

BIOLOGICAL STUDIES ON POWDER POST BEETLES *Lyctus linearis* GOEZE IN EGYPT (LYCTIDAE: COLEOPTERA)

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ABSTRACT

Biology of the powder post beetles, *Lyctus linearis* Goeze (Lyctidea: Coleoptera) was investigated under laboratory conditions. The female of beetles lay its eggs in the pores on the wood surface. The insect undergoes had four annual generations. The incubation period of 1st, 2nd, 3rd and 4th generations was 7.2, 6.8, 7.9 and 10.7 days, respectively. Rate of hatchability ranged between 66 % and 100 %. The duration of the larval stage ranged between 28 and 103 days during four annual generations. The pre- pupa, pupa, adult hardness and adult longevity durations were averaged 1-5, 6-15, 1-5 and 11-29 days, respectively

INTRODUCTION

The species *Lyctus linearis* named by Goeze in 1777 is a member of family lyctidae from the order Coleoptera. As all species, this family is a wood boring beetle. Creffied (1996) stated that They may cause severe damage to seasonal hard wood, wooden floors and furniture. Moussa (1977) mentioned that it attack timber in building, furniture and stored timber Groden *et al.*(1999) showed that it attacks especially the sapwood of the old cut tree. Haggag (1991) mentioned that *Lyctus impressus* attacks citrus, guava, mulberry and Egyptian willow trees. In (2000) Haggag and Batt added that female beetle lays its eggs in pores on the surface of wood. The activity period of beetles extended from the 2nd week of February until the 4th week of October. Nour (1963 a&b), Helal (1986) and Batt (1989) surveyed *Lyctus africanus* Lesne. From fig, mango, acacia, mulberry, sisso, Poinciana, willow, peach, oak and sesbane trees as well as bamboo and cotton stalks. During the last few, years *Lyctus linearis* became important insect pest, therefore the present study aimed to shed more light on its biology on wood royal-poinciana

MATERIALS AND METHODS

To preparing pure culture of powder-post beetles, collected infested samples of Poinciana wood with the insect from Shebeen El-Kanater (Qalubia governorate) in January 2008. Infested branches were cut into cutting about 20 cm.long and protected in jars covered with muslin under laboratory conditions until adult emergence. Newly emerged beetles were transferred to uninfested poinciana- royal wood cutting (10 cm long and 3 cm diameter) at a rate of 5 female and 5 male convicted into a new jar for studying adult behavior,mating,feeding as well as larval , pupal duration and adult longevity and fecundity. For studying oviposition activity, prepared

artificial diet Helal (1977) which mean dough made from wheat flour, yeast and water then air-dried, stained with carbol fuchsin to know pre-oviposition, number of eggs per female, hatchability and number of eggs.

Larval stage:

Estimated as follows:

The larval duration = Generation period – (incubation period + pupation period + pre-oviposition period)

Pupal stage:

To estimate the pupal duration. Ten full-grown larva were obtained from infested cutting and kept in glass tubes to artificial diet till the adult emergence

Adult stage:

Longevity of adult estimated by elapsed period between emergence and death of adult.

Number of generations:

Number and duration of generations studied through one year extending from April 2007 until March 2008.

RESULTS AND DISCUSSION

A) The egg stage

Eggs of *L. linearis* are cylindrical elongated with rounded ends in shape. The eggs cannot visible because the female lays them deep within the pores of the wood. A few eggs could be gathered from the powdery wood material fallen from severely infested cutting (Figure 1).

The eggs of *L. linearis* in small cracks, crevices in the wood as well as in the pores on the surface. Recent emergence holes are common site of oviposition. The incubation period varied from generation to another, ranged from 4 to 13 days. The highest incubation period was in 4th generation ranged from 8 to 13 days with an average 10.7 ± 0.6 days at temperature 15.8 °c and R.H. 54.3 % ,while lowest incubation period was in 2nd generation at temperature 29.5 °c and R.H.43.8 %. Statistical analysis showed highly significant differences between the different generations (F.value = 6.2). (Table1).

B) The larval stage:

1- General description:

The newly hatched larva was transparent white in color. Young larva eats a yolk like substance inside its egg before boring into the wood; the larva gradually reduces infested timber to dust, leaving a thin veneer of sound wood on the outside. The infested article then crumbles it eats through sapwood and become the larva c-shaped, creamy –white color (Figure1).

2-Larval duration

The average duration of larval stage during the 1st, 2nd, 3rd and 4th generation was 48.9, 35, 46.8 and 90.1 days respectively. Statistical analysis showed highly significant between duration means of larval stage in four generations (Table 1)

The newly hatched larva of powder post beetle *L. linearis* burrow in internal surface layer during feeding on the sapwood, making straight

galleries. The larval galleries are circular and gradually increase in size by increasing larval growth. When the larva become full-grown and ready to pupate, it making curved mine at the end of the larval gallery.

