EFFECT OF COLD STORAGE ON SOME BIOLOGICAL CHARACTERISTICS OF *CORANUS AFRICANA* EL-SEBAEY (HETEROPTERA : REDUVIIDAE)

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Abstract

The Assian bug *Coranus africana* El-Sebaey (Heteroptera: Reduviidae) has recently been recorded in Egypt. It is occurred on various economic and wild plants at different locations. In the present work the effect of cold storage temperatures (5, 10, 15°C) and 70% R.H, using *the larval stage of Anagasta kuehniella* Zell (Lepidoptera: Pyralidae) as a prey were studied. The storage periods of five nymphal stages, male and female at 15°C averaged 5.1, 6.43, 7.3, 8.9, 10.01, 10.31 and 9.79 weeks respectively. They were longer than storage periods at 10 and 5°C. Parameters of reporoductive biology, age specific survivorship, fecundity, egg hatchability and food consumption were also influenced by storage temperatures.

INTRODUCTION

All reduviids are predators except tritomins, most of them appear to orient to their prey visually. Valuable sources on reduviid biology include the works of Miller (1971), based on the fauna of Zimbabwe and North America; Putchkov (1987) on the fauna of the Ukraine and Louis (1974) on the fauna of Chana. The avaluable biological informations of the Egyptian reduviid are given by Awadalla *et al.* (1990) Afifi *et al.* (1993a,b); and EL-Sebaey (1996, 1998, 2001a).

Coranus africana EL-Sebaey (Heteroptera: Reduviidae) has recently been registered in Egypt by El-Sebaey (2002). The predator was reported in various economic crops as cotton, tomato, clover, maize, as well as several wild desert plants. Several biological aspects were studied by using two common cotton pests in Egypt, *Spodoptera littoralis* (Bosid.) and *Agrotis ipsilon* Rott. and other stored product pests (*Anagasta kuehniella* Zell. and *Corcyra cephalonica* Stt. as laboratory prey (El-Sebaey 2001 b, El-Sebaey & El-Bishry 2001). Also the effect of rearing space on the development were determined by El-Sebaey and El-Shazly (2002). Field trails to evalute the predators in different economic crops have been measured in Egypt by El-Sebaey *et al.* (2002, 2004) and El-Sebaey & Abd El-Wahab (2003).

The objective of the present study is to determine the effect of cold storage on some biological aspects of *C. africana* to be used in biological control programs at any time.

MATERIALS AND METHODS

A laboratory cultures of *Coranus africana* (Heteroptera: Reduviidae) were collected from economic crops as tomato, clover, cotton and desert grasses. The predator was recorded at Fayoum and Giza Governorates. A detailed description of rearing tecknique was given by El-Sebaey (2001b), and El-Sebaey & El-Bishry (2001).

A culture of *Anagasta kuehniella* (Lepidoptera: Pyralidae) was initated by moths emerged from infested flour obtained from mills. They were kept under laboratory constant condition 27°C and 65% R.H. A methods adopted from El-Sebaey (1996, 1998) were employed.

Biological experiments:

Experiments were conducted using incubations adjusted at 5°C, 10°C and 15°C ±1°C and 70% R. H.

The newly emergence of each nymphal stage was immediately isolated from stock cultures in the individual rearing tube (100 tubes are replicated for each experiment. Each tube (1.5cm. diameter X 3.5 cm. height with a perforated cover) was provided with a disc of filter paper and sufficient larvae of *A. kuehniella* then kept continuously at storage temperatures 5°C, 10°C and 15°C ± 1°C and 70% R. H. Daily inspections were carried out to record molting and mortality of the nymphs. Also the newly emerged adults were collected and paired. One couple in rearing cage (20 cages as replicates for each experiment). Each cage (2.5 cm diameter and 5cm height), was provided with a filter paper disc and covered with a perforated plastic cover. A supply of sufficient prey larvae were added daily to each cage. The oviposited eggs were examined daily, counted transferred, to the incubation cages (2.5cm. diameter X 5cm. height) and provided with a filter paper disc and covered with a perforated plastic cover, at a rate of 10eggs/cage (20 cages were used replicates for each experiment). Daily inspection took place to count the moulting nymphs and to estimate the percentage of hatchability.

