Bionomics of Cigarette Beetle *Lasioderma serricorne* F. (Anobiidae: Coleoptera)*

N. K. Bhalodia† and M. S. Chari

A I C R P (Tobacco), Gujarat Agricultural University, Anand Campus, Anand-388 110

ABSTRACT

Studies were conducted on the bionomics of *Lasioderma serricorne* F. The life history, sex differences, sex ratio and number of generations are presented. The duration of egg, larval, prepupal, pupal and adult periods are given. There are four larval instars and the development from egg to adult on three different foods viz., wheatflour + yeast, VFC tobacco powder and VFC tobacco seeds varied from 46 to 76 days; 39 to 84 days and 67 to 85 days, respectively. At controlled temperature it varied from 44 to 58 days. Studies on the olfactory and gustatory responses indicated that grubs prefer wheatflour + yeast and VFC tobacco powder. (*Received on Nov. 28, 1974*).

INTRODUCTION

CIGARETTE beetle *Lasioderma serricorne* F. is a serious pest of tobacco in storage. The grubs damage the leaf by feeding and forming galleries in the leaves. In the case of severe infestation the grubs make the leaves into powder. They also make holes on cigarettes by entering through wrapper. They feed on the filler tobacco and make them unfit for smoking.

Fletcher and Ghosh (1919) recorded this pest on spices. Ramakrishna Ayyar (1934) reported this pest on tobacco from South India. Rao and Prasad (1956) reported it on seeds of *Striga* sp. Joshi and Srivastava (1964) on processed food "bari" and Hussain and Khan (1966) on stored castor beans. Kurup and Parkhe (1961) and Joshi (1968) gave a brief description of its life history on VFC tobacco and Lanka tobacco. The results of research work on the bionomics of the cigarette beetle forms the subject matter of this paper.

MATERIALS AND METHODS

Initial culture of *L. serricorne* F. was established by collecting large number of mature larvae from the godown of the Bidi Tobacco Research Station, Anand. They were reared on artificial diet containing wheatflour + yeast powder B P C mixed in the ratio 2:1 in plastic tubes (4·5 cm × 3·0 cm). Tobacco was not used as food with a view to eliminate any possible influence of variations in the quality of tobacco on insect biology. The pupae obtained from these larvae were sexed and kept in individual glass petri dishes. The beetles, on emergence, were paired for studies on mating

* Part of the M.Sc. (Agri) thesis submitted by the senior author to the Gujarat Agricultural University, Ahmedabad, 1974.

† Present address: Voltas Ltd., Chemical Division, Bombay—400 038.

behaviour, fecundity and duration of different stages. Fecundity studies were made by introducing freshly emerged male and female beetles in a petri dish containing a piece of tobacco leaf folded two to three times for egg laying. Eggs were counted every day and were placed in individual petri dishes for recording incubation period. Freshly hatched grubs were transferred to plastic tubes containing wheatflour + yeast powder (2:1), VFC tobacco powder and VFC tobacco seeds as food.

The olfactory and gustatory responses of the *L. serricorne* F. grubs to different foods were studied in a circular galvanized trough measuring 100 cm in diameter and 35 cm in height (Plate 1). Eight sectors were drawn at the bottom of the trough at equal distance from one another. Eight treatments viz., VFC tobacco powder (var. HR. 62-7), bidi tobacco powder (var. Anand-2), chewing tobacco powder (var. Anand-145), VFC tobacco seeds (var. HR. 62-7), bidi tobacco seeds (var. Anand-2), chewing tobacco seeds (var. Anand-145), coriander seeds and wheatflour + yeast were tried. Five grams food material of each was uniformly spread in these sectors at an equidistance from the centre. Twenty, third instar larvae were released in the centre of the trough. The trough was coverd with a black cloth and was kept in a position by a string. This was replicated four times following a randomized block design. Observations on the number of grubs attracted to different diets were recorded after 12 hours, 24 hours, 48 hours, 8 days and 15 days after release of grubs. Angular transformation was followed for statistical analysis.

TABLE 1

Pre-oviposition, oviposition and post-oviposition period of *L. serricorne* F. at laboratory and controlled temperatures.

