International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2019): 7.583

Effects of Pesticides Chlorpyrifos and Dimethoate on Moulting in Macrobrachium Rosenbergii (de Man)

V. N. Hegde[1], V. V. Dalvie[2]

Department of Zoology S.V.K.M.'s Mithibai College (Autonomous), Vile Parle (W), Mumbai 400 056, India
Affiliated to University of Mumbai

Abstract: ***The indiscriminate use of pesticides has led to the contamination of air, soil, surface water, groundwater and vegetation. Moreover, pesticides have impacted many non-target vegetation and organisms. Studies show that many pesticides enter the ecosystem and act in a manner that may enhance the effects of other pesticides, while still others may accumulate in the organisms causing long term changes in them. In the present study, an attempt has been made to show the individual and synergistic effects of two organophosphorous pesticides viz. Chlorpyrifos and Dimethoate on the giant freshwater prawn Macrobrachium rosenbergii (de Man), in terms of the process of moulting observed over a period of 28 days under laboratory conditions. The process of moulting can be taken as a parameter to observe the sub lethal effects of the pesticides. The prawns showed stress and the process of moulting was affected with the treatment of pesticides. Individual effect of pesticide, Chlorpyrifos caused greater stress than Dimethoate as compared with the control group. Similarly it was observed that synergistically Dimethoate enhances (positive synergism) effect of Chlorpyrifos leading to greater toxic effects even at lower concentrations in terms of delay, deformities and mortality during moulting. Hence, the present study shows the potency of pesticide toxicity individually and synergistically on moulting in prawns.***

Keywords: Chlorpyrifos, Dimethoate, Synergism, Moulting, Macrobrachium rosenbergii (de Man)

1. Introduction

The giant freshwater prawn *Macrobrachium rosenbergii* descends rivers to breed in brackish water and the young postlarval stages ascend rivers to freshwater bodies where they grow. During their ascent upstream, they sometimes enter paddy fields, which are flooded during the monsoon, and remain there till the paddy matures. The farmer harvests the prawns before the paddy is harvested. Many farmers practice paddy cum prawn culture. On their descent, the adult prawns have to adapt to brackish water and the postlarvae on their ascent have to adjust to conditions of freshwater.

During their ascent it is not clearly known as to how the larvae are able to adjust to the decreasing salinity, but the entire process takess fifteen days to a month. Another phenomenon which is seen in these as well as in all crustaceans is the process of moulting. Growth itself is dependent on it. The process of moulting depends on a number of factors such as availability of food, the lunar period, the X and Y organs and the water quality, (Hosamani et al., 2017 and Reddy, 2005). In recent times the indiscriminate use of pesticides has led to contamination of water bodies. The presence of pollutants in the aquatic medium especially the use of pesticides is detrimental to aquatic fauna.

In the present study, the effect of the two organophosphorous pesticides namely Chlorpyrifos and Dimethoate, individually and taken together (synergistic) on juveniles of *M .rosenbergii* was studied, they being non target species in the water, (Bacon and Woodbrunk, 1995; Fest and Schmidt, 1982; and Wilkinson, 1976).

2. Material and Methods

2.1 Acclimatization and preliminary investigation

The prawns were collected from the river Vaitarna and brought to the laboratory in polythene bags placed in a carton to avoid any mechanical disturbance. The prawns were then acclimatized for a period of ten days prior to the experiment.

2.2 Experimental procedure for trials

Pesticides Chlorpyrifos (O,O-diethyl-O-9(3,5,6-trichlor-2-pyridyl) and Dimethoate (O,O-dimethylS-(2-(methylamino)-2-oxoethyl)ester) were used in the present study. Six glass containers were used for the experiments. Length and weight of the prawns were recorded before the commencement of the experiment. The animals were kept away from mechanical or visual disturbance in 10 liters of aged water. In the control group no pesticide was added ,in group two and three, sub lethal doses of pesticide Chlorpyrifos (0.0002 ppm) and Dimethoate (0.02 ppm) were added respectively after the aliquots were prepared from the stock solution using lead and pesticide free double distilled water,LC50 for Chlorpyrifos and Dimethoate being 0.0002ppm and 0.02ppm respectively. In sets four, five and six, mixture of both the pesticides namely Chlorpyrifos (C) and Dimethoate (D) in the proportion 1:1, 1:3 and 3:1 in their sub lethal concentrations were added. Prawns of uniform size 5cm (±2mm) and uniform weight 3g (±100mg) were selected and 10 such prawns were introduced in each of the six experimental sets. The temperature was kept constant at 25°C (±1^{0}C) and pH was maintained between 7.0 to 7/5 throughout the experiment. The results were noted in tabular form and graphical representation.

Prawns were given pellet feed adlibitum, twice a day. The concentration of the pesticide(s) was maintained throughout the experimental period of four weeks. The normal moulting (Plate 1) period for juvenile *M. rosenbergii* varies between 22 and 24 days depending upon the environmental conditions (Saravanan et al., 2008).

3. Observations

In the control, moulting was observed in eight prawns on the 22nd day and the remaining two prawns moulted on 24th day (Plate2). The exuvia of the prawns was entire without any break. The moulting in six prawns exposed to Chlorpyrifos (C) took place on the 24th day, the moults were in numerous pieces which indicates stress. On the 27th day only one prawn moulted and three prawns did not moult (Plate 3) In the tank containing Dