Egypt. J. Agric. Res., 78 (1), 2000.

BIOLOGICAL AND ECOLOGICAL STUDIES ON THE LYCTID BEETLE, *LYCTUS IMPRESSUS* LOM. (*LYCTIDAE: COLEOPTERA*) ON CITRUS TREES IN EGYPT

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(Manuscript received 16 April, 1998)

Abstract

The biology and ecology of the Powder post beetle *Lyctus impressus* Lom (Lyctidae: Coleoptera) was investigated under the prevailing laboratory conditions. Female beetle lays its eggs in pores on the surface of wood. Adult longevity was 10.05 days and 8.93 days for female and male, respectively. The pre-pupal, pupal and adult hardness durations were 5-11 days, 5-17 days, and 3-10 days, respectively. The pest undergoes three annual generations. Adult activity period extends from the 2nd week of February until the 4th week of October with three distinct population peaks, during the 1st half of April, 4th week of June to 3rd week of July and 4th week of August to 3rd week of September.

Temperature appeared to be a principal weather factor influencing beetles activity, while the effect of relative humidity was less evident.

INTRODUCTION

Lyctid beetles (Lyctidae: Coleoptera) are important insect pests. They may cause severe damage to seasonal hardwood, wooden floors and furniture, Shalaby (1958) reported *Lyctus impressus* Lom. from oak floors in Cairo and Moussa (1977) mentioned that it attacks furniture, ply wood, fig wood and timber in buildings. Haggag (1991) added that *L.impressus* attacks citrus, guava, mulberry and Egyptian willow trees. 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, *L.impressus* infestation acquired an increasing economic importance in citrus orchards. As a matter of fact, little is known about the status of *L.impressus* on citrus. Therefore, the present study was aimed to shed more light on its biology and ecology on citrus.

MATERIALS AND METHODS

Citrus branches infested with *Lyctus impressus* Lom. were collected from Shebeen El-Kanater (Qalubia governorate) in January 1996. Branches were cut into cuttings about 30cm. long and introduced into jars covered with muslin, then kept under laboratory conditions until beetles emergence. Newly emerged beetles were transferred to uninfested citrus cuttings (10cm. long and 3 cm. diameter) at a rate of 5 females and 5 males confined into a new jar.

Laboratory observations on the various aspects of the biology of the different stages and the number of annual generations were taken through one year extending from February 1996 until March 1997.

Meanwhile, the population fluctuations and annual generations of the beetle were also studied through two successive years extending from January 1996 to December 1997. Five cuttings of citrus branches (about 20 cm. long and 3cm. diameter) infested with *L.impressus* were collected weekly from citrus orchards at Shebeen El-Kanater (Qalubia governorate), kept in glass jars and the number of emerged beetles were counted. Population data was correlated with day-maximum temperature (DMxT), night-minimum temperature (N.Mn.T) and daily mean relative humidity (DMRH).

RESULTS AND DISCUSSION

1. Number of annual generations: Under the prevailing laboratory conditions, *L.impressus* underwent three annual generations, Table 1.

1st generation: In 1996, it elapsed 18 weeks from the 3rd week of February to the 1st. week of July under mean conditions of 29.94^{o}C DMxT, 15.96^{o}C NMn T and 53.37% DMRH. In 1997, the corresponding duration was 15 weeks from the 3rd week of March to the 2nd week of July under mean conditions of 32.13^{o}C DM x T, 18.01^{o}C NMn T. and 50.87% DMRH.

2nd generation: In 1996, the 2nd generation elapsed 13 weeks from the 1st week of July to the 2nd week of October under mean conditions of 33.89^{o}C D M x T, 21.90^{o}C NMn T and 61.21% DMRH. In 1997, the corresponding period was 11 weeks from the 2nd week of July until the 1st. week of October under mean conditions of 34.13^{o}C D M x T, 22.13^{o}C N Mn T and 61.58% DMRH.

Table 1. Durations of the annual generations of *L.impressus* in two successive years under laboratory condtions.