The weekly consumed prey by each nymph and adult in the experiments were recorded as reported by El-Sebaey & El-Bishry (2001).

RESULTS AND DISCUSSION

1-Storage at 5°C:

Data in (Table 1) indicated that the survival rate at 5°C of first nymphal instar was 84.4% at the first week and decreased sharply to reach 57.8% and 49.9% in storage at second and third weeks. For the second and third instar this rate decreased gradually from 90.5% and 95.24% at the 1st week to reach 13.3% and 14.3 at the sixth and seventh week, respectively. The survival rate of fourth and fifth

instars increased in all storage weeks. It was 100% in the first week and decreased gradually to reach 23.81&27.59%, respectively in the 7th week; the storage period extend to 8th (4.77%) and 9th (3.4%), respectively.

The total storage periods of five nymphal instars were 3.21, 4.13, 5.08, 5.85 and 6.03 weeks, resprectively. In second storage week, second, third and fourth instars developed by the presence of 4.8, 10.1 and 14.3%, respectively.

The males and females lived up to 9th and 10th weeks after adults emergence, with highestes survival (100%) in storage for first two weeks and declined gradually. The female didn't deposite any eggs during it's life span (7.39 weeks) at 5°C.

All stages of *C. africana* stored successfuly at 5°C when reared on larvae of *A. kuehniella.* The mean weekly consumption rates of nymphal stage increased gradually with the development of various instars (Table 1).

The number of *A. kuehniella* larvae consumed in storage at first week by the five nymphal, female and male were in respective 1.41, 1.44, 1.64, 1.69, 1.76, 1.72 and 1.67 larva/week. These rates decreased gradually with increase of the storage weeks.

2-Storage at 10°C:

Storage period of *C. africana* varied with the stage at 10°C (Table 2). All first two stadia lived up to the end of storage first week, the survival rate was decreased sharply to the end of storage period. All the last three nymphal stages and male lived up to the second week; also all females lived to the third week, the survival rate was decreased gradually (Table 2).

The storage total period of the five stadia, female and male were 4.01, 4.1, 6.16, 6.89, 7.42, 8.82 and 7.71 weeks, respectively. During storage second week, the last three stadia developed by the presence of 0.3, 10.1 and 20.1%, repectively; also the fourth stadium developed by 22% in storage third week. The female did not lay any eggs during it's life span.

C. africana stored successfully at 10°C when reared on *A. kuhniella* larvae. Generally, the weekly number of consumed larvae increased with the development of various instars. The number of larvae consumed in storage first week by the five nymphal stages, female and male in respective were 0.5, 0.7, 1.1, 1.75, 1.8, 1.9 and 1.81 larva/week. These rate decreased gradullay till storage period end (Table 2).

3- Storage at 15°C:

Data summarized in (Table 3) showed that all stages of *C. africana* at 15°C lived up to the end of third week except the females lived up to 5th week after emergence. The survival rates of all stadia and adults were decreased gradually to

the end of storage. On the other hand, the storage period were 5.1, 6.43, 7.3, 8.9, 10.01, 10.31, 9.79/ week, respectively.

All nymphal stages except first stage developed during storage second week by 6.67, 10.2 and 20.1%, respectively.

The weekly rate of deposited eggs/♀ (Table 3) varied during the successive weeks of oviposition. This rate attained its highest value during the 4th and 5th weeks (16.01 and 16.69 eggs, respectively). This rate decreased gradually till 10th week of storage period.

This reduviid stored successfully at 15°C when reared on larvae of *A. kuehniella.* The mean weekly consumption rates of nymphs and adult stages increased gradually with the development of various instars (Table 3). The numbers of larvae consumed in first storage week were1.1, 1.46, 1.6, 2.2, 2.3, 2.32 and 2.21 larvae/week, respectively. These rates increased gradually till half time of storage period and then decreased gradually .

At all storage temperatures (5, 10 and 15°C), the eggs didn't hatch, and the storage temperatures affected incubation period and hatchability.

The storage period varied with temperatures used (Table 1, 2, 3). Nymphal storage periods varied with temperatures used; being significantly longer at 15C° in each instar than at 10C° and 5C° ($P>0.05$). The nymphal survival rate also varied with temperatures used in storage with significant differences. Also the weekly consumption rate existed had significantly differences ($P>0.05$).

