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BIOLOGY AND FECUNDITY OF THE MELON BUG *ASPONGOPUS VIDUATUS* (FABRICIUS), IN THE LABORATORY

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Abstract: The study was conducted at Elfula, South Kordofan State, Sudan to investigate the life cycle and fecundity of *Aspongopus viduatus* (Fabricius). Female reproductive system of the insect at aestivation period and later at the active period was examined. The results show that the females had no oocytes during aestivation, however following the termination of aestivation period oocytes developed. The total number of eggs laid by a single female averaged of 448±0.90 eggs. Most of the eggs were laid during the first two weeks following the end of the aestivation period. The main oviposition period was 64±17.7 days, pre-oviposition period and post oviposition periods were 5.17±1.7 and 10.7±1.7, respectively. The incubation period was 8.5±0.75 days and hatchability% was 94.4±3.01%, respectively. The mean developmental periods of the nymphal instars were 7.9±0.75, 10.9±1.3, 7.14±1.6, 9.8±1.1 and 13.3±1.9 for the 1st, 2nd, 3rd, 4th and 5th nymphal instars, respectively.
Keywords: *Aspongopus viduatus,* biology and fecundity.

Introduction

The melon bug *Aspongpus viduatus* (*Cordius viduatus*) (Fabricicus) (Hemipter, Diniduridae) is one of the most destructive pest threatening watermelon *Citrulus lanatus* (Thuab.) the multi-purposes crop in Kordofan and Darfur States, Sudan (Adra, 2005). It is grown for cash, food crop and as water source in summer for both human and animals (Ibrahim, 2004; Adra, 2005).

A. viduatus is widely distributed in the Near East and Africa (Schmutterer, 1969). It is present in almost all Africa, Arabian, Peninsula, Egypt, Israel Iran and Turkey (Linnavuori, 1994; Rolston et al., 1996). This pest is known as main pest of watermelon in Sudan (Mustafa et al., 2008). In this country, a prevalent pest is collected and its oil extracted after holding in hot water for certain time. This oil is used as food and medicine in dermatological diseases due to

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its antibacterial effect (Tauscher et al., 1981; Mariod et al., 2004; Mariod et al., 2011). Mohamed (1977) reported that the pest occurred in Sudan mainly in Kordofan, Darfur, Kassala, Khartoum, Blue Nile and Upper Nile Provinces. Schmutterer (1969) reported that *A. viduatus* attacked melon, cucumber, a number of wild cucurbits, cotton and groundnuts.

A. viduatus's female can lay about 300 eggs and there are five nyphal instars (Mohamed, 2003 and Adra, 2005), however Ben-Yakir (1996) reported that a female could deposit up to 741 eggs. The incubation period averaged 7.25 - 9 days (Mohammed, 2003; Adra, 2005; Ben-Yakir etal 1996).The whole duration periods averaged 5.8 - 6.8 , 9-12,4-6, 9.5 and 12.5- 14.5 for the 1st ,2nd ,3rd ,4th and 5th nymphal instar, respectively (Mohammed, 2003, Adra, 2005).

The aim of this study was to investigate the life cycle and fecundity of *A. viduatus* under laboratory conditions.

Materials and Methods

The study was conducted at Elfula 2009, South Kordofan State, Sudan to investigate the life cycle and fecundity of *A. viduatus*. Elfolla lies within latitude 11^{o}.30′ 12^{o}.0′ W and longitudes 28^{o}.0′ 28 ^{o}30′ N at the border of the savanna belt. The rainy season extends from July to October, with maximum rain fall in August. The average annual rainfall about 400-600 mm. Soil is loamy to sandy, however in the south the soil is clay (called Elfula elzarga).Vegetation was a mixture of grasses, herbs, shrubs and trees (Elfoula Agricultural Office, 2009).

