
S.E.	4.9	4.4	4.2	3.8
C.V.%	36.2	44.1	30.1	30.1

Means followed by same the letter in a row are not significantly different at the 5% level using DMRT. The numbers in parentheses indicate the range.

male stroking the female genitalia with its antennae. This stimulated the female. The male then turned around and introduced its genital organ (aedeagus) into the female genital opening. They positioned themselves with the tips of their abdomens adhering. Mating was frequent during the early mornings (06:00 to 10:00 hrs) and evening (16:30 to 19:00 hrs) and lasted for three hours.

Table 4. Premating, pre-oviposition, oviposition periods and egg incubation periods (days ± S.E) and fecundity of *Aspavia armigera* on four rice varieties.

Period (days)	Rice variety			
	ITA 301	ITA 305	ITA 307	ITA 315
Pre-mating	5.5±0.4(3-7)a	6.9±0.5(5-9)a	9.6±1.1(6-15)b	18.2±0.7(13-22)c
Pre-oviposition	4.1±0.3(3-5)a	9.3±1.0(6-15)b	6.4±0.4(5-8)a	9.0±1.1(6-15)b
Oviposition	41.7±2.0(13-54)a	30.8±1.1(27-36)a	22.6±4.2(11-52)b	18.1±2.0(11-32)b
Fecundity	80.3±1.1(15-136)a	76.1±13.8(4-147)a	79.6±8.4(39-113)a	65.6±10.5(20-24)a
Egg incubation	4.6±0.15(4-5)a	4.3±0.15(4-5)a	4.6±0.2(4-5)a	4.7±0.3(4-6)a

Each value is a mean of 10 replicates.
Means followed by the same letter in a row are not significantly different at the 5% level using DMRT.
The numbers in parentheses are ranges.

The females of *A. armigera* were oviparous and laid eggs in captivity under laboratory conditions. Eggs were laid indiscriminately in batches of 2 to 40 on the panicles. A few clutches of eggs were also found on the grains. Although there were numerical differences in fecundity, they were not statistically significant. Virgin females laid relatively fewer eggs than their mated counterparts, and they were not viable. The eggs incubated for 4 to 6 days before the nymphs hatched. The mean oviposition periods were shorter on ITA 307 and ITA 315 (41.7 and 30.8 days respectively) than on ITA 301 and ITA 305 (22.6 and 18.1 days respectively) (Table 4).

Morphometrics of developmental stages of Aspavia armigera

Description of the eggs: Eggs were oval in shape, dirty-white when freshly laid, changing to dark brown at the end of the incubation period. They were taped anteriorly with whitish hair-like projections, the sides surrounded with dark reticulations in two regions; reticulations were also present on the caps of the eggs though not covering the entire surface. The eggs had a mean length of 0.92 mm and were 0.75 mm wide, the chorion was transparent with the reticulations only at the sides, and the average incubation period was 4.6 (range = 4 to 6) days.

First to third instar: The body of the first instar was dark-brown in the anterior region and light brown at the abdomen, which was rounded. The head capsule had a pair of compound eyes, two antennae that were not as long as the body, four antennal segments each demarcated by a white band at the joints, and eight abdominal segments with dark brown markings on the edges of each of the last six segments. The mean body length was 1.11 mm, the abdominal width was 0.90 mm and the vertex width was 0.40 mm. There was a progressive growth to the second instar with the body gradually turning uniformly dark-brown and a growth ratio of 1.35. The third instar was greenish when freshly moulted but turned brownish with time. The prothoracic spines first appeared at this stage, and the growth ratio increased to 1.43.

Fourth and fifth instars: Body length, width of abdomen and head capsule (vertex) increased progressively in the fourth and fifth instars. The ground colour remained brownish with two prominent yellow spots on the upper part of the scutellum. In the fourth instar, the length of the prothoracic spines increased, and the growth ratio was 1.22. The abdominal segments were more distinct in the fifth instar, giving the appearance of a miniature adult; the growth ratio was 1.27. There was a linear relationship and a significant correlation between nymphal development and head capsule width (y = 0.2 + 0.17X; r = 0.99).

Adults: Adult were about 6 to 8 mm long and 4 to 5 mm wide. The ground colour was brownish with three yellow spots at the apices of the scutellum and a prothoracic spine on either side of its dorsal surface.

Experiment 2: Biology of *Aspavia armigera* on its alternative hosts: soybean, cowpea, *Amaranthus cruentus* and rice

Survival and development of nymphal Aspavia armigera on its alternative hosts

The mean incubation periods were 4.6 (4 to 6) days, 4.9 (4 to 7) days, (4 to 5) days and 4.8 (4 to 6) days on soybean, cowpea, amaranthus and rice respectively. *A. armigera* completed its development on the three alternative hosts. The first instar nymphs had the shortest period on cowpea (av. 2.4 (2 to 4) days while fifth instar nymphs had the longest mean developmental period of 8.8 (6 to 11) days on amaranthus. The total mean developmental periods were 25.7, 25.5, 21.4 and 20.3 days on soybean, amaranthus, rice and cowpea respectively. Nymphal development was significantly ($p<0.05$) delayed on soybean (25.7 days) and amaranthus (25.5 days) (Table 5).