Sr. No.	*Period of study*	*Temperature °C*			*No. of observations*	*Duration in days*								
						Pre-oviposition			*Oviposition*			*Post-oviposition*		
		Min.	*Max.*	*Av.*		*Min.*	*Max.*	*Av.*	*Min.*	*Max.*	*Av.*	*Min.*	*Max.*	*Av.*
1	1-8-72 to 25-8-72	25·27	35·00	27·81	100	1	6	2·77	4	9	6·87	1	7	2·97
2	1-2-73 to 25-12-73	20·33	28·88	24·88	35	0	2	1·23	7	16	15·98	6	14	11·18
3	2-7-73 to 5-8-73	30·88	36·44	34·77	30	0	2	1·30	9	16	12·16	4	17	10·43
4	8-9-73 to 3-10-73	28·06	32·77	30·89	30	0	3	1·59	10	17	14·28	2	9	6·15
	Controlled temperature													
5	10-7-73 to 10-8-73	31·0 ± 0·5°C			32	0	2	1·46	6	16	11·75	3	12	8·64

TABLE 2.

Duration of larval instars and number of moults of *L. serricorne* F. at laboratory and controlled temperatures.

Larval food	*Average temperature (°C)*	*No. of larvae observed*	*Duration of larval instars in days*												*No. of moults*
			I			*II*			*III*			*IV*			
			Min.	*Max.*	*Av.*	*Min.*	*Max.*	*Av.*	*Min.*	*Max.*	*Av.*	*Min.*	*Max.*	*Av.*	
Laboratory Temperature															
Wheatflour + Yeast	23·34	25	5	7	6·24	5	7	5·84	4	7	5·88	4	7	5·64	3
,,	27·60	31	5	7	5·67	5	7	5·74	4	7	5·61	5	7	5·74	3
,,	32·18	30	4	6	5·30	4	7	5·40	4	7	5·63	5	7	5·80	3
,,	30·71	29	5	8	6·01	5	8	6·03	5	8	6·54	5	8	6·54	3
VFC tobacco powder	36·78	55	4	7	5·63	4	7	5·36	4	6	5·20	5	6	5·41	3
,,	32·18	28	5	7	5·96	5	7	5·72	5	8	6·13	5	9	6·28	3
VFC tobacco seeds	32·18	29	5	8	6·78	5	8	7·41	6	8	7·55	6	10	8·12	3
Controlled temperature															
Wheatflour + Yeast	31·0±0·5	30	4	6	4·83	4	6	5·00	4	6	5·33	4	6	5·06	3

RESULTS AND DISCUSSION

Pre-oviposition and oviposition periods and fecundity:

The beetles start mating 12 hours after emergence. During the process of mating the stimulated male approaches the female from behind or sides and moves its antennae near the female. The female unwilling for mating, runs away, whereas, the female ready to mate, remains calm and moves its antennae indicating its readiness to mate. The beetles mated more than once during their life, but the second mating took place six hours after the first mating. The duration of mating period was varied from 15 to 64 minutes with an average of 32 minutes. The eggs were laid one to two days after mating. The pre-oviposition period varied from zero to six days. The females preferred to lay more eggs on the dorsal surface of midrib furrow. Maximum number of eggs were laid on the second and third day of their emergence. The oviposition and post-oviposition periods varied from 4 to 17 and 1 to 17 days, respectively (Table 1). A single female laid 23 to 83 eggs during its life time. The maximum number of eggs laid by a single female varied from 1 to 31 per day. At controlled temperature of $31{\cdot}0 \pm 0{\cdot}5°C$ the pre-oviposition, oviposition and post-oviposition periods varied from zero to two and 6 to 16 and 3 to 12 days, respectively

Egg Stage:

Freshly laid egg of *L. serricorne* F. is whitish, oval with slight swelling in the middle region and bluntly rounded at both the ends with a spine like projection of chorion at one of the ends (Fig. 1 A) measuring on an average 0·38 mm in length and 0·20 mm in breadth. The incubation period varied from 4 to 11 days (Table 3) when adults were reared on different diets. When adults were reared on wheatflour + yeast, at controlled temperature of $31{\cdot}0 \pm 0{\cdot}5°C$ the incubation period was 4 to 7 days. Kurup and Parkhe (1961) reported the incubation period of 5 to 8 on the same diet.

Larval Stage:

There are four larval instars. The colour of the larva changes through successive instars and the mature larva is creamy white with dense hairs. The larval duration of *L. serricorne* F. on different foods tried (Table 3), varied from 19 to 34 days; 17 to 43 days and 27 to 43 days. Of the three diets tried, wheatflour + yeast provided a good dietary medium for larva to complete its life cycle earlier, which is in agreement with the findings of Pant (1956) and Kurup and Parkhe (1961). At controlled temperature larval period varied from 19 to 24 days. Kurup and Parkhe (1961) and Joshi (1968) reported 18 to 29 and 20 to 32 days, respectively on wheatflour + yeast and VFC tobacco.

