Effect of some stored insect pest species on biological aspects of the predator, *Amphibolus venator* Klug (Hemiptera: Reduviidae)

By

ATEF A. ABD-ELGAYED AND NARMEN A. YOUSSEF

Plant Protection Department, Faculty of Agriculture, Fayoum University

ABSTRACT:

The Reduviid predator, *Amphibolus venator* Klug (Reduviidae: Hemiptera) was reared on larvae of *Plodia interpunctella* Hb., *Tribolium confusum* Duv., *Trogoderma granarium* Everts, *Lasioderma serricorni* Fab and *Rhizopertha dominica* F. under optimum laboratory conditions of 27 ± 1C and 60 ± 5 % R.H. The most preferable host was found to be *R. dominica* and *L. serricorni* larvae, followed by *T. confusum* and *P. interpunctella*, while the larvae of *T. granarium* appeared to be unsuitable host for this predator.

Key words: Biological parameters, *Amphibolus venator* Predator, Stored insect pests

INTRODUCTION

Biological control of stored grains insect pests and their products is a safe method and does not damage human health or environment. Several species of predatory bugs have been studied as biological control agents such as *Amphibolus venator* (Klug), *Peregrinator biannulipes* (Montrouzier and Signoret) , *Joppeicus paradoxus* Puton and *Xylocoris flavipes* Reuter (Pingale 1954, Hussain and Aslam 1970, Abdella 1981, Tawfik *et al.* 1984, Awadallah *et al* 1990, Imamura *et al.* 2006, Murata *et al* 2007and Imamura *et al* 2008)

The predacious reduviid, *A. venator* Klug was found in stored grain attacked many species of stored product insect pests. According to Hussein and Aslam (1970), this predator was found all the year round with a peak during April-September and the total development period from oviposition to adult emergence was found to vary from 14 to 165 days. Generally, few available reviews were recorded about this predator. Therefore, the present study was made to evaluate its host preference on different stored product insect pest.

MATERIALS AND METHODS

To study prey preference of the reduviid predator, *A. venator* on five larval species of different stored product insect pests were selected and used as food for this predator to study its biological aspects under the constant conditions of 27 ± 1C and 60 ± 5 % R.H. (Imamura *et al.* 2006). The relative humidity was maintained in a desicator by mean of concentration of potassium hydroxide that provide 60 ±5 % R.H. (Buxton & Mellanby, 1934 and Abdella, 1981).

Larval hosts culture:

Mature larvae of tested species (Table, 1) were collected by a fine hair brush from infested stored products. For feeding, the larvae of each pest were introduced in a plastic cage (each measured 25 cm. in diameter and 15 cm. in height), provided with 300 g of corn meal, covered with muslin cloth and fixed with a rubber band. Each container was provided with corrugated filter paper to serve as an oviposition site and facilitates prey movement. As shown in Table (1), the third instar larvae were used in case of *P. interpunctella and T. granarium* while the 5th instar ones were used in case of *T. confusum*, *L.serricorni* and *R. dominica* (Abdella, 1981).

Table (1): Larval instars of different stored products pests used as food for rearing *A. venator,* under laboratory conditions.

Species	Family	Larval instar used
Plodia interpunctella Hb	Pyralidae	3rd
Tribolium confusum Duv.	Tenebrionidae	5th
Trogoderma granarium Everts	Dermestidae	3rd
Lasioderma serricorni Fab.	Anobiidae	5th
Rhizopertha dominica F.	Bostrychidae	5th

Predator culture:

To establish a stock culture of *A. venator*, nymphs and adults were collected from crevices walls and wood equipment's at mills and silos by using a fine camel-hair brush. The collected stages were transferred to the plastic containers , each contained 300 g of corn meal highly infested with *Tribolium* to reproduce and provide continuous supply of victims for the predator. To avoid cannibalism among predators individuals, larvae of the prey were added twice weekly. Strips or corrugated filter paper were placed inside each container to serve as an oviposition site, and a piece of muslin held in position by a rubber band was used to close each rearing unit (Awadallah *et al.,* 1990).