Percentage survival rates of nymphs reared on the alternative hosts were generally high though not significantly different from one another. The highest survival rate was 90.0% on rice and cowpea, the lowest on amaranthus (82%). The highest growth index was obtained on cowpea, while the lowest (3.42) was recorded on soybean. The average sex ratio (m:f) was 1: 1.2 (Table 5).

Longevity of mated and unmated adults of Aspavia armigera fed on soybean, cowpea, amaranthus and rice

The average longevity of mated males of *A. armigera* fed on soybean, amaranthus, rice and cowpea was 32.1, 29.8, 27.8 and 26.0 days respectively. Unmated males lived for an average of 41 (31 to 60) days on soybean, which was statistically different from the period on amaranthus (37 days), rice (30.4 days) and cowpea (8 days). Mated females lived for a significantly shorter period on cowpea (21.9 days) and rice (26 days) (Table 6).

Table 5. Egg incubation period, mean nymphal development (days ± S.E), survival, growth index and sex ratio of *Aspavia armigera* on its alternative hosts.

Parameter	Alternative hists			
	Soybean (TGX 1448-2E)	**Rice (ITA 315)**	**Amaranthus (NH 84/493)**	**Cowpea (IT86D-715)**
Egg incubation	4.6±0.22 (4-6)	4.8±0.25 (4-6)	4.6±0.16 (4-5)	4.9±0.35 (4-7)
Instar I	3.5±0.17) (3-4)	3.2±0.13 (3-4)	3.3±0.15 (3.4)	2.4±0.22 (2-4)
Instar II	4.0±0.25 (3-5)	3.1±0.1 (3-4)	3.7±0.26 (3-5)	2.9±0.23 (2-9)
Instar III	4.9±0.2 (4-6)	3.7±0.21 (3-5)	4.7±0.26 (4-6)	3.7±0.15 (2-9)
Instar IV	4.8±0.25 (4-6)	4.4±0.22 (3-5)	5.0±0.26 (4-6)	4.4±0.27 (8-5)
Instar V	8.5±0.76 (6-12)	7.0±0.15 (6-8)	8.8±0.47 (6-11)	6.9±0.23 (5-8)
Mean developmental period	25.7±0.97a (21-32)	21.4±0.43b (18-23)	25.5±1.5a (23-29)	20.3±0.45c (18-22)
Mean survival (%)	88.0a	90.0a	82.0a	90.0a
Growth index	3.42	3.52	3.83	4.43
Sex ratio	1:1.4	1:1.12	1:1.10	1:1.2

Means followed by the same letter in a row are not significantly different at the 5% level using DMRT. The numbers in parentheses are ranges.

Table 6. Mean longevity (days ±S.E.) of adult of *Aspavia armigera* reared on its alternative hosts.

Alternative hosts	Male longevity {days)			
	Male		**Female**	
	Unmated	**Mated**	**Unmated**	**Mated**
Soybean (TGX 1448-2E)	41.0±2.45a (31-60)	32.10±1.17a (27-49)	38.30±2.71a (24-49)	30.1±2.21a (21-46)
Rice (ITA 315)	30.0±2.0 (6-23)	16.0±1.6 (7-29)	17.6±1.9 (9-23)	12.3±1.6 (6-21)
Amaranthus (NH84/93)	37.0±4.4b (7-51)	29.8±3.9a (12-40)	40.8±4.2a (15-61)	27.5±31.7ab (10-51)
Cowpea (IT86D-715)	28.4±4.9b (6-44)	26.0±2.75a (21-55)	34.5±3.0a (21-50)	21.9±3.67b (10-51)

Means followed by the same letter in a row are not significantly different at the 5% level using DMRT. The numbers in parentheses are ranges.

Pre-mating, mating, pre-oviposition, oviposition periods and fecundity of Aspavia armigera on its alternative hosts

The mean pre-mating period of *A. armigera* was 8.4 days on soybean, 15.1 days on cowpea, 10.7 days on amaranthus and 10.5 days on rice (Table 7). The pre-oviposition period of a mated female was 13.0 days on soybean, 16.0 days on cowpea, 17.6 days on amaranthus and 12.3 days on rice. Oviposition periods recorded for *A. armigera* on its alternative hosts ranged between 5 and 20 days on cowpea and 6 and 18 days on rice (control). Significantly higher numbers of eggs (fecundity) were laid by mated females of *A. armigera* fed on soybean than those fed on cowpea. The fecundity of mated females on amaranthus was not significantly different from that on rice (Table 7).