3-The Pre-pupa:

When the larva reaches the maturity, it constructs a pupal – chamber, in which it transforms into pre-pupa. The length of pupal-cell is (3 – 3.5) mm and the width is (0, 9 – 1, 4) mm. The pre-pupa is fat-white in color. (Figure 1). Duration of pre-pupa ranged between 1 and 5 days through the four generation under laboratory conditions. The longest pre-pupa period ranged 2-5 days with an average 3.2 ± 0.3 days in 4th generation at mean temperature 19.9°C and 51.23 R.H. The shortest duration of pre-pupa was recorded during 2nd generation at 32.6°C and 51, 01%R.H.

C- The Pupal stage:

Pupa of powder post beetles *L. linearis*. is excrete in type and fat-white in color.(Fig:1). The female and male pupa are nearly similar in shape and size. The duration of the pupal stage varied from 6 to 15 days through four successive generations. The result showed that the longest duration ranged from 10-15 day with an average of (12.00 ± 0.53) days which was recorded in 4th generation at mean temperature 21.1°C 47.2 % R.H. The shortest duration was 6-8 days with mean of $7.8 + 0.39$ days , it was recorded in 2nd generation at temperature 33.2 °c and 51.1% R.H

Statistical analysis showed significant differences between the pupal duration during four tested generation under laboratory conditions (F.value =13.86) . Table (1) and Fig (1)

D- The adult stage:

The adult of *L. linearis* is reddish-brown in color while shape is elongated and slightly flattened; The head is prominent and is not covered by the pronotum. The antennae have 11 segments and the last two segments are broadent into a terminal club. The elytra are striated with more rows of small puncture marks between striations.(Fig-1). Before emergence, the adult remained quiet in pupal-chamber for a period ranged between 1 to 5 days until the exoskeleton of the body become hard. The new adult chews its way to the surface and emerges leaving behind a circular hole. The period of the hardness differs from generation to another, it ranged from 1 to 5 days, longest period of the hardness was recorded in 4th generation (2-5) days with an average 3.3 ± 0.3 days at temp 21.5 °C and 42.4 % R.H. While,the shortest period of the hardness was appeared in first generation (1-3) days with an average 2.1 ± 0.23 days at temperature 29.4 °c and 44.2% R.H. Statistical analyses showed highly significant differences between periods hardness during four generation under laboratory conditions. (Table: 1) and (Fig: 1)

The mated female begins in search for suitable oviposition site. It tested the wood surface to examine its susceptibility for infestation, then begin laying eggs, oviposit: small cracks and crevices in the wood as well as in the pores on the wood surface, recent emergence holls are common sites of ovipostition. The longest longevity of adult male ranged from 18 days to 25 days with a mean of 20.4 ± 0.7 days. The longevity of males was registered

in the fourth generation while shortest longevity ranged from 11 days to 19 days with mean 15.0 ± 0.8 days, it was appeared in the second generation, Also the longest longevity of adult female ranged from 18 days to 29 days with an average (21.7 ± 0.76) days in the fourth generation, while the shortest longevity ranged from 14 days to 26 days with an average 17.3 ± 1.15 days .(Table 2) Statistical analysis showed significant differences between the male longevities, so in the female longevity . Helal, (1980) stated that adult longevity of *L. africanus* ranged from 2 days to 28 days.

1- pre-oviposition

The pre-oviposition period differed from generation to another, The maximum period was ranged in the fourth generation (from 1 day to 4 days with an average of (2.2 ± 0.29 days) while the shortest period was occurred in the second generation (from 0 days to 2 days) with mean 1.0 ± 0.14 days. The statistical analysis showed significant differences between the pre-oviposition period through the four generations. (Table 2)

2) Oviposition period:

An Oviposition period was (6.7 ± 0.60), (5.2 ± 0.49), (6.2 ± 0.44) and (7.3 ± 0.47) days in 1st, 2nd, 3rd and 4th generations, respectively. Statistical analysis showed significant differences between the oviposition periods through the four generation (F Value = 3.11). (Table: 2)

3) Post-oviposition period:

Post –oviposition period in 1st, 2nd, 3rd and 4th generations was (9-13), (9-13), (9-14) and (9-14) day respectively. Statistical analysis showed there was no significant difference between the post-oviposition periods. (Table 2)

4) Number of laid eggs per female:

Results in Table (4) illustrated that the number of laid eggs per female was varied during the four annual generations. The highest number of laid eggs per female was recorded in the second generation ranged from 29 to 59 egg with an average of 42.5 ± 3.31 egg. While, the lowest number of eggs in fourth generation ranged from 18 to 38 egg with an average 25.3 ± 2.33 eggs.(Table 1:4). Helal (1980) in Egypt, mentioned that average eggs per-female was 32 eggs and laid singly or in groups. Statistical analysis showed highly significant difference between mean number of eggs per female during the four generations. (F. value: 8.12)

