CHAPTER : 1

RESPONSES OF LARVAE AND ADULTS OF TOBACCO BEETLE, *LASIODERMA SERRICORNE* (F.) COLEOPTERA : ANOBIIDAE TO MEDIA CONDITIONED BY CONSPECIFIC ADULTS AND LARVAE

A nutritive medium used for raising a population of an insect species is said to be "Conditioned" when individuals of that species have lived in the culture medium for some time. A few individuals are enough to condition the culture medium. Such a phenomenon has been described first by Park (1937) and later by Sokoloff (1974) in case of *Tribolium* beetles. The degree of conditioning depends on the number of insects and duration of occupation (Ghent, 1963; Mondal, 1983). The medium which is thus conditioned involves at least three factors (i) depletion of the nutritive value of the medium (ii) accumulation of exuviae, dead animals and similar debris (iii) and, finally, and most remarkably, the accumulation of any secretion(s) left behind by the insects that is taken up by the medium (Ghent, 1963; Sokoloff, 1972). There are various reports on the attractive and/or repellent effect of *Tribolium*-conditioned medium on the conspecific and interspecific larvae as well as adults (Ghent, 1963; Ogden, 1969; Ryan and O'Ceallachain, 1976; O'Ceallachain and Ryan, 1977; Hughes, 1982; Suzuki and Sugawara, 1979; Faustini *et al.*, 1982a and Mondal, 1985).

Apparently, no such information is available concerning the secretion of any substance(s) by L. serricorne, except the sex pheromone by adult females (Burkholder, 1970; Coffelt and Burkholder, 1972). There is also no information about the responses of the L. serricorne larvae or adults to the culture media conditioned by conspecific larvae or adults. The present work was, therefore, undertaken to study the responses of larval and adult L. serricorne to the medium conditioned by conspecific larvae and adults.

MATERIAL AND METHODS

The L. serricorne F. were reared in the laboratory and the culture was maintained at ambient temperature and humidity. The average temperature range was 25° - 30°C. The culture medium consisted of wheat flour containing 5% brewers yeast powder.

Method for conditioning the medium:- The medium was conditioned by allowing 10 adults or larvae per gm of fresh flour for 3 days. For conditioning of the medium by adults, unmated males or females (5 - 6 days old) were used, and, for conditioning by larval instars, freshly collected larvae were used. After the definite period of conditioning, the insect stages were separated from the medium and then the latter was utilized for the tests. Uninfested flour was used as fresh flour in the test.

Unmated adult males and females (5 - 6 days old) were used in this experiment. To minimise the possibility of adults being contaminated with the secretions from opposite sex, they were sorted out from the cultures at pupal stage. The sexes were isolated by observations of the characters described by Halstead (1963). The larval instars were identified as described by Bhalodia (1974). The adults and larval instars were subjected to six different preference tests.

i) fresh flour (FF) Vs flour conditioned (CF) by males
ii) FF Vs CF by females
iii) FF Vs CF by 1st instar larvae
iv) FF Vs Cf by 2nd " "
v) FF Vs CF by 3rd " "
vi) FF Vs CF by 4th " "

*Plastic petri dishes (9 cm diameter) were used as the "Choice chamber". Two holes (2.2 cm diameter) were bored, each at a distance of 1.7 cm from the centre of the chamber, in opposite directions along the diameter. The floors of the chambers were roughened by placing filter papers (Whatman No.1) so as to facilitate easy movement of the test insects. For each test two glass thimbles (2 cm deep and 2.4 cm wide) each filled with conditioned flour and fresh flour respectively and covered with fine muslin cloth were inserted through the two holes of a petri dish. In the experiments with adults, only one insect was released

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* Special scientific non-odorant grade

at each time in the centre of the choice chamber. The chamber was then kept undisturbed in dark. The response was recorded after 5 minutes each time. The tests with adult insects were replicated 100 times, using new adults every time. In the experiments with larval instars, 5 larvae were released at each time in the centre of the chamber. The chamber was kept in dark and the attractiveness or otherwise was recorded after 15 minutes every time. The experiments were replicated 20 times for each instar. The larvae for testing were collected an hour before from the stock culture. The muslin cloth and filter paper were changed every time before starting a new test so as to eliminate contamination by previously tested insects.

Adults and larvae found over the muslin covering of a thimble were regarded as showing positive response to either fresh or conditioned medium as the case may be. Those found else-where were assumed to have shown no response. Only those numbers of larvae and adults found over the thimbles were taken into account. Statistical analysis was carried out as per methods of Bishop (1983).

RESULTS AND DISCUSSION

The percentage distribution of Lasioderma serricorne adults and larvae over the fresh medium and the medium conditioned by conspecific larval instars and adults are given in Table 1.1 - 1.6. The attractiveness of a medium

was gauged statistically by using Chi-square distribution method (Bishop, 1983), based on an expected distribution of 50 : 50 in respect of conditioned versus fresh medium. The attraction of male L. serricorne toward medium conditioned only by the females may be due to the secretion of sex pheromone by the females (Table 1.5). It is already known that the male L. serricorne show strong attraction towards the sex pheromone secreted by the females (Burkholder, 1970; Coffelt and Burkholder, 1972). Strong repulsion of conspecific females from female-conditioned flour (Table 1.5) may help dispersion as well as reduction of competition for suitable sites for egg laying. During the present investigation, it was also noted that the 3rd and 4th instar larvae exhibited repulsive behaviour with respect to the medium conditioned by females. In this context, it is pertinent to refer to the work of Mondal (1985), who found that, in the case of T. castaneum, larvae show no attraction towards pheromone(s) secreted by females. The result of the present experiment with larval instars (Table 1.5) agree with this observation as far as conditioning of medium by female pheromonal substances may be concerned. This behaviour too, facilitates dispersion and provision of adequate food supply to developing larval instars. On the other hand, it was noted that the females were attracted to the media conditioned by almost all the larval instars as well as males (Tables 1.1 - 1.4 and 1.6).