Table 7. Premating, pre-oviposition, oviposition periods (days ± S.E) and fecundity of *Aspavia armigera* on its alternative hosts.

Period (dasys)	Alternative hists			
	Soybean (TGX 1448-2E)	Cowpea (IT86D-715)	Amaranthus (NH493) H84/	Rice (ITA 315)
Pre-mating	8.4±1.3 (5-16)	15.1±1.7 (6-25)	10.7±1.7 (6-25)	10.5±1.6 (6-19)
Pre-oviposition	13.0±2.0 (6-23)	16.0±1.6 (7-29)	17.6±1.9 (9-23)	12.3±1.6 (6-21)
Oviposition	10.8±1.3 (5-16)	10.3±1.7 (5-20)	13.4±1.2 (6-18)	13.8±1.2 (6-18)
Fecundity	27.5±3.3a (17-42)	19.4±1.9b (13-32)	21.4±2.7ab (12-38)	23.1±3.1ab (12-38)

Means followed by the same letter in a row are not significantly different at the 5% level using DMRT. The numbers in parentheses are ranges.

DISCUSSION

This study has shown that the development of nymphs of *A. armigera* was successfully completed on the four rice varieties (ITA 301, ITA 305, ITA 307 and ITA 315). This suggests that these varieties supported the population growth of *A. armigera* in the field. The long oviposition period and high fecundity of mated females when fed on soft panicles of ITA 301 and the corresponding shortest developmental period are pointers to the fact that this variety is the most suitable of the four varieties tested. This also implies that rice fields planted with ITA 301 will aid population explosions of *A. armigera* within a short period. Although differences in *A. armigera* fecundity among the rice varieties were not significant, the relatively low number of eggs laid by mated females on ITA 315 and the delayed development of *A. armigera* on this variety suggest some level of antibiosis. This type of resistance was among the three types of resistance described by PAINTER (1951). These observations agree with similar work conducted in Ibadan by OLAGBAJU (1988) and EWETE & OLAGBAJU (1990) on cowpea and different rice varieties, where cowpea TVu1890 was found to exhibit antibiosis.

According to SAUPHANOR (1985) and SLANSKY & PANIZZI (1987), the suitability of different crop varieties for insect reproduction, development and growth may be determined by the amount of anti-growth substances such as allelochemicals. Growth inhibitors have been confirmed in legumes which form the basis of resistance or otherwise of crops to insect attack (PAINTER 1951, KOGAN 1975, AKINSOLA 1979, WEDER 1981, DOBIE 1984). Thus, the presence of these chemical substances, suspected in seeds of ITA 315, may have been responsible for the significantly low mean survival as well as the low growth index recorded on this variety. However, the high mean percentage survival of this bug on ITA 301 also supports its suitability. Similar work on host suitability with the rice feeding tiger moth *Crantonotus gangis* L. was reported by CATINDIG (1993). The significant shorter life span of mated females of *A. armigera* on ITA 315 suggests that this variety cannot support its population increase. Similar results on the life span of *A. armigera* on other crops such as cowpea and soybean have been reported (EGWUATU & TAYLOR 1977, SCHALK & FERY 1982, AKOB 1990).

The increasing sizes of the head capsules of the immature stages of *A. armigera* confirmed earlier reports that there are five nymphal instars in *A. armigera* (AINA 1975, OCHIENG 1977, EWETE & OLAGBAJU 1990). Similarly, the mean growth ratio of 1.32 obtained in this study was close to the value 1.4 postulated by DYAR (1890) for lepidopteran larvae, indicating that the growth of *A. armigera* progressed at a constant rate at each moult (DYAR 1890, RICHARDS 1949, MBUYONGA 1991, ODEBIYI 1981, OLAGBAJU 1988).

The nymphal development of this bug on soybean, cowpea and amaranthus was completed successfully, indicating that these other crops also supported its population growth. However, the long developmental period on amaranthus showed that this crop is less favourable to the bug's development. Nevertheless, the high percentage nymphal survival, as well as the highest growth index recorded by this bug on cowpea, indicates that this contains less of the growth inhibitors mentioned by WEDER (1981), and is therefore the most preferred by the bug. The shortest nymphal developmental period, the high percentage survival and highest growth index of *A. armigera* on cowpea pods also suggest that this crop will support a rapid population build-up of this pest. The developmental period may be longer and the mortality rate higher under natural conditions because of several environmental factors that come into play. Generally, the features revealed in this lifecycle study point to the short developmental period of *A. armigera* and its ability to colonize its host and reproduce at a fast rate. This makes *A. armigera* an economic pest which is deserving of immediate attention.

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