

## BIOLOGICAL STUDIES ON *ORYCTES RHINOCEROS* L. (COLEOPTERA: SCARABAEIDAE)

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### Abstract

Biological studies of *Oryctes rhinoceros* L. were carried out under laboratory conditions ( $20 \pm 5^\circ\text{C}$  &  $55 \pm 5\% \text{R.H.}$ ). Obtained results could be summarized as follows.

**1-Egg stage:** The incubation period was 13.32 days, while hatchability percentage was 90 %. However, the area of freshly deposited eggs was  $7.043 \text{ mu}^2$  and increased to  $34.26 \text{ mu}^2$ . before hatching.

**2- Larval stage:** The durations of first and second larval instar were 22.8, 21.1 days respectively, while that of the third larval instar was 132.1 days. The total larval durations was 176 days. The larval mortalities varied which according to larval instar, they were 22.22%, 18.6%, 14% resp. It was more reduced in the third larval instar under room temperature and total larval mortality percentage was 54.82 %.

**3-Pupal stage:** The pre-pupal and pupal durations were 15, 21.4 days respectively, while mortality percentages were 22.45 %, 13.16 %.

**4-Total developmental periods and total mortality:** the Total developmental periods were 225.72 days while the total mortality percentages were 67% respectively.

**5- Survival rate of different stages derived from egg:** were studied and the results cleared that survival rate was decreased by increasing age were 70 %, 57%, 49% for larval and 38 % and 33 % for pre-pupae and pupae.

**6- Adult stage:** adult longevity was 13 days for male while it was 34.4 days for female, pre-oviposition period 6.2 days, 15, 21.4 days oviposition period 10.9 days post-oviposition period 17.3 days, fecundity 16.9 egg / female, fertility 72.12 %, life cycle was 231.92 days, total period of generation for male and female were 238.72 & 260.12 days resp. This insect has one generation o per year.

### INTRODUCTION

Both adult and immature stages of *Oryctes rhinoceros* L. are considered as soil insects which have economic importance in many parts of the world. The damage caused by these pest invading date palm trees and that of black palm beetle alone cannot be comparable as the *R. ferruigenus*, which considered a destructive pest.

The black palm beetles, *Oryctes rhinoceros* L. was recorded firstly in date palm plantations of Sharkia and Ismailia Governorates and recorded from Egypt by Salah

(1993), Alfieri (1976) and Shalaby (1958) in the MOA collection, Plant Prot. Res Institute.

It was an important pest in Ismailia Governorate, causing very serious problems of date palm tree during spring and summer.

Little work has been done on such Scarabaeid, *Oryctes rhinoceros* L. in Egypt, special stress has been laid by Abd El- Fatah (1991), El-Deeb (1992 a and b) and Ramadan, Howayda (1993) on *Tropinota Squalida* and Desai *et al* (1994) on *Oryctes rhinoceros* L.

The present work aimed to study some biological aspects of the immature and mature stages of *Oryctes rhinoceros* L under laboratory conditions.

## MATERIALS AND METHODS

The experiments were carried out under Laboratory conditions ( $20 \pm 5^{\circ}\text{C}$  &  $55 \pm 5\%$  R.H.). High number of adult beetles were collected from Kassassen district, Ismailia Governorate, and kept in special wooden screened cages (50x29.5x24 cm.) on proper matter consistend of autoclaved mixture of moisted soil (clay -cattle dung in ratio 1:1) heated for half an hour in autokalif at  $121^{\circ}\text{C}$  under one atmosphere as oviposiyion sites for adults females, pieces of sugercane sliced as adult food, changed two times weekly. The incubation period of eggs was studied by placing, 10 replicates, each replicates consisted of 10 newly deposited eggs in moistened soil- cattle dung mixture in 10 plastic cups .The eggs were exmained daily for any hatching.

To determine the durations of larval and pupal stages , Hundred newly hatched larvae were reared each separately in a cylindrical plastic containers containing mixture of moisted soil .The soil was examined daily and was kept sufficiently moist when about to pupate the full grown larvae were removed individually to cylindrical plastic container with some soil to observe the pupation. The durations of developmental stages (egg, larva and pupa) together with their survival mortality percentages, The life span, Fecundity, Fertility, survival and mortality percentages of adults were determined by placing adults in 10 replicates each replicates consisted of one pair with some cages some soil as the previous method .The freshly deposited eggs of 8 females were measured daily until hatching using eyepieces micrometer and areas were calculated by using Maurizio formula (1954).

$$\text{Area} = \frac{a \times b}{2} \times \text{II} \quad a = \text{Max. Length}$$

$$b = \text{Max. Width} \quad \text{II} = 3.14$$

All the obtained data were statistically analysed according to Duncan`s (1955) and Littel and Hills (1975).