E-Number and duration of generation:

As shown in Table (3), the powder post beetle *L.linearis* had four annual successive generations, The first generation extended from 1st week of April to 2nd week of June, It recorded 10 weeks at temp 28.3°C & 42.3% R.H, the second generation was started from 2nd week of June to 2nd week of August, its duration was 8 weeks. The third generation took place between 2nd week of August and 4th week of October for period of 10 weeks at 25°C & 53% R.H, the fourth generation started from 4th week of October to 2nd week of March (18 weeks). The longest period of generation was obtained in the fourth generation which recorded 18 weeks while shortest period generation was achieved in the second generation (8 weeks).

Nour (1963 b) mentioned that *Lyctus africanus* has two generations in Egypt when reared on oak-wood while, Helal (1980) stated that, in Egypt *Lyctus africanus* has five annual generations per year on the royal-Poinciana wood.

F) Nature of damage and behavior:

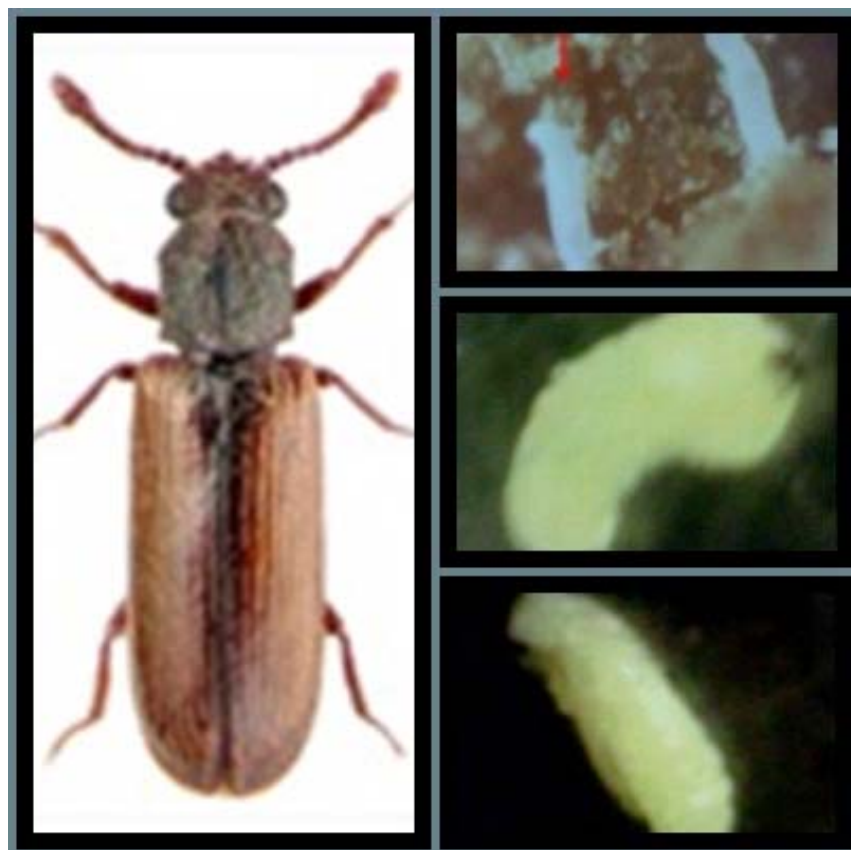
The damages caused by two stages, adult and larva. The adult caused exit-holes at surface wood as well as reducing the wood value. The larval damage is caused by its feeding on sapwood making straight – tunnels. The larval tunnels packed with powder dust. The exit-hole and larval tunnels resulting losses of wood quality

Table (3): Number and duration of generations of *L. linearis* when reared on royal-poinciana wood under laboratory conditions.

Gen.	Generation period		Duration in weeks	Laboratory condition	
	From	To		Temp C°	R.H%
1	1 st week of April	2 nd week of June	10	28.3	42.3
2	2 nd week of June	2 nd week of August	8	31.0	46.0
3	2 nd week of August	4 th week of October	10	25.0	53.3
4	4 th week of October	2 nd week of march	18	18.5	51.5

Table (4): Number of eggs per female and hatchability rate of *L. linearis* Goeze during the four successive generations

Gen.	No. of egg / female		Rate of hatchability		Laboratory condition	
	Mean ± S.E	Range	Mean ± S.E	Range	Temp c°	R.H%
1 st	34.3±1.93	22-42	91.4±2.21	80-100	26.13	39.28
2 nd	42.5±3.31	29-59	74.6±2.8	66-90	29.6	43.81
3 rd	40.4±1.81	28-49	87.8±1.4	82-96	28.7	49.05
4 th	25.3±2.33	18-38	84.8±1.04	80-90	15.8	53.3
F.value	8.12		49.1			
L.S.D	7.6		3.4			