It is an adaption on the part of females in assuring least possible competion with enhanced chances of mating as well oviposition. It was not possible here to suggest that the females are positively attracted to the media conditioned by any one or more of the particular larval stages from among 1st to 4th instars. In case of males, it could be said that they are certainly not repelled by any substances that conditioned the media. Attraction of females and different larval instars to male conditioned media (Table 1.6) clearly demonstrates the presence of some secretion(s) by the males which have aggregation/attraction influence.

These findings are similar to those reported in case different species of Tribolium by Ryan and O'Ceallachain (1976); O'Ceallachain and Ryan, (1977); Suzuki and Sugawara (1979); Faustini et al. (1982 a & b) and Hughes (1982). They reported that the media conditioned by conspecific males were attractive to the adults of both sexes of T. castaneum, T. confusum and T. brevicornis. These authors opined that the attraction was due to aggregation pheromone produced by the males. The larval attraction, in the present experiment, towards the male-conditioned flour (Table 1.6) also may be due to the presence of aggregation pheromone. It also agrees with Suzuki and Sugawara (1979), Suzuki (1980) and Mondal (1985), who worked on T. castaneum only, have also arrived at similar conclusion regarding aggregation pheromone produced by the conspecific males. It

appears that secretion by the male L. serricorne is slightly different in its activity from the usual aggregation pheromones noted in other beetles (Abdel-Kader and Barak, 1979; Barak and Burkholder, 1977; Khorramshahi and Burkholder, 1981; Faustini et al. 1982 a & b) as it does not attract individuals of the same sex. Further, the media conditioned by 3rd and 4th instar larvae exhibited greater attraction in case of all larval stages and adult females (Tables 1.3 and 1.4) but not the males. This preferential attraction may be due to the presence of a different type of aggregation/attractant pheromone(s). Less well defined attraction by the media conditioned by 1st and 2nd instars (Tables 1.1 and 1.2) was probably due either to insufficient secretion or due to incomplete development of the concerned glands.

SUMMARY

Adult and larval responses to the culture media conditioned by conspecific adults and all larval instars were tested in cigarette beetle, L. serricorne F. The female-conditioned flour attracted only males and it was strongly avoided by female beetles. The results indicated that either a sex pheromone like substance or some other bodily substance(s) of the adult females can profitably be used as oviposition deterrent for the females of the species. The media conditioned individually by 3rd and 4th instar and male showed strong attraction in case of all stages except

the males. This fact may also be put to beneficial use as an attractant to lure away the insects in traps from where they can be easily disposed. The isolation and subsequent chemical synthesis of such factors may prove of immense practical value in the management of this pest. Further studies with these secretions are in progress.

Table 1.1. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by 1st instar larvae.

Insect stages tested	Distribution of larvae and adults (%) Conditioned	Fresh	No response	χ^2
1st Instar	44	22	34	7.34**
2nd Instar	62	20	18	21.52**
3rd Instar	16	36	48	7.7 **
4th Instar	40	20	40	6.66**
Male	34	40	26	0.48NS
Female	32	40	28	0.88NS

** Significant at 1% level

NS Non significant

Table 1.2. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by 2nd instar larvae.

Insect stages tested	Distribution of larvae and adults (%) Conditioned	Fresh	No response	χ^2
1st Instar	8	78	14	58.98 **
2nd Instar	36	44	20	0.8 NS
3rd Instar	20	36	44	4.58 *
4th Instar	58	22	20	16.2 **
Male	26	22	52	0.34 NS
Female	48	28	24	5.26 *

** Significant at 1% level

* Significant at 5% level

NS Non significant

Table 1.3. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by 3rd instar larvae.

Insect stages tested	Distribution of larvae and adults (%)			χ^2
	Conditioned	Fresh	No response	
1st Instar	54	35	11	4.06 *
2nd Instar	58	34	8	6.26 *
3rd Instar	44	20	36	9.0 **
4th Instar	44	32	24	1.9 NS
Male	24	22	54	0.08 NS
Female	52	28	20	7.2 **

** Significant at 1% level

* Significant at 5% level

NS Non significant

Table 1.4. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by 4th instar larvae.

Insect stages tested	Distribution of larvae and adults (%) Conditioned	Fresh	No response	χ^2
1st Instar	61	36	3	6.44 *
2nd Instar	50	21	29	11.84 **
3rd Instar	52	16	32	19.06 **
4th Instar	50	14	36	20.26 **
Male	20	20	60	0.0 NS
Female	56	14	30	25.2 **

** Significant at 1% level

* Significant at 5% level

NS Non significant

Table 1.5. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by female insects.

Insect stages tested	Distribution of larvae and adults (%) Conditioned	Fresh	No response	χ^2
1st Instar	16	10	74	1.38 NS
2nd Instar	42	42	16	0.0 Ns
3rd Instar	20	42	38	7.8 **
4th Instar	8	18	74	3.84 *
Male	46	16	38	14.52 **
Female	12	66	22	39.38 **

** Significant at 1% level

* Significant at 5% level

NS Non significant

Table 1.6. Percentage distribution of L. serricorne larvae and adults over fresh and conditioned medium by male insects.

Insect stages tested	Distribution of larvae and adults (%) Conditioned	Fresh	No response	χ^2
1st Instar	44	32	24	1.9 Ns
2nd Instar	58	32	10	7.52 **
3rd Instar	50	34	16	3.04 NS
4th Instar	42	18	40	9.6 **
Male	28	26	46	0.08 NS
Female	48	22	30	9.66 **

** Significant at 1% level

NS Non significant