## RESULTS AND DISCUSSION

### 1. The Egg stage

**1.1. Incubation period:** Data presented in Table (1) show that the incubation period of egg stage was ( $13.32 \pm 0.427$ ) under Laboratory conditions ( $20 \pm 5^\circ\text{C} \& 55 \pm 5\% \text{R.H.}$ ). while Deasi *et al* (1994) revealed that it was 9 days

**1.2. Hatchability:** The results represented in Table (1) revealed that the hatchability of eggs was ( $90\% \pm 2.581$ ), under Laboratory conditions ( $20 \pm 5^\circ\text{C} \& 55 \pm 5\% \text{R.H.}$ ). while Ramadan, Howayda (1993) mentioned that it was 65.4% at room temperature ( $23 - 25^\circ\text{C}$ ) for *T. squalia*.

**1.3. Egg measurements:** The freshly deposited eggs are shiny, opaque milky white color ovoid or nearly spherical shape. The size of the freshly deposited egg varied from female to another, however its area ranged between  $7.043 - 34.264 \mu\text{m}^2$  in Table (2). The size of eggs (expressed as area in  $\mu\text{m}^2$ ) increased gradually until hatching. The maximum area was noticed at 14<sup>th</sup> days after laying while Ramadan, Howayda (1993) mentioned that the newly deposited egg of *T.squalida* averaged about  $1.7\mu\text{m}^2$  in its longer diameter and  $1.5\mu\text{m}^2$  in its shortest one .During the last days increased in size up to  $2.2\mu\text{m}^2$  in diameter.

### 2. Larval stage

**2.1. larval duration :** The results obtained in Table (1) showed that there are three larval instars for this insect, the mean duration for the first instar was ( $22.8 \pm 0.8$  days ), it decreased to ( $21.1 \pm 0.378$  days ) for the 2<sup>nd</sup> instars, while the third instar was the longest one, ( $132.1 \pm 0.546$  days ) . The mean total larval duration was ( $176 \pm 0.666$  days) .According to Deasi *et al* . (1994), There are three larval instars for this insect took an average of 21.27, 19.87 and 132.4 days respectively.

**2.2. Percentage of Larval mortality:** The results presented in Table (1) show that the highest mortality occurred during the first larval instar was 22.22 %, while it was 18.6 % for the second instar ,the mean lowest mortality percentage 14% was recorded by the third instar larvae. The mean total larval mortality was 54.82%. These results agree with those obtained by Abd El-fatah-(1991) who recorded that mortality percentages were 27 ,15 and 9% for the 1<sup>st</sup>,2<sup>nd</sup> and 3<sup>rd</sup> the first instars of *T.squalida* respectively.

**2.3. Survival of larval stage:** The obtained data in Table (1) revealed that larval survival reached 70 % in the first larval instar and it decreased to 57 % and 49 % for 2<sup>nd</sup> and 3<sup>rd</sup> instars respectively, while El-Deeb (1992b) found that survival percentages for 1<sup>st</sup>,2<sup>nd</sup>,3<sup>rd</sup> larval instar of *T. squalida* which derived from 1<sup>st</sup> instar were 74.5, 65.5% under laboratory conditions.

### 3. The pupal stage:

**3.1. Pre-pupal and pupal duration:** The obtained data in Table (1) show that the pre-pupal duration was ( $15 \pm 0.537$ ) while the pupal duration was ( $21.4 \pm 0.371$ ) according to Abd EL-Fatah (1991) who cleared that pre-pupal and pupal stage of *T.squalida* (as Scarabaeid insect) was about 5 and 10.8 days.

**3.2. Pre-pupal and Pupal mortality percentages:** Data presented in Table (1) reveal that the mean mortality of pre-pupal stage was 22.45% while the mean mortality of pupal stage was 13.16 % while Abd El-Fatah (1991) found that the mean percentage of pre-pupal and pupal mortality of *T.squalida* was 19 % and 0.5 %.