Host preference experiments:

To study the prey preference of *A. venator*, one couple of newly healthy emerged adults, collected from the stock culture, was confined in a Petri dish (9 cm diameter), provided with 10 larvae of each host on filter paper discs and kept at 27 ± 1C and 60 ± 5 % R.H.. Such unit represented one replicate. Ten replicates for each prey were used and examined daily for renewing the prey. Pre-oviposition, oviposition and post oviposition periods as well as, male adult longevity and preying capacity for both sexes in addition to the daily counts of deposited eggs/ female were calculated and recorded. The eggs were transferred to other dishes and then kept under the same laboratory conditions in order to determine durations of nymphal instars, mortality percentages and sex ratio (Awadallah *et al*., 1990).

Obtained data in all experments were statistically analyzed and the L.S.D. test and the standard error for biological studies was calculated according to Senedecor and Cochran (1980).

RESULTS AND DISCUSSION

Immature stages:

Egg stage:

Data summarized in (Table 2) indicate that the incubation period of *A. venator* eggs slightly affected by the prey and ranged between 8 and 16 days, with insignificant differences among them. Hatchability percentages were recorded 96.8, 95.9, 97.8, 88.9 and 93.8% after feeding on *L.serricorni, P. interpunctella, R. dominica, T. granarium and T. confusum,* respectively. Imamura *et al.* (2006) recorded the shortest incubation period of the some egg species correlated with highest percentage of hatching (93.4 %) when reared on larvae of *T. confusum* at 30^{o} C.

Nymphal stage:

The number of nymphal instars, durations, mortality percentages and sex ratio as being affected by were investigated (Table 2). All secured adults passed the nymphal stage through 5 instars at feeding on any of the five preys larvae used. These results agree with those previously recorded by (Hussain and Aslam, 1970) who found that *A. venator* nymphal stage had five instars.

The first nymphal instar lasted 7.3 days on *R. dominica* and 13.2 days on *T. granarium*. The second instar ranged between 4.3 and 10.2 days on *R. dominica* and *T. granarium*, respectively. The some trend could be applied for third instar but the fourth one recorded 12.3, 15.2, 16.6, 22.6 and 18.7 days with *L.serricorni, P. interpunctella, R. dominica, T. granarium and T. confusum,* respectively. The duration of the fifth instar nymph differed significantly (35.1 days) on *T. granarium* as compared with the other preys; the values were 25.6, 28.2, 25.3 and 30.2 days on *L.serricorni, P. interpunctella, R. dominica and T. confusum,* respectively (Table 2).

On all experimental preys (Table 3), the highest percentages of mortality were recorded at the first (9.12%) and fifth (13.9 %) nymphal instars reared on *T. granarium* larvae and the lowest (0.0%) was, however ,recorded for the fourth instar after feeding on *L.serricorni* and *R. dominica*. Generally, the shortest nymphal duration (58.6 days) was recorded on *R. dominica* with lowest mortality (8.9 %) and the longest period (93.3 days) was, however, recorded on *T. granarium* with highest mortality (38.02%).

After feeding on *L.serricorni*, *R. dominica* and *T. confusum* larvae, females outnumbered males i.e., the sex ratio was (female: male) were 1.2:1, 1.4:1 and 1.8:1, respectively, while this ratio was 1:1 under feeding on larvae of *P. interpunctella* and *T. granarium*.

At all experimented preys, both daily and total consumed preys increased gradually by development of nymphal instar. Total consumption was 335.9, 143.7, 292.6, 163.6 and 354.3 preys on *L.serricorni, P. interpunctella, R. dominica, T. granarium and T. confusum,* respectively (Table 4).

Table (2): Incubation periods and nymphal durations (days) of *A.venator* eggs reared on different larval prey under laboratory conditions (Mean ± S.E.)

Incubation period and duration (days)		No. of larval hosts (prey)				
		L. serricorni	*P. interpunctella*	*R. dominica*	*T. granarium*	*T. confusum*
Egg stage		**11.5 ± 0.21**	**13.4 ± 0.11**	**12.2 ± 0.21**	**15.1 ± 0.21**	**14.4 ±0.22**
Nymphal stage	**1st**	**8.6 ± 0.23**	**10.7 ± 0.70**	**7.3 ± 0.77**	**13.2 ± 0.35**	**11.6 ± 0.77**
	2nd	**4.3 ± 0.36**	**6.2 ± 0.32**	**4.3 ± 0.57**	**10.2 ± 0.42**	**5.1± 0.57**
	3rd	**8.3 ± 0.20**	**9.1 ± 0.21**	**7.1 ± 0.20**	**12.2 ± 0.21**	**9.0 ± 0.20**
	4th	**12.3 ± 0.11**	**15.2 ± 0.63**	**14.6 ±1.32**	**22.6 ± 0.33**	**18.7 ± 2.30**
	5th	**25.6 ± 1.01**	**28.2 ± 0.53**	**25.3 ± 1.11**	**35.1 ± 0.36**	**30.2 ± 1.23**