Year	Generation	Occurrence period		Duration	Mean laboratory conditions		
		From	To	in weeks	D Mx T.	N Mn. T.	DMRH.
1996	1*st.*	3*rd.*week of Feb.1996	1*st.*week of July	18	29.94°C	15.96°C	53.37
	2*nd.*	1*st.*week of July	2*nd.*week of Oct.	13	33.89°C	21.90°C	61.21
	3*rd.*	2*nd.*week of Oct.	3*rd.*week of March 1997	21	21.96°C	10.42°C	66.36
1997	1*st.*	3*rd.*week of March 1997	2*nd.*week of July	15	32.13°C	18.01°C	50.87
	2*nd.*	2*nd.*week of July	1*st.*week of Oct.	11	34.13°C	22.13°C	61.58
	3*rd.*	1*st.*week of Oct.	4*th.*week of Feb.. 1998	19	22.37°C	10.76°C	65.50

3rd generation: In 1996 this generation lasted for 21 weeks; from the 2nd week of October to the 3rd week of March under mean conditions of 21.96°C D M x T, 10.42°C NMn T and 66.36% DMRH, whereas in 1997 it elapsed 19 weeks from the 1st week of October to 4th week of February under mean conditions of 22.37°C DM x T., 10.76°C NMn T and 65.50% DMRH.

Nour (1963b) stated that, in Egypt, *Lyctus africanus* has two generations a year. Adults appear in two broods, the first in May and the second any time between July and September. The number of emerged beetles was positively correlated with increase of temperature. On the other hand, Helal (1980) reported that under laboratory conditions *L.africanus* has five annual generations with respective durations of 42,44,38,54 and 149 days.

2. Biological observations: The durations of certain stages of *L.impressus* under laboratory conditions during the 3 successive annual generation are shown in Table 2.

2.1. Egg stage: Eggs are laid inside wood pores and are very difficult get out. Accordingly, no precise data could be collected on either incubation period or number of eggs laid. However, few eggs could be gathered from the powdery wood material fallen from severely infested cuttings. Eggs are elongate in shape, white in colour and measure 0.6x0.4 mm.

2.2. larval stage: Larvae bore into sapwood making tunnels in all directions. Like other lyctid larvae, they attain a whitish cylindrical C-shaped body with distinct 3-segmented thoracic legs. Full grown larvae turn to yellowish-white in colour and measure 5.61±0.4 mm in length. Larval duration lasted for 81.0, 55.19 and 103.1 days for the 1st, 2nd and 3rd generations, respectively. Helal (1980) mentioned that the larval duration of *Lyctus africanus* ranged 17-98 days.

2.3. Pre-pupal stage: When the larva reaches maturity, it constructs a pupal chamber, where it transforms into pre-pupa. The average length of the pre-pupa is 4.13±0.29 mm (3.8-4.5 mm). The shortest duration of the pre-pupa (7.0±2.83 days) was recorded during the 1st. generation at 16.8-30.8°C and 51% R.H. and the longest duration (8.0±0.63 days), took place during the 2nd. generation at 22.96-31.17°C and 61% R.H).

2.4- Pupal stage: The Pupa is exarate and measures 2.6-3.2 mm, with an average of 2.93±0.19 mm in length and 0.8-1.0 mm with an average of 0.95±0.76 mm

Table 2. Larval, pre-pupal, pupal and adult hardness periods of *L.impressus* during the 3 successive annual generations (February 1996-March 1997).

Generation	Generation Period			Duration in days				Average		
	From	To	weeks	Larva	Pre-pupa	Pupa	Hard-ness	D MxT °C	N Mn T °C	DMRH %
1*st.*	3*rd.*week of Feb.	1*st.* week of July	18	81.00±5.1 (77-89)	7.0±2.8 (5-11)	14.0±1.9 (10-17)	6.79±2.21 (4-10)	30.83±4.6	16.47±3.9	51.00±5.0
2*nd.*	1*st.* week of July	2*nd.* week of Oct.	13	55.19±5.7 (48-63)	8.00±0.63 (7-9)	7.4±0.96 (5-8)	4.5±0.5 (4-5)	31.17±8.1	22.96±7.5	61.38±2.0
3*rd.*	2*nd.*week of Oct.	3*rd.*week of Mar., 1997	21	103.1±5.7 (96-104)	7.6±1.9 (5-11)	11.8±3.7 (5-17)	7.0±2.31 (3-10)	19.51±5.6	9.31±2.75	68.69±4.5

in width. The shortest pupal duration (7.44±0.96 days) was obtained during the 2nd generation and the longest duration (14.0±1.93 days) occurred during the 1st generation. Helal (1980) found that the pupal duration of *L.africanus* ranged 2-4 days.

2.5. Adult stage: After emergence from the pupa, the adult beetle stays inside the pupal chamber for several days until its exoskeleton hardness. Emerging beetles make circular exit holes with 1.5±0.17 mm diameter. Beetles are small, slender, elongate and brown in colour. Their body length ranges 2.3-3.1 mm. with an average of 2.84±0.27 mm. and body width ranges 0.7-1.0 mm. with an average of 0.85±0.10 mm. Adult longevities of both female and male beetles were 4-17 days, with an average of 10.05±3.18 days, and 4-16 days, with an average of 8.93±3.01 days, respectively. Helal (1980) stated that adult longevity of *L.africanus* ranged 2-28 days, and the sex ratio was I: 1.34 (males: females). The shortest hardness period (4.5±0.5 days) was recorded during the 2nd generation and the longest period (7±2.3 days) occurred during the 3rd generation.