All the biological activity of adults varied with storage temperatures used. The oviposition periods, egg-laying activity and survivorship rate existed significantly differed and being better at 15C°. Also significant differences ($P>0.05$) existed between the consumption weekly rates of females and males and between three temperatures.

C. africana reared at 30C° and 70% R. H. on different prey (*Anagasta kuehniella* Zell, *Corcyra cephalonica* Stt., *Spodoptera littoralis* (Bosid.) and *Agrotis ypsilon* Rott). When reared on first prey, the nymphal development was the shortest and the survival rate was the highest. On the other hand, all biological activity of adults varied with prey used, the oviposition period, egg-laying activity and survivorship rate were best on the same prey. Also the incubation period and the hatchability rate of deposited eggs were affected by the prey used (El-Sebaey 2001a and EL-Sebaey & El-Bishry, 2001).

The methodology of mass rearing determined when studied the biological activity of nymphal stages and adults by rearing this predator in different size of containers at 30C° and 70% R. H. on *A. kuehniella.* (El-Sebaey & El-Shazly, 2002).

Table 1. Effect of low temperature (5°C) and storage period on survival and food consumption of *Coranus africana* instars

Period / Instars	Storage period / week														
	1st week			2nd week			3rd week			4th week			5th week		
	S.	M.	F.	S57.8.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.
First instar	84.4	15.6	1.41 ± 1.1	80.9	42.2	1.3 ± 0.9	49.9	51.1	0.43 ± 0.5	—	100	—	—	—	—
Second instar	90.5	9.5	1.44 ± 0.21	85.7	19.1	1.37 ± 0.64	66.7	33.3	1.05 ± 0.42	57.1	42.9	0.71 ± 0.45	38.1	61.9	0.4 ± 0.49
Third instar	92.24	4.76	1,64 ± 0.65	89.5	14.3	1.68 ± 0.72	70.4	29.6	1.80 ± 0.77	61.91	38.09	1.69 ± 0.99	48.82	51.18	1.63 ± 0.69
Fourth instar	100	—	1.69 ± 0.51	90.4	10.5	1.71 ± 0.6	71.4	28.6	1.83 ± 0.76	66.7	33.3	2.01 ± 0.81	47.62	52.38	1.94 ± 1.08
Fifth instar	100	—	1.76 ± 0.79	100-	9.6	1.92 ± 0.75	79.3	20.7	2.1 ± 0.82	68.97	31.03	2.13 ± 0.92	48.83	51.17	1.99 ± 1.07
Female	100	—	1.72 ± 0.61	100	—	2.11 ± 0.49	90.9	9.1	2.36 ± 0.77	81.8	18.2	2.16 ± 0.61	63.64	36.36	0.3 ± 0.49
Male	100	—	1.67 ± 0.94	—	—	2.01 ± 0.58	—	—	2.27 ± 0.61	72.7	27.3	2.0 ± 0.77	54.5	45.5	2.1 ± 0.6

S: Survival rate % M: Mortality rate % F: Food Consumption/week

Table 1. Cont.

Storage period / week																			
6th week			7th week			8th week			9th week			10th week			11th week			Total period
S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.21 ± 0.07
13.3	85.7	—	—	100	—	—	—	—	—	—	—	—	—	—	—	—	—	4.13 ± 1.45
28.5	71.5	1.06 ± 0.37	14.3	85.7	0.5 ± 0.04	—	100	—	—	—	—	—	—	—	—	—	—	5.008 ± 1.21
38.1	61.9	1.2 ± 0.4	23.81	76.19	0.53 ± 0.001	4.77	95.23	—	—	—	—	—	—	—	—	—	—	5.85 ± 1.64
41.38	58.62	1.77 ± 0.79	27.59	72.4	0.9 ± 0.75	13.8	86.2	0.4 ± 0.02	3.4	100	—	—	100	—	—	—	—	6.03 ± 1.87
54.5	45.5	1.73 ± 0.6	36.6	63.4	1.5 ± 0.5	27.3	72.7	0.75 ± 0.43	9.1	96.6	—	4.9	95.1	—	—	100	—	7.39 ± 1.62
45.4	54.6	1.71 ± 0.39	27.3	72.7	1.4 ± 0.49	18.2	81.8	0.5 ± 0.01	9.1	90.9	—	—	100	—	—	—	—	6.45 ± 2.06