	Total	59.1 ± 1.22	69.4 ± 3.42	58.6 ± 3.16	93.3 ± 2.70	74.9 ± 3.42
Life cycle		70.6 ± 1.22	82.8 ± 2.95	70.8 ± 3.20	108.4 ± 3.20	88.0 ± 3.20

Table (3): Mortality percentages of the eggs and different developmental nymphal instars of *A.venator* reared on different larval prey under laboratory conditions (Mean ± S.E.)

Mortality percentages		Prey No. of larval hosts (prey)				
		L. serricorni	*P. interpunctella*	*R. dominica*	*T. granarium*	*T. confusum*
Egg stage		3.20	4.21	2.22	11.1	6.25
Nymphal stage	1st	4.80	6.90	4.20	9.12	6.90
	2nd	1.2	5.2	1.2	3.7	0.0
	3rd	0.0	3.2	0.0	6.8	0.0
	4th	0.0	1.4	0.0	4.5	0.0
	5th	1.3	9.22	3.5	13.9	7.40
	Total	7.3	25.9	8.9	38.2	14.3

Table (4): Total number of consumed larvae by one of *A.venator* nymph during its whole instars and sex ratios under laboratory conditions

Stage		No. of larval hosts (prey)				
		L. serricorni	*P. interpunctella*	*R. dominica*	*T. granarium*	*T. confusum*
Nymphal stage	1st	20.7(2.4)	11.2(1.1)	22.4(3.1	14.6(1.1)	23.2(2)
	2nd	18.6(4.3)	10.4(1.7)	16.3(3.8)	13.2(1.3)	20.4(4)
	3rd	35.2(4.2)	17.3(1.9)	29.1(4.1)	16.3(1.3)	36(4)
	4th	88.6(7.2)	38.4(2.5)	63.9(4.4)	45.6(2.1)	93.5(5)
	5th	172.8(6.8)	66.4(2.3)	160.9(6.4)	74.2(2.11)	181.2(6)
	Total	335.9(5.7)	143.7(2.1)	292.6(4.9)	163.6(1.8)	354.3(4.7)
Sex ratio		1.2:1	1:1	1.4:1	1:1	1.8:1

The correlated parenthesized data show average of daily consumption.

Adult stage:

Regardless of host larval species the preoviposition, oviposition and postoviposition ranged between 8.5 and 15.6, 85.9-170.2 and 1.2-3.1 days, respectively. The longest oviposition period (170.2 days) and the highest preying capacity (1584.2 adult) were recorded after feeding on *L.serricorni* larvae, while the shortest period (85.9 days) associated with the lowest preying capacity (206 preys) were recorded when the adult predator supplied with larvae of *T. granarium* (Tables 5 , 6).

Data summarized in table (5) indicated that the male adult longevity ranged between 52.4 days for *T. granarium* preys and 154.2 days for *R. dominica* preys. The intermediate period (115.4 day) and high preying capacity (715.5 larvae) were recorded after feeding on *L.serricorni*.

The predator females lived an average of 182.7 days after feeding on *L.serricorni* and 161.2 days after rearing on *R. dominica,* while it shortened to 102.7 days only after feeding on *T. granarium,* with preying capacities of 1659.2, 1369.3 and 240.2 preys, respectively. Generally, the highest number of eggs was recorded in the second month of the oviposition period, and then decreased gradually until the fifth month. (table 4,5 and fig. 2).

Highest total number of deposited eggs was recorded after feeding on *R. dominica* larvae (341.3 egg / female), with a daily average of 3.2 eggs and the lowest total was, however, recorded after feeding on *T. granarium* larvae (57.9 eggs / female), with a daily average of 0.67 eggs. An intermediate value of 228.8 and 189.1 eggs were recorded after feeding on *L.serricorni* and *T. confusum* larvae*,* respectively (table 7).