Duration of larval instars and number of moults of *L. serricorne* F. were studied at laboratory conditions and controlled temperature on various diets.

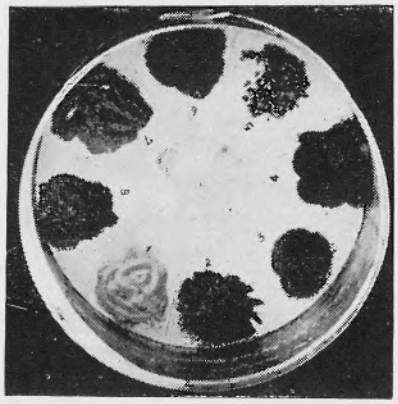

Plate 1. Technique followed for Olfactory and gustatory response studies by the grubs of *L. serricorne* F. to different diets.

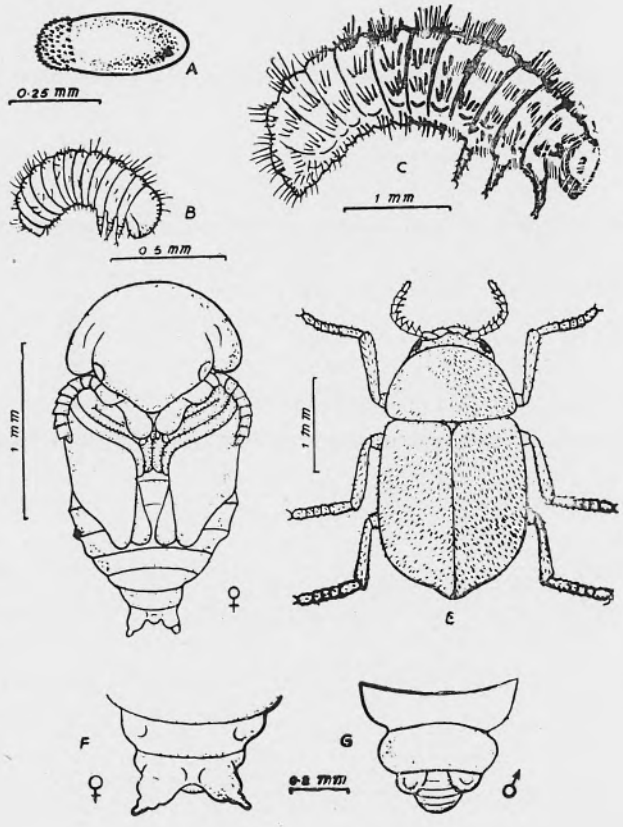

Fig. 1.

A : Egg
B : First Instar Larva
C : Full Grown Larva
D : Pupa
E : Adult Beetle
F : Female Pupa
G : Male Pupa

TABLE 3.

Duration of various stages of *L. serricorne* F.