Table 2. Effect of low temperature (10°C) and storage period on survival and food consumption of *Coranus africana* instars

Period / Instars	Storage period / week																	
	1st week			2nd week			3rd week			4th week			5th week			6th week		
	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.
First instar	100	-	0.5 ± 0.1	75	25	1.3 ± 0.71	50	50	0.83 ± 0.61	37.5	62.5	0.33 ±0.4	-	100	-	-	-	-
Second instar	100	-	0.7 ± 0.45	80	20	1.2 ± 0.41	60	40	1.3 ± 0.1	47.0	53	1.5 ± 0.6	27	73	1.64 ± 0.65	-	100	-
Third instar	100	-	1.1 ± 0.41	100	-	1.5 ± 0.81	85	15	1.38 ± 0.48	75	25	1.13 ± 0.59	50	50	0.83 ± 0.37	40	60	0.8 ± 0.4
Fourth instar	100	-	1.75 ± 0.69	100	-	1.86 ± 0.91	90	10	2.01 ± 0.83	80	20	1.87 ± 0.81	65	35	1.5 ± 0.65	50	50	1.36 ± 0.48
Fifth instar	100	-	1.8 ± 0.87	100	-	1.9 ± 0.83	93	7	2.2 ± 0.65	85	15	2.23 ± 0.85	70	30	2.5 ± 0.91	60	40	1.54 ± 0.63
Female	100	-	1.9 ± 0.67	100	-	1.92 ± 0.72	100	-	2.18 ± 0.79	100	-	2.21 ± 0.72	90.9	9.1	2.54 ± 0.49	72.7	27.3	1.81 ± 0.33
Male	100	-	1.81 ± 0.71	100	-	1.9 ± 0.66	91	9	2.1 ± 0.83	81.9	18.1	2.18 ± 0.39	63.6	36.4	2.01 ± 0.31	54.49	45.5	1.4 ± 0.49

S: Survival rate % M: Mortality rate % F: Food Consumption/week

Table 2. Cont.

Storage period / week																		
7th week			8th week			9th week			10th week			11th week			12th week			Total period
S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.01 ± 2.29
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.1 ± 1.1
20	80	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-	-	6.16 ± 0.13
30	70	0.66 ± 0.47	10	90	-	-	100	-	-	-	-	-	-	-	-	-	-	6.89 ± 0.2
45	55	1.2 ± 0.4	25	75	-	12	88	-	-	100	-	-	-	-	-	-	-	7.42 ± 2.16
63.6	36.4	1.31 ± 0.45	54.49	45.51	1.1 ± 0.57	36.64	63.36	0.6 ± 0.48	27.2	72.8	-	9.9	90.1	-	-	100	-	8.82 ± 2.12
45.5	54.5	1.14 ± 0.35	36.36	63.64	0.60 ± 0.49	18.2	81.8	-	10	90	-	-	100	-	-	-	-	7.71 ± 2.14

Table 3. Effect of low temperature (15ºC) and storage period on survival and food consumption of *Coranus africana* instars