The relationship between three weather factors (DMxT, NMnT and DMRH) and the durations of the pre-pupal stage, pupal stage and adult hardness period was studied. Statistical analysis showed a significant negative correlation between DM x T and both pupal duration and adult hardness period (r = -0.9998 and -0.585, respectively), while the correlation between NMnT and pre-pupal duration was insignificant (r = +0.415). The relationship between NMnT and pupal duration or adult hardness period was negative and significant (r =-0.635 and -0.888, respectively), whereas no correlation existed between NMnT and pre-pupal duration (r = +0.388). On the other hand, there was a significant positive correlation between DMRH and the duration of the pre-pupal stage (r=+0.698) and an insignificant relationship between DMRH and both duration of pupal stage and adult hardness (r = -0.454 and -0.432, respectively).

3. Population fluctuations: The population fluctuation of *L.impressus* beetles on citrus cuttings is shown in Fig. 1. The activity period of the beetles extended from the 2nd week of February until the 4th week of October for about 34-35 weeks. In coincidence with the laboratory results three population peaks were recorded yearly.

In 1996, the first peak occurred during the 2nd week of April (270 beetles) at D M x T. of 33.5°C, N Mn T. of 15.3°C and 46% DMRH. The second peak took place during the 3rd week of July (247 beetles) at D M x T. of 34.2°C, the N Mn T. of 22.9°C and 61.2% DMRH. The third peak occurred during the 3rd. week of September (54 beetles) at the D M x T. of 33.9, the N Mn T. of 20.5°C and 61% DMRH.

In 1997, the first peak occurred during the 1st week of April (294 beetles) at D M x T of 26.9°C, NMn T of 10.8°C and 59% DMRH. The second peak was observed during the 4th. week of June (178 beetles) at D M x T of 34.4°C, N Mn T of 17.5°C and 50.0% DMRH. The third peak took place during the 4th. week of August (92 beetles) at DM x T of 32.2, N Mn T of 18.8°C and 65% DMRH.

Statistical analysis, Table 3 indicated that in 1996 correlation between D M x T. and the number of emerged beetles was significant and positive for both 1st and 3rd peaks (r =+0.63 and r = +0.73, respectively) and insignificantly negative for the 2nd peak (r =-0.43). In 1997, this relationship was insignificant and negative for the 1st and 2nd peaks (-0.32 and -0.21, respectively) and significantly ngative for the 3rd peak (r =-0.62).

Correlation between NMnT and the number of emerged beetles was significant and positive at both the 2nd and 3nd peaks (r =-0.50 and + 0.69 and + 0.57) 1996 and 1997, and insignificant at the 1st peak (r=+0.42 in 1996) and (r=-0.32 in 1997).

Beetle activity was significantly and negatively correlated with DMRH at the 1st peak in 1996 (r =-0.59) and the 2nd peak in 1997 (r=-0.73), but insignificantly correlated with it at the 2nd and 3rd peaks in 1996 (r=+0.01 and -0.15, respectively) and 1st. and 3rd. peaks in 1997 (r =+0.43 and -0.15, respectively).

Table 3. Simple correlation coefficients (r) for the relationship between three weather factor and the number of emerged beetles of *L.impressus* at Qalubia governorate during 1996 and 1997.

Weather factor	Peak	1996		1997	
		r	P	r	P
D Max T	1st	+0.63	0.05	-0.32	0
	2nd	-0.43	-	-0.21	0
	3rd	+0.73	0.05	-0.62	0.05
N Min. T	1st	+0.42	-	-0.32	-
	2nd	+0.50	0.05	+0.50	0.05
	3rd	+0.69	0.05	+0.57	0.05
DMRH%	1st	-0.59	0.05	+0.43	-
	2nd	+0.01	-	-0.73	0.05
	3rd	-0.15	-	-0.15	-