The culture

About 2500 *A. viduatus* adults of both sexes were brought from Elkhiwai, North Kordofan, Sudan in June 2009, placed under thick and dense low-lying *Guiera senegalensis* (J. F. Gmel.) trees at the farm of the Faculty of Natural Resources and Environmental Studies (FNRES), University of West Kordofan Elfula, Sudan and monitored. After the first showers in July the insects migrated to the field where they fed on grass, wild cucarbits and other herbaceous plants during the day and sheltered at night in *Combretum cordofanum* (Engl. & Diels), *Guiera senegalensis* (J. F. Gmel.), *Calotropis procera* (Aiton) and under *Sorghum bicolor* (L.) plants. Hundreds of insects of both sexes were collected from the mentioned green plants, put on watermelon plant and covered with a mosquito net (Plate 1), Copulated males and females were then collected and placed in rearing glasses (20 x 12 x 12 cm) containing moist sand (50g) covered with pieces of mosquito net fitted tightly with rubber bands and kept in the laboratory. Sufficient amount of fresh leaves and shoots of watermelon plant were daily provided.

Sampling methods

Ten samples (120 eggs each) of newly laid eggs were taken, from the leaves and shoots of the watermelon plant using a fine moist camel hair brush and transferred to Petri-dishes (9.5 cm) containing moist filter paper for incubation. Drops of water (3 drops) were daily added to the Petri-dishes to keep them moist.Ten one -day old nymphs, were transferred using a moist camel hair brush into a Petri-dish lined with moist filter paper. Nymphs were provided daily with fresh leaves and shoots of watermelon Ten of 2^{nd} -5^{th} nymphal instars were transferred to 0.5 liter glass jars containing moist sand and covered with mosquito net fixed closely with rubber bands. Provision of food continued and records of the incubation period, hatchability% and developmental period of each instar. Temperature and relative humidity and nymphal mortality were recorded.

Results and Discussion

Table 1 reveal that females during the aestivation period (April-June) do not carry eggs, but eggs were found during July – August. The first showers which initiate vegetation growth provide food and stimulate development of insects. Our findings are agreed with those of Adra (2005) and Mohammed (2003) who mentioned that *A.viduatus* migrated from the aestivation sites to the breeding sites in July, where copulation took place. Egg development of insects is controlled by hormones and many external factors such as photoperiod and temperature (Barror *et al*., 1976; Denlinger, 2002). Chapman (1971) reported that *Eurgaster sp*. (Heteroptera) migrates to the aestivation sites and back to the breeding sites but only became sexually mature when it finally settled at its breeding site. Also overies of *Agonoscelis pubescens* (Heteroptera) female bear eggs only during September after migrating from aestivation sites to the breeding sites (Bilal, 2003).

Oocytes development in most insects is controlled by the corpora allata (Elzinga, 1978; Shimokawa *et al*., 2008). Lack of corpus allatum hormone (during the aestivation period) results in failure of oocytes development (Yin and Chippende, 1979, Shimokawa *et al*., 2008). This is why *A.viduatus* had no oocytes during aestivation period. *A.viduatus* prefers *Citrulus lanatus* (Thuab.) as food and as oviposition sites. Most of the eggs are laid during the first two weeks following the onset of the ovipsoion period. Similar findings were reported by Mohamed, (2003) and Adra, (2005).

Optimum temperature and humidity, adequate rain fall as well as good vegetation cover create suitable conditions for the insect survival (Bilal, 2003).

The results reveal that the total number of eggs laid by a single female averaged 448±0.90 eggs. The mean oviposition period was 64±17.74 days, pre-oviposition period and post ovipositon periods were 5.17±1.74 and 10.67±1.74 days, respectively (Table 2). Eggs are laid individually or in clusters on the main stem or leaves (Plate 3 and 4). The peak period of egg laying was during the first and secound weeks of the ovipsoion period, and then it decreased with time (Table 3). During incubation the green color of the egg turned gradually to reddish or pale. The incubation period was 8.51±0.75 days and hatchability % was 94.43±3.01 % (Table 4).

Mohammed, 2003 and Adra, 2005 reported that a female of *A. viduatus* deposits about 287-295 eggs, however Ben-Yakir *et al* (1996) reported that a female could deposit up to 741 eggs during a period of 150 days. Eggs are laid individually or in clusters on the main stems or on the lower part of the leaves of the host plants (Schmutterer, 1969), or in rows along the stem (Pollard, 1955; Schmutterer, 1969). The former added that the insect lightly glued the eggs together so that they can be lifted as one long stick of eggs. They are tiny, cylindrical and green in color, but when ready to hatch they gradually change color from green to reddish or purple (Schmutterer, 1969; Mohammed, 2003; Adra, 2005).