Sr. No.	Period of study		Temperature (°C)		Larval Food	No. of individuals observed	No. of days											
							Egg stage		Larval stage		Pre-pupal stage		Pupal stage		Adult stage		Life span	
	From	To	Range	Average			Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
1.	25.10.72	20.12.73	24·73—31·38	27·60	Wheat-flour+Yeast	31	5—7	6·12	23—26	24·70	1—3	1·87	4—6	5·48	10—23	17·57	47—59	**53·45**
2.	25.12.72	5.2.73	20·0—27·22	23·34	,,	25	6—7	6·20	24—28	25·56	1—5	1·96	5—7	6·52	14—25	18·80	53—63	**57·04**
3.	1.7.73	15.9.73	27·22—37·50	32·18	,,	30	4—8	6·30	19—24	22·20	1—3	1·70	4—8	5·66	10—25	16·83	46—60	**52·40**
4.	8.9.73	26.11.73	27·77—33·05	30·71	,,	29	5—8	6·60	21—30	25·48	2—4	2·27	5—8	6·00	12—27	19·55	50—69	**58·89**
5.	1.12.73	25.2.74	19·44—28·88	25·24	,,	32	5—9	7·00	23—34	29·93	2—4	2·56	6—9	6·90	17—35	25·96	66—76	**71·68**
6.	27.3.73	13.5.73	35·06 38·33	36·78	VFC tobacco powder	55	5—7	5·50	17—26	21·60	1—4	2·25	4—6	5·14	5—14	9·36	39—50	**44·32**
7.	1.7.73	15.9.73	27·22—37·50	32·18	,,	28	5—8	6·50	22—33	26·92	1—4	2·32	6—10	7·14	10—24	15·67	52—67	**58·10**
8.	8.9.73	26.11.73	27·77—33·05	30·71	,,	29	5—9	6·88	18—34	25·75	1—4	2·13	5—8	6·27	17—34	27·20	55—76	**66·82**
9.	1.12.73	25.2.74	19·44—28·88	25·24	,,	29	7—11	8·73	29—43	35·86	2—4	3·20	6—8	6·86	17—33	24·48	72—84	**78·13**
10.	1.7.73	15.9.73	27·22—37·50	32·18	VFC tobacco seeds	29	5—50	5·00	32—41	35·65	2—4	2·51	4—6	5·25	18—33	23·31	67—78	71·89
11.	8.9.73	26.11.73	27·77—33·05	30·71	,,	30	5—5	5·00	27—43	36·26	2—5	3·30	5—10	6·70	20—35	29·46	62—85	**81·10**
Controlled temperature																		
12.	2.7.73	20.9.73	31·0+0·5°C		Wheat-flour+Yeast	30	4—7	5·50	19—24	21·65	1—5	1·56	5—7	5·62	20—26	22·18	44—58	52·06

TABLE 4.

Olfactory and gustatory response by the larvae of *L. serricorne* F. to different diets.

Name of the diet	*Percentage larvae after*					
	12 hours	*24 hours*	*48 hours*	*8 days*	*15 days*	*Average*
VFC tobacco powder	23·4	22·1	23·7	25·3	25·6	24·02
	(15·7)	(14·2)	(16·2)	(18·2)	(18·7)	(16·60)
Bidi tobacco powder	19·2	19·6	13·5	17·6	13·9	16·8
	(15·7)	(11·2)	(5·5)	(9·1)	(5·7)	(9·22)
Chewing tobacco powder	10·7	9·3	9·3	12·5	11·1	10·6
	(3·4)	(2·6)	(2·6)	(4·6)	(3·7)	(3·4)
VFC tobacco seeds	18·1	16·8	13·6	15·0	11·1	14·9
	(9·7)	(8·3)	(5·5)	(6·7)	(3·7)	(6·8)
Bidi tobacco seeds	15·4	14·3	10·9	11·8	11·1	12·7
	(7·0)	(6·1)	(3·6)	(4·1)	(3·7)	(4·9)
Chewing tobacco seeds	11·8	11·8	13·6	10·7	12·5	12·1
	(4·1)	(4·1)	(5·5)	(3·4)	(4·6)	(4·3)
Coriander seeds	19·2	17·2	19·1	20·6	15·7	18·4
	(10·9)	(8·8)	(10·7)	(12·4)	(7·3)	(10·2)
Wheatflour + yeast	35·2	38·2	42·7	36·1	45·7	39·6
	(33·3)	(38·2)	(46·0)	(34·6)	(51·2)	(40·7)
S.Em.	4·9	3·5	3·7	3·7	2·0	3·5
C.D. at 5%	14·51	10·52	10·88	10·88	5·88	10·53
C.V.%	52·85	37·38	40·14	40·96	22·35	38·73

Figures in parentheses are retransformed means.

The findings are summarized in Table 2.

From the data in Table 2 it is evident that duration of larval instars on wheatflour + yeast and VFC tobacco powder was less as compared to seeds. At controlled temperature the duration of instars varied from 4 to 6 days.

First Instar:

The newly hatched larva is quite a thin and transperant (Fig. 1B). This instar bears closely pressed hairs on individual segments. The hairs are deep brown at hatching time. The first instar larva measures on an average 0·56 mm in length and 0·17 mm in breadth.

Second Instar:

The whitish-yellow second instar larva having thickly covered and erect hairs measures on an average 0·68 mm in length and 0·19 mm in breadth.

Third Instar:

The third instar larva is stout yellowish and bears long hairs on the

head capsule and abdominal segments. This instar larva measures on an average 8·88 mm in length and 0·34 mm in breadth.