**3.3. Survival of pupal stage from eggs:** The obtained data in Table(1) revealed that the survival percentage of pupae resulted from egg stage was 33 % while **Abd El-Fatah (1991)** reported that survival percentage for pupae of *T.squalida* was 90.64% under laboratory conditions .

**4. The total developmental period:** Data obtained in Table (1) indicate that the mean of total developmental periods was  $225.72 \pm 0.924$ .days.

### 5. Adult stage

Data presented in Table (1) show that adult female lives about 34.4 days includes three distinct periods [pre- oviposition 6.2 days , oviposition 10.9 days and post-oviposition 17.3 days], while adult male lived about 13.00 days, female, fecundity was about 16.9 eggs/ female, the fertility was 72.12 % , the whole generation period was averaged 238.72 & 260.12 days for males and females respectively, while life-cycle averaged 231.92 days, this means that, the insect has one generation only per year. Abd El – Fatah (1991) in his studies on *T.squalida*, recorded that the oviposition periods were 7.2, 12.5 and 18.2 days resp., the adult longevity for male and female were about 24.3 and 37.9 days, fecundity was 30.2 egg/female, the fertility was 82.4% and total life cycle was 326.79 days.

**5.1. Survival of adult stage from eggs.** Data in Table (1) show that the survival percentage of adult stage resulted from egg stage was 27%. while El- Deeb (1992 b) recoded that survival of adult from eggs of *T.Squalida* under laboratory condition reached to 100% and decreased to 92.78&83.94% at 25 & 20°C. resp.

Table 1. Mean durations, survival, mortality percentage and other biological aspects for different stages of *Oryctes rhinoceros* L. under laboratory conditions (20±5C & 55±5%R.H.).

	Egg	Larval instars				Cocoonal duration			Total durations of immature stage	Female longevity				Longevity / male	Fec. / ♀	Fer. / ♂ %	Total life cycle	Total period of generation		Total %	S.
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	Total	Pre-pupal	Pupae	Total cocona		Pre-ovip. period	Ovip. period	Post ovip. period	Total					♂	♀		
Durations (days)	13.32	22.8	21.1	132.1	176	15	21.4	36.4	225.72	6.2	10.9	17.3	34.4	13.0	16.9	72.12	231.92	238.72	260.12	-	
S. E. ±	0.427	0.8	0.378	0.546	0.666	0.537	0.371	0.763	0.924	1.143	1.870	3.383	5.895	1.247	2.869	12.191	1.144	1.098	5.766	-	
Survival %	90	70	57	49	-	38	33	-	-	-	-	-	-	-	-	-	-	-	-	-	27
Mortality %	10	22.22	18.6	14	54.82	22.45	13.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1<sup>st</sup> = first larval instar  
 2<sup>nd</sup> = second larval instar  
 3<sup>rd</sup> = third larval instar  
 No. of eggs used 100

Fec. = Fecundity  
 Ovip. = oviposition  
 ♀ = female

S.E. ± = Stander error  
 Fer. % = Fertility percentage  
 ♂ = male

Table 2. Egg measurements (area  $\mu^2$  during the incubation period for groups of eggs each deposited by eight female) each figure denotes the means of 21 eggs).

Replicates Days	Measurements of egg									%	S.E.±
	1	2	3	4	5	6	7	8	Mean		
1st day	7.2031	6.719	7.058	6.847	6.928	6.865	7.326	7.404	7.043	0.00	0.087
2	8.546	7.975	8.185	8.137	7.995	7.995	8.578	8.835	8.280	4.466	0.115
3	10.079	9.457	9.686	9.634	9.479	9.479	10.113	10.393	9.789	9.93	0.125
4	11.737	11.066	11.313	11.256	11.089	11.089	11.774	12.076	11.425	15.86	0.130
5	13.520	12.800	13.065	13.004	12.825	12.825	13.561	13.884	13.185	22.23	0.145
6	15.429	14.659	14.943	14.878	14.686	14.686	15.473	15.819	15.071	29.07	0.156
7	17.464	16.644	16.946	16.877	16.673	16.673	17.51	17.878	17.08	36.44	0.166
8	19.6246	18.754	19.294	19.001	18.785	18.785	19.673	20.064	19.247	44.2	0.175
9	21.910	20.991	21.562	21.238	21.023	21.023	21.962	22.375	21.510	52.39	0.185
10	24.322	23.353	23.954	23.628	23.387	23.387	24.376	24.812	23.902	61.06	0.195
11	26.859	25.840	26.473	26.129	25.876	25.967	26.916	27.374	26.428	70.59	0.201
12	29.479	28.172	29.22	28.832	28.200	28.626	29.582	30.062	29.021	79.60	0.240
13	32.216	30.96	31.509	31.616	31.085	31.431	31.873	32.844	31.691	89.26	0.217
14	35.126	33.748	34.634	35.266	33.158	33.158	33.896	35.126	34.264	98.48	0.312
15	H	H	H	39.187	H	H	H	H	4.898	100	4.898
1st day	273.514	261.136	267.842	305.526	261.183	261.989	272.613	278.939	272.837		7.353
Total	18.234	17.409	17.856	20.368	17.412	17.466	18.174	18.596	18.189		0.490
Mean	2.601	2.513	2.522	2.625	2.494	2.515	2.555	2.624	2.412		0.315
± S.E.	7.2031	6.719	7.058	6.847	6.928	6.865	7.326	7.404	7.043	0.00	0.087