Oviposition period was long (64 days), which may due to the long rainy season and good climatic conditions that influencing the fecundity and result in eggs increase and symontanously population increase. Pre-oiposition period was short this may also refered to above mentioned factors that may stimulate corpus allatum hormone to develop oocytes.

The hatchability was high (94%) that indicates the high degree of fecundity and consequancy of population was increased. However the nymphal mortality reached 44%, meaning that the population density was decreased. Nevertheless hatchability, nymphal mortality, predators, parasites, pathogens and the climate are the important factors influencing population density and shoud be considered in the strategy of the pest management.

The life cycle of the studed insect showed that the head, mouth parts, antennae, thorax and legs of the first nymphs were black (Plate 2). There were three small stripes on the back. The colour changed to light orange then dark orange, antennae had four segments, the stripes on the back grew broader, the flexible membrane which separated the tergum from sternum was clear. The whole duration of the 1st nyphal instar under laboratory condition (27.0 ^{o}C and RH 95.64%) was 7.9±0.75 days ranged from 6.5 to 9.5 days. Mortality during this stage was 21.1%.

Second nymphal instar was oval in shape, creamy to yellowish in colour, mouth parts, head, legs and antennae were black, with three thoracic segments and seven abdominal segments bearing 7 pairs of spiracles and two pairs in the thorax, antennae have 4 segments (Plate) the duration of the 2nd nymphal stage, ranged from 9.2 to 12.5 days with a mean of 10.9±1.25 days. Mortality during this stage was 15.3%.

Third nymphal instars were oval in shape light yellowish brown in colour with three creamy spots on the back. Head, mouth parts, thorax and legs were pink at the first moult then turned to black, legs segmented into six segments with a pair of claws, there were seven pairs of spiracles on the abdomen and two on the thorax (meso and metathorax) arranged on the flexible membrane which separated the tergum from sternum sclerites. Nymphal instar development period under room conditions (27.0 ^{o}C and 95.64% RH) ranged from 6.3 to 8 days with mean of 7.1±1.2 days. Mortality during the 3rd nymphal instar stage was about 6.2%.

The 4th nymphal instar was rather flat in shape, grey to brown in colour, the pronotum pale brown with three creamy stripes on the back. The abdomen was grey while its margin was creamy, antennae were four segmented, and wings started to appear.

Flexible membrane bearing seven pairs of spiracles on the abdomen and two pairs on the thorax.The developmental period of the 4th nymph instar ranged from 7.5 to 13.0 days with a mean of 9.8±1.1 days. Mean mortality during the 4th nymphal stage was about 0.8%.

The 5th nymphal instar was oval in shape, brownish to black green in colour, wing rudiments were clear and less than half of the abdomen, tergum and sternum sclerites were separated by a flexible membrane bearing clear seven pairs of spiracles on the abdomen and two pairs on the 2nd and 3rd thoracic segments. The pronotum was creamy to grey in colour. The development period of 5th nymphal instar ranged from 11.0 to 17.0 days, with a mean of 13.3±1.94 days. Mortality in this stage was about 0.9%.

After the 5th nymphal stage the adult emerged; it was oval and rather flat in shape, pronotum was yellowish to brown, wings were leathery completed to the end of the abdomen, they were brown and black, male and female were much alike except that female's final abdominal segment was carved while the male's sticked out straight.

Table 1: Reproductive system of *A. viduatus* females during and after termination of aestivatation

Month	No. of females Tested	No. of developed oocytes
April	10	0.0
May	10	0.0
June	10	0.0
August	10	280
September	10	211
October	10	240
Total	60	731

Table 2: Fecundity and oviposition period of *A. viduatus* under laboratory conditions

	No. of eggs/ female	Pre-ovi-position period (days)	Ovi-position period (days)	Post ovi-position Period (days)	life span (days) Female
	448.8	5.17	64.00	10.67	80
SE	0.90	1.74	17.4	1.74	17.4
LSD	±0.73	±1.47	±14.5	±1.47	±14.5

Table 3: Mean number of eggs laid by single female per week

Weeks after end of aestivation period	Mean number of eggs laid by a single female in a week
1st	4.31[a] (73.6)*
2nd	3.98[ab] (66.3)*
3rd	3.53[bc] (47.9)*
4th	3.50[bc] (48.5)*
5th	3.18[cd] (43.2)*
6th	2.75[de] (31.3)*
7th	2.69[de] (40.4)*
8th	2.17[ef] (23.5)*
9th	1.63[fg] (18.4)*
10th	1.37[gh] (18.4)*

11th	1.18 ^{gh} (13.4)*
12th	1.12 ^{gh} (12.0)*
13th	1.11 ^{gh} (10.8)*
14th	0.78 ^{h} (1.2)*
SE	0.90
LSD	0.93

Means followed the same letter (s) in the same column are not significantly different at (P<0.05)

-Data transferred to arc sine $\sqrt{(\% + 0.05)}$

* Numbers in parenthes are eggs laid by single female in the week.

