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THE EFFECT OF INDUSTRIAL EFFLUENTS ON MOULTING IN *MACROMIA CINGULATA* (RAMBUR) (ANISOPTERA: CORDULIIDAE)

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The larvae were reared in different sublethal concentrations of tannery and paper and pulp mill effluents for 3 weeks. The tannery effluent was found to shorten the time taken for the first moult in captivity, whereas the paper and pulp mill effluent arrested moulting in the larvae. It is inferred that the effluents from the tannery and the paper and pulp mill could have a juvenomimetic (mimic of juvenile hormone) effect on the dragonfly larvae, inhibiting moulting and growth.

INTRODUCTION

The wet process industries like tanneries and paper and pulp mills discharge effluents which contain a wide variety of both inorganic and organic materials, including toxic substances, into surface waters. Many studies on the effects of tannery and paper and pulp mill effluents on various animals have been made (e.g. GHOSE & KONAR 1980; GURUPRASADA RAO & NANDAKUMAR, 1982; SUBRAMANIAN et al. 1988; CHANDRASEKARAN et al. 1989). LALONDE & BROWN (1954), BUCHANAN et al. (1970) and WEIS & MANTEL (1976) have carried out moulting studies in crustaceans with reference to pesticides. However, information on the effect of industrial effluents on moulting in insects is scarce. The dragonfly larvae which inhabit the littoral areas of fresh waters are useful as predators in the biological control of mosquito larvae. They are classified as sensitive forms, characteristic of clean waters (KHAN, 1983). The present investigation is an attempt to study the effect of tannery and paper and pulp mill effluents on moulting in the larvae of *Macromia cingulata*.

MATERIAL AND METHODS

The larvae of *M. cingulata* were collected from a local pond at Erode town and acclimatized to laboratory conditions for a week in a glass aquarium containing aerated tap water. They were fed with mosquito larvae. The tannery effluent was collected from the Kattuvaikal, which discharges into the Kalingarayan canal, a tributary of the River Bhavani, and paper and pulp mill effluent from TNPL, Pugalur, Tamil Nadu. Bio-assays were carried out using larvae of unknown instar in an intermoult stage with a body length of 15 mm and a head width of 4 mm. The 96 hr LC 50 value for both the effluents was found to be 50%. Various sublethal concentrations of the effluents (5, 10, 15, 20 and 25%) were prepared with tap water. Seven individuals of equal size were introduced into each test solution contained in compartmented glass troughs. Simultaneously controls were also maintained. The experimental waters were renewed daily and the larvae were provided with mosquito larvae. The same level of prey density was maintained throughout the experimental period. Observations were made for 3 weeks and the body length and head width were measured on the day of ecdysis. The measurements were tabulated.

RESULTS

The time of moulting and the measurements of body length and head width in the control and effluent treated larvae of *M. cingulata* on various days are given in Tables I and II. It was found that the control animals moulted on the 12th and then on the 19th day. In all concentrations of tannery effluent, moulting was observed on either the 3rd or 4th day of exposure. After this, there was no further moulting throughout the experimental period. In contrast, none of the individuals reared in the paper and pulp mill effluent showed any moulting during the period of observation.

DISCUSSION

Growth in insects is largely limited by the rigid cuticle. This problem is overcome by shedding of the cuticle from time to time (moulting) for continued growth. In the present study, the tannery effluent shortened the duration of the instars in *M. cingulata*. Similar observations have been made by WEIS & MANTEL (1976) in fiddler crabs treated with D.D.T. Similarly, the inhibition of moulting in *M. cingulata* exposed to paper and pulp mill effluent is in accord with the results for the larvae of crustaceans exposed to pesticide and heavy metal treatments (BUCHANAN et al., 1970; EPIFANIO, 1971; SHEALY & SANDIFER, 1975; RAJA & AJMALKHAN, 1989). In insects, the postembryonic development involves an orderly series of stages to the adult. The processes involved are primarily controlled by a system of regulatory hormones which interact to produce a sequence of events resulting in the normal number of instars and, finally, maturity. In larval moults, juvenile hormone secreted by the corpora allata suppresses the activity of moulting hormone. SUSHMA & TONAPI (1978), SAXENA & JAIN (1984) and SAXENA et al. (1987) showed that synthetic

Table I

Duration of moulting and body size in the control and tannery effluent treated *M. cingulata* larvae – [Each value is the mean (± SD) of 7 observations]

Concentration (%)	Initial size (cm)		First moult			Second moult		
	BL	HW	Time taken (days)	Size (cm) BL	HW	Time taken (days)	Size (cm) BL	HW
Control	1.5 ± 0.3	0.4 ± 0.06	12 ± 1.5	2.0 ± 0.3*	0.6 ± 0.04*	19 ± 2.00	2.05 ± 0.3*	0.6 ± 0.05
5	1.5 ± 0.2	0.4 ± 0.04	4 ± 1.0	1.8 ± 0.2*	0.5 ± 0.05*	-		
10	1.5 ± 0.1	0.4 ± 0.03	3 ± 1.0	1.7 ± 0.2*	0.5 ± 0.03*	-		
15	1.5 ± 0.1	0.4 ± 0.04	3 ± 1.0	1.7 ± 0.1*	0.5 ± 0.04*	-		
20	1.5 ± 0.3	0.4 ± 0.05	4 ± 1.0	1.8 ± 0.1*	0.5 ± 0.05*	-		
25	1.5 ± 0.2	0.4 ± 0.05	4 ± 1.0	1.8 ± 0.2*	0.5 ± 0.03*	-		

* Significant at P<0.05

BL: body length; – HW: head width

Table II

Duration of moulting and body size in the control and paper and pulp mill effluent treated *M. cingulata* larvae – [Each value is the mean (± SD) of 7 observations]

Concentration (%)	Initial size (cm)		First moult			Second moult		
	BL	HW	Time taken (days)	Size (cm) BL	HW	Time taken (days)	Size (cm) BL	HW
Control	1.5 ± 0.3	0.4 ± 0.06	12 ± 1.5	2.0 ± 0.3*	0.6 ± 0.04*	19 ± 2.00	2.5 ± 0.3*	0.6 ± 0.05
5	1.5 ± 0.2	0.4 ± 0.05	-			-		
10	1.5 ± 0.3	0.4 ± 0.03	-			-		
15	1.5 ± 0.1	0.4 ± 0.02	-			-		
20	1.5 ± 0.2	0.4 ± 0.04	-			-		
25	1.5 ± 0.1	0.4 ± 0.04	-			-		

* Significant at P<0.05

BL: body length; – HW: head width

plant extracts had juvenomimetic (mimic of juvenile hormone) effects on insects. It is suggested here that the effluents from the tannery and the paper and pulp mill might have the same mode of action.

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