Full Grown Larva:

The head and body of the full grown larva (Fig. 1C) are thickly covered with deep brown hairs. This instar larva measures on an average 2·28 mm in length and 0·57 mm in breadth. Full grown larva becomes sluggish in movement, stops feeding and starts spinning a cocoon before pupation.

Prepupa and Pupa:

The pupation takes place in the cocoon prepared out of food particles and remains inside the cocoon till the emergence of adult. The pre-pupal period on different diets tried, varied from 1 to 5 days, 1 to 4 days and 2 to 5 days (Table 2). The pre-pupal period lasted for 1 to 5 days at controlled temperature. The pupa (Fig. 1D) is white with black compound eyes. When pupa is removed from the cocoon, the developing wings are seen lying across the ventral surface of the body. The pupal period on different diets studied varied from 4 to 9 days; 4 to 10 days and 4 to 10 days. At controlled temperature it varied from 5 to 7 days (Table 3). Kurup and Parkhe (1961) and Joshi (1968) reported 3 to 13 days and 4 to 5 days on wheatflour + yeast and VFC tobacco, respectively. Male pupa measured on an average 2·71 mm in length and 1·27 mm in breadth, whereas the female pupa measured on an average 2·92 mm in length and 1·25 mm in breadth.

Sex Difference:

Sexing the adults at pupal stage is most useful for experimental purpose. The projections at the caudal end of the pupa of the insect destined to be female beetle (Fig. 1F) are long stout, and with a tendency to diverge, forming an angle. The projection of the caudal end of the insect destined to be male beetle (Fig. 1G) are short, parallel and closely situated. These projections, which are extended parts of the genitalia slowly become retracted inside the body when the pupa is completely transformed into an adult. It is thus a temporary exhibition of the character of sex differences.

Adult Stage:

The body of adult beetle (Fig. 1E) is oval in shape with ventrally retracted head. It is brown in colour. The elytra, thorax, legs and head are covered with fine hairs. The ventral surface of abdomen and thorax are clothed with silvery gray hairs. The longevity of adults on various diets studied varied from 10 to 35 days; 5 to 34 days and 18 to 35 days (Table 3). At controlled temperature it varied from 20 to 26 days. The female beetle measures on an average 2·63 mm in length and 1·35 mm in breadth, whereas the male beetle measures on an average 2·14 mm in length and 1·23 mm in breadth. From the results it is evident that the female is bigger than male beetle.

Sex Ratio:

The sex ratio of *L. serricorne* F. was worked out by collecting larvae from various studies. From 880 pupae observed, it is evident that the females are more in nature as compared to the males. Since the ratio of males to females was 1:1.33.

The data on entire life span of the beetle—egg to the death of the adult (Table 3)—indicate that it was shortest on wheatflour + yeast and VFC tobacco powder as compared to VFC tobacco seeds. This longer life span of the beetle in seeds may be due to low carbohydrates. Kurup and Parkhe (1961) and Joshi (1968) reported 41 to 58 and 37 to 64 days on wheatflour + yeast and VFC tobacco respectively.

The life-span of the beetle studied on wheatflour + yeast at controlled temperature and varied laboratory temperatures were almost at par with each other. This indicates that the optimum temperature required for the beetles to complete their life cycle varies between 31·0 to 32·18°C.

Number of Generations:

To determine the number of generations of *L. serricorne* F. in a year, laboratory reared culture was maintained separately throughout the year on three diets. The results indicate that the beetles reared on wheatflour + yeast had four generations, whereas the beetles fed on VFC tobacco powder and seeds had three generations in a year. Kurup and Parkhe (1961) reported 6 generations under factory conditions.

Studies on the olfactory and gustatory responses of the grubs of *L. serricorne* F. to different diets (Table 4), indicate that the maximum grubs were attracted to wheatflour + yeast, next best being VFC tobacco powder. There was no significant difference in percentage of grubs attracted to other diets tried. Kurup and Parkhe (1961) reported that the grubs prefer bright grades of VFC tobacco than the lower grades. Present findings also indicate that the grubs showed affinity to wheatflour + yeast and VFC tobacco powder, because of their sweet taste and flavour when compared to other diets.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to Dr. G. J. Patel, Project Co-ordinator, All India Co-ordinated Research Project on Tobacco, for providing necessary facilities to carry out the present work. The authors wish to acknowledge the award of fellowship to the senior author by American Spring and Pressing Works Private Limited, Malad, Bombay for prosecuting his post-graduate study.

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