Table 4: Egg incubation period, % hatchability, nymphal mortality and development periods

	Egg incubation Period± SE (days)	Hatchability %	Mean nymphal developmental periods (days)				
			1st nymph (days) ± SE	2nd nymph (days) ± SE	3rd nymph (days) ± SE	4th nymph (days) ± SE	5th nymph (days) ± SE
	8.51±0.75	94.43%	7.9±0.75	10.9±1.3	7.14±1.6	9.8±1.1	13.33±1.94
Mortality %			21.1	15.3	6.2	0.8	0.9
LSD	1.28	1.87	1.28	2.13	1.98	1.87	3.31

B A

Plate 1: Field rearing cage (A) and laboratory rearing cages (B).

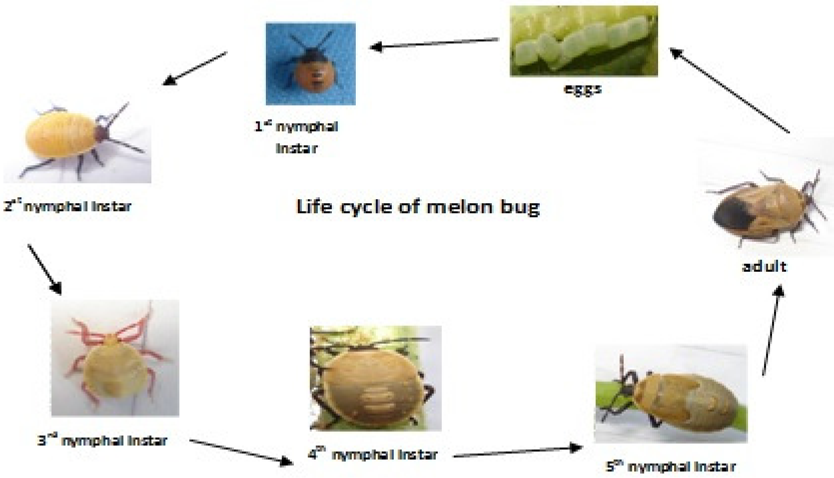

Plate 2: Life cycle of the melon bug

Plate 3: Eggs of melon bug lay on stem of watermelon plant in clusters

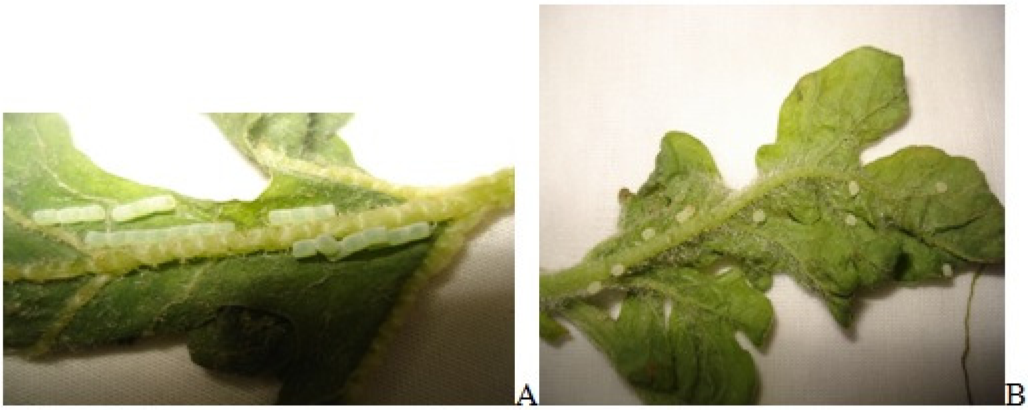

Plate 3: Eggs of melon bug laid on leaves of watermelon plant individually and in clusters

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