Fig(1) Stages of *Lyctus linearis* Goeze: Adult, egg, larva and pupa

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دراسات بيولوجية على خنفساء ليكتس الأوربية في مصر
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تصيب خنفساء ليكتس الأوربية *Lyctus linearis* Goeze من عائلة Lyctidae رتبة غمدية الأجنحة الأخشاب الخام في المخازن وخشب الأرضيات و أثاث المنازل، وتضع الحشرة بيضها في مسام الخشب ، للحشرة اربعة اجيال سنويا ، يستغرق كل من الجيل الاول والثاني والثالث والرابع ١٠ و ٨ و ١٠ و ١٨ اسبوعا على التوالي بينما تستغرق فترة حضانة البيض في كل من الاجيال الاربعة ٧.٢ و ٦.٨ و ٧.٩ و ١٠.٧ يوما على التوالي، في حين تراوحت نسبة الفقس ما بين ١٠٠ الى ٦٦% وتراوحت فترة الطور اليرقي في كل من الاجيال الاربعة ما بين ٢٨ الى ١٠٣ يوما ، وقد استغرقت فترة ما قبل العذراء والعذراء (١ – ٥) أيام و(١- ٦) أيام ، في حين استغرقت فترة التصلب (١: ٥) يوما اما الفترة التي استغرقتها الحشرة اليافعة تراوحت ما بين ١١ الى ٢٩ يوما .

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Table (1): Annual duration of generations and duration of different stages of *L. linearis* which reared on Royal Poinciana under laboratory conditions .

Stages	Duration (in days)																F Value	L. S. D.
	1 st generation				2 nd generation				3 rd generation				4 th generation					
	Mean ± S.E	range	Temp °C	R.H%	Mean ± S.E	range	Temp °C	R.H%	Mean ±S.E	range	Temp °C	R.H%	Mean ±S.E	range	Tamp	R.H%		
Preoviposition	1.2±0.20	0-2	29.7	41.5	1.0±0.14	0-2	34.5	42.3	1.5±0.22	0-2	34	45.6	2.2±0.29	0-2	17.9	59.6	5.63	0.63
incubation	7.2±0.68	4-11	26.2	40	6.8±0.69	4-11	29.5	43.8	7.9±0.40	6-11	28.7	49.1	10.7±0.60	8-13	15.8	54.3	6.2	1.84
larva	48.9±2.77	38-63	26.1	37.6	35.0±1.48	28-43	30.2	44.9	46.8±2.5	36-60	24.9	55.06	90.1±2.7	81-108	16.8	54.11	100.7	12.36
pupa	9.0±0.39	7-11	30.1	44.3	7.8±0.39	6-8	33.2	51.1	10.7±0.49	9-14	19.5	58.5	12±0.53	10-15	21.1	47.2	13.86	2.56
hardness	2.1±0.23	1-3	29.4	44.2	2.3±0.26	1-4	27.3	46.2	3.1±0.31	2-5	17.5	58.5	3.3±0.3	2-5	21.5	42.4	4.44	1.44
Total	68.4±4.03	50-90	28.3	42.3	52.9±2.68	40-69	31	46	70±3.88	52.92	25	53.3	118.3±4.22	101-143	18.5	51.5	56.97	19.4

Table (2): Oviposition period and Adult longevities of *L. linearis* Goeze which reared on royal poinciana under laboratory condition

longevity		Duration								F Value	L. S. D.
		1 st generation		2 nd generation		3 rd generation		4 th generation			
		Temp	R.H.	Temp	R.H.	Temp	R.H.	Temp	R.H.		
		28.4°C	38.2 R.H.	29.6°C	43.5 R.H.	28°C	50.8 R.H.	15.7°C	55.80 R.H.		
		Mean ±SE	Range	Mean ±S.E	Range	Mean± S.E.	Range.	Mean ± S.E.	Range.		
Female	Pre-Ovi	1.2 ± 0.20	0-2	1.0±0.14	0-2	1.5±0.22	0-2	2.2±0.29	1-4	5.63	0.63*
		6.7 ±0.60	4-10	5.2±0.49	3-8	6.2±0.44	5-9	7.3±0.47	5-10	3.11	1.45**

Male	PostTotal	10.8±0.36	9-13	11.1±0.43	9-13	11.2±0.51	9-14	12.1±0.62	9-14	1.29	---
	---	18.8 ±0.85	14-23	17.3±1.15	14-26	18.9±0.57	17-23	21.7±0.76	18-29	4.64	2.47**
		17.3 ±0.94	13-23	150±0.80	11-18	18.1±0.78	14-22	20.4±0.7	18-25	7.53	2.35**

*Significant at level of 0.05

**Significant at level of 0.01