Period / Instars	Storage period / week																	
	1st week			2nd week			3rd week			4th week			5th week			6th week		
	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.
First instar	100	-	1.46 ± 1.1	100	-	0.56 ± 0.1	90.9	9.1	0.73 ± 0.9	86.36	13.6	1.15 ± 0.05	73.9	26.1	2.1 ± 0.07	26.1	73.9	-
Second instar	100	-	1.1 ± 0.68	100	-	2.1 ± 1.75	100	-	2.3 ± 0.85	91.9	8.91	2.5 ± 0.68	77.7	22.3	2.4 ± 0.81	64.4	35.6	1.9 ± 0.78
Third instar	100	-	1.6 ± 0.81	100	-	2.16 ± 1.1	100	-	2.5 ± 1.1	94.0	6.0	2.7 ± 1.2	86.7	13.3	2.91 ± 1.01	76.7	23.3	2.4 ± 0.84
Fourth instar	100	-	2.2 ± 1.2	100	-	2.3 ± 1.1	100	-	2.6 ± 0.9	95.0	5.0	2.9 ± 0.8	87.5	12.5	3.1 ± 1.04	80.0	20.0	2.6 ± 1.05
Fifth instar	100	-	2.3 ± 1.1	100	-	2.41 ± 0.89	100	-	3.18 ± 0.71	95.0	5.0	3.25 ± 0.32	90	10	4.01 ± 0.83	81.9	18.1	3.9 ± 0.66
Female	100	-	2.32 ± 0.62	100 *14.65 ± 0.82	-	3.01 ± 0.43	100 *15.5 ± 1.4	-	3.82 ± 0.72	100 *16.01 ± 0.60	-	3.96 ± 0.66	100 *16.69 ± 0.82	-	3.09 ± 0.79	84.61 *10.5 ± 1.67	15.39	2.31 ± 0.61
Male	100	-	2.21 ± 0.78	100	-	2.31 ± 0.63	100	-	2.41 ± 0.77	96.1	3.9	2.46 ± 0.66	92.31	7.69	2.98 ± 0.63	82.1	17.9	2.1 ± 0.7

S: Survival rate % M: Mortality rate % F: Food Consumption/week *: Egg laying

Table 3. Cont.

Storage period / week																					Total
7th week			8th week			9th week			10th week			11th week			12th week			13th week			
S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	S.	M.	F.	period
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.1 ± 0.62
46..7	53.3	1.67 ± 0.74	13.8	68.2	0.94 ± 0.7	—	100	—	—	—	—	—	—	—	—	—	—	—	—	—	6.43 ± 1.2
66.7	33.3	1.8 ± 0.76	53..3	46.7	1.5 ± 0.4	36.7	63.3	1.1 ± 0.31	—	100	—	—	—	—	—	—	—	—	—	—	7.3 ± 1.3
70	30	2.3 ± 1.1	60.01	40.8	1.95 ± 1.02	50.1	49.9	1.3 ± 0.47	30.9	69.1	0.56 ± 0.4	—	100	—	—	—	—	—	—	—	8.9 ± 0.7
70	30	3.8 ± 0.74	65	35	4.0 ± 1.2	60	40	2.5 ± 0.65	45	55	1.7 ± 1.1	35	65	0.56 ± 0.06	—	100	—	—	—	—	10.01 ± 0.5
72.7 *9.58 ± .0.76	27.3	1.64 ± 0.48	66.7 7.36 ± 0.88	33.3	1.36 ± 0.48	61.52 *5.1 ± 0.94	38.48	1.01 ± 0.05	54.49 4.75 ± 0.83	45.5	0.82 ± 0.74	36.39 *—	63.6	0.5 ± 0.01	18.14 *—	81.8 —	— —	*—	100	—	10.31 ± 1.5
69.2	30.8	1.56 ± 0.49	64.5	38.5	1.1 ± 0.5	53.8	46.2	0.86	46.1	53.9	6.56 ± 0.49	30.8	69.2	0.33	—	100	—	—	—	—	9.79 ± 1.9

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تأثير درجات الحـــرارة المنخفضة على الظواهر البيولوجية للمفترس *Coranus africana* El-Sebaey (رتبة نصفية الأجنحة ــ فصيلة البق السفاح)

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تم إستخدام درجات الحرارة المنخفضة (٥، ١٠، ١٥°م) ورطوبة نسبية ٧٠% بإستخدام يرقات فراش دقيق البحر الأبيض المتوسط *Anagasta kuehniella* Zell كعائل معملى لتخزين الأعمار المختلفة من المفترس *Coranus africana* El-Sebaey . كانت أطول مدة تخزين عند درجة حرارة ١٥°م للأعمار الحورية الخمسة والإناث والذكور على التوالى ٦,٤٣ ، ٧,٣ ، ٨,٩ ، ١٠,٠١ ، ١٠,٣١ ، ٩,٧٩ / إسبوع. أيضاً تم دراسة نسبة الإعاشة ومعدل وضع البيض ومعدل التغذية للأعمار المختلفة من المفترس عند نفس درجات الحرارة السابقة لتكون متوفرة فى أى وقت لإستخدامها فى برامج المكافحة المتكاملة.