$\text{mm}^2$  = mill micron.

M. eggs = measurements of eggs

% = accumulation percentage of increase in egg size until hatching.

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## دراسات بيولوجية لحفار عنق النخيل

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أجريت الدراسات البيولوجية بتربية الحشرة تحت الظروف المعملية ( حرارة  $20 \pm 5^\circ \text{C}$  و رطوبة نسبية  $55 \pm 5\%$  ) وكانت النتائج كما يلي:-

١- طور البيضة : كانت فترة حضانة البيضة ( $13,32 \pm 0,47$  يوم) كما وجد أن حجم البيض يزداد كلما تقدم في العمر حيث بلغت مساحته عند الوضع  $7,043$  وزاد إلى  $34,264$  ملليمكرون عند الفقس

٢- طور اليرقة: وجد أن لهذه الحشرة ثلاثة أعمار يرقيه بمتوسط طول العمر اليرقي الأول ( $22,8 \pm 0,8$  يوم) و الثاني ( $21,1 \pm 0,378$  يوم) وكان الثالث أطول ( $132,1 \pm 0,546$  يوم) وبذلك يكون متوسط طول فترة الطور اليرقي كله ( $176 \pm 0,666$  يوم) كما اختلفت النسبة المئوية للموت في طور اليرقة تبعاً للعمر ودرجة الحرارة حيث زادت نسبة الموت زيادة كبيرة في العمر اليرقي الأول وقلت كثيراً في العمرين الثاني والثالث فكانت  $22,22\%$  ،  $18,6\%$  ،  $14\%$  على التوالي أما العمر اليرقي كله فكانت نسبة الموت  $54,82\%$  .

٣- طور العذراء: بلغت طول فترة حياة ما قبل العذراء ( $15 \pm 0,537$  يوم). متوسط فترة العذراء ( $21,4 \pm 0,371$  يوم) متوسط النسبة المئوية للموت في طور ما قبل العذراء  $22,45\%$  . طور العذراء  $13,16\%$  .

٤- معدلات البقاء للأطوار الغيربالغة وبالبالغة: تم دراسة معدلات البقاء للأطوار الناتجة من البيضة و اتضح من النتائج أن معدلات البقاء في طور اليرقة تصل إلي  $70\%$  في العمر اليرقي الأول ونقل إلى  $57\%$  ،  $49\%$  لكلا من العمر البرقي الثاني والثالث على الترتيب أما في طور العذراء كانت  $33\%$  . أما في الحشرة الكاملة  $27\%$  .

٥- طور فتر حياة الحشرة الكاملة : تعيش الأنثى  $34,4$  يوم ، بينما يعيش الذكر  $13$  يوم

أ- فترات وضع البيض : كانت متوسط فترة ما قبل وضع البيض  $6,2$  يوم - فترة وضع البيض  $10,9$  يوم أما فترة ما بعد وضع البيض  $17,3$  يوم .

ب- الخصوبة ومعدل فقس البيض: كان متوسط عدد البيض للأنثى الواحدة  $16,9$  بيضة / أنثى كان معدل الفقس  $72,12\%$  .

ت- دورة الحياة: أكملت الحشرة دورة حياتها في فترة حوالي  $231,92$  يوم.

ث- طول مدة الجيل الواحد : يبلغ  $238,72$  يوم و  $260,12$  يوم لكل من الذكور و الإناث على الترتيب لهذه الحشرة جيل واحد في السنة.