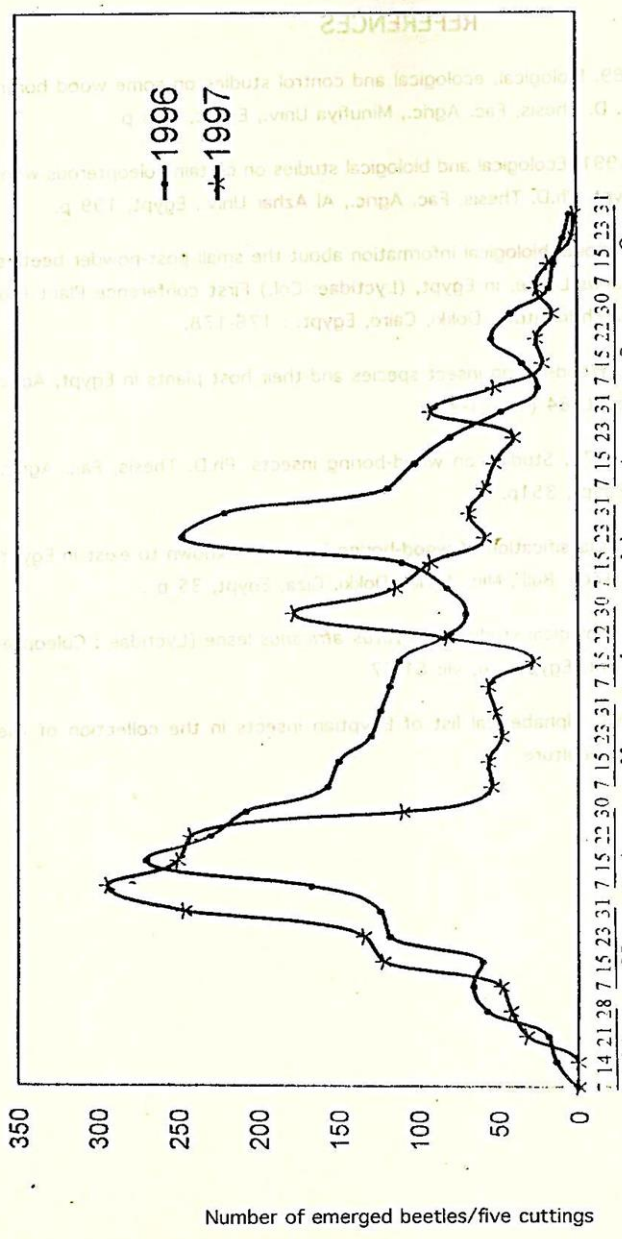

Fig. 1. Weekly numbers of emerged beetles of *Lyctus impressus* at Qalubia Governorate in 1996 and 1997.

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دراسات بيولوجية وإيكولوجية علي خنفساء ليكتس امبرسس في مصر

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تصيب خنفساء ليكتس امبرسس *Lyctus impressus* Lom. من عائلة Lyctidae ورتبه غمدية الاجنحة عوائل متعدده. وتضع الحشرة بيضها في مسام الخشب، وتعيش إناثها ١٠,٠٥ يوما والذكور ٨,٩٣ يوما. وتختلف مدد أطوار اليرقة وما قبل العذراء والعذراء وكذلك تصلب الحشرة الكاملة تبعا لاختلاف درجة الحرارة والرطوبة النسبية خلال الاجيال المختلفة للحشرة الكاملة تبعا لاختلاف درجة الحرارة والرطوبه النسبية خلال الاجيال المختلفة للحشرة لتستغرف ٤٨ – ١٠٤ يوما، ٥ – ١١ يوما، و ٥ – ١٧ يوما ، و ٣ – ١٠ يوما علي التوالي. وللحشرة ثلاثة أجيال سنويا. وتمتد فترة نشاطها في الطبيعة من الاسبوع الثاني من فبراير حتي الاسبوع الرابع من اكتوبر ولها خلال تلك الفترة ثلاث قمم للتعداد: الاولي خلال الاسبوعين الاول والثاني من ابريل، والثانية خلال الفترة من الاسبوع الرابع من يونيو حتي الاسبوع الثالث من يوليو، الثالثة خلال المدة من الاسبوع الرابع من اغسطس حتي الاسبوع الثالث من سبتمبر.

ويبين التحليل الإحصائي ان هناك ارتباط معنويا بين متوسط درجه الحرارة العظمي وعدد الحشرات الخارجة خلال الجيل الاول والثالث عام ١٩٩٦ والجيل الثالث عام ١٩٩٧، اما بالنسبة لتأثير متوسط درجة الحرارة الصغري علي تعداد الحشرات فقد كان هناك ارتباطا معنويا خلال قمتي التعداد الثانية والثالثة عامي ١٩٩٦، ١٩٩٧، وكذلك كان لمتوسط الرطوبة النسبية تأثيرا معنويا علي تعداد الحشرات خلال الجيل الاول عام ١٩٩٦ والثاني عام ١٩٩٧.