At the laboratory conditions (27^{o} C and 60 % R.H.) and on the fifth instar larvae of *L.serricorni,* and *R. dominica* as preys, the longest oviposition period and general female longevity were found to be correlated with the highest counts of total eggs deposited per female and rate of reproduction / female / day. Under such conditions, highest total and daily consumed preys were recorded.

In the available literature, Hussain and Aslam (1970) in Pakistan stated that the predacious reduviid, *A. venator* was found in grain stores attacking *T. granarium*, *T. castaneum*, *Tenebroides mauritanicus* L., *Oryzaephilus surinamensis* L. and *Corcyra cephalonica* Stnt. In the laboratory, larvae of these species in addition to *T. confusum*. were preyed by *A. venator,* adults of which they consumed approximately 2.5 *Trogoderma* larvae /day during the summer months. The total developmental period from oviposition to adult emergence was found to vary from 14 to 165 days. In 2007 Murata *et al.* evaluated the suppression of the confused flour beetle, *T. confusum* by the anthocorid bug, *X. flavipes* and the reduviid bug, *A. venator*. Four treatments were used; *X. flavipes* and *A. venator* adults released and control (no predators). After 25 days, these treatments showed 96.6 76.2 and 95.6% suppression, respectively. Furthermore, *A. venator* attacked *X. flavipes* adults.

Table (5): Adult longevity of *A.venator* as being affected by types of prey under laboratory conditions (Mean ±S.E.)

Adult longevity (days)		**No. of larval hosts (prey)**				
		L. serricorni	***P. interpunctella***	***R. dominica***	***T. granarium***	***T. confusum***
Male longevity		**115.4 ± 3.22**	**96.2 ± 4.21**	**154.2 ± 6.4**	**52.4 ± 10.5**	**105.3 ± 6.4**
Female longevity	**Pre-oviposition**	**9.4 ± 0.33**	**11.4 ± 0.54**	**8.5 ± 0.23**	**15.6 ± 0.82**	**10.4 ± 0.90**
	oviposition	**170.2 ± 0.44**	**120.8 ± 0.21**	**150.8 ± 0.32**	**85.9 ± 0.33**	**160.7 ± 0.33**
	post oviposition	**3.1 ± 0.66**	**1.4 ± 0.62**	**2.2 ± 0.85**	**1.2 ± 0.22**	**2.1 ± 0.72**
	Total	**182.7 ± 5.30**	**133.6 ± 0.40**	**161.2 ± 2.60**	**102.7 ± 4.2**	**173.2 ± 7.3**

Table (6): Total number of consumed larvae by one of *A. venator* adult during its whole life under laboratory conditions

Adult		No. of larval hosts (prey)				
		L. serricorni	*P. interpunctella*	*R. dominica*	*T. granarium*	*T. confusum*
Male		715.5(6.2)	307.8(3.2)	786.7(5.1)	62.9(1.2)	421.2(4)
Female	Pre-oviposition	56.4(6.0)	34.2(3.0)	61.2(7.2)	32.8(2.1)	41.6(4.0)
	oviposition	1584.2(9.2)	628.2(5.2)	1296.9(8.6)	206.1(2.4)	746.2(7.6)
	post oviposition	18.6(6.0)	4.2(3.0)	11.0(5.0)	1.3(1.1)	6.2(3.0)
Total		1659.2(9.1)	666.6(4.9)	1369.3(8.5)	240.2(2.3)	794.0(4.6)

The correlated parenthesized data show average of daily consumption.

Table (7): Monthly number of eggs laid by mated of *A. venator* female adults fed on different types of prey under laboratory conditions

Monthly number of eggs	No. of larval hosts (prey)				
	L. serricorni	*P. interpunctella*	*R. dominica*	*T. granarium*	*T. confusum*
1st	33.1(100)	22.1(100)	43.2(100)	12.3(100)	24.1(100)
2nd	99.1(100)	63.1(90)	96.9(100)	35.4(70)	79.6(100)
3rd	55.2(100)	21.1(80)	84.7(100)	9.8(10)	44.7(100)
4th	20.8(100)	7.5(50)	84.6(100)	0	15.5(80)
5th	10.6(70)	3.1(10)	26.2(80)	0	9.2(50)
6th	9.8(10)	0	8.7(20)	0	16.0(10)
Total	228.6 ± 3.7	116.9 ± 4.3	341.3 ± 1.2	57.5 ± 12.3	189.1 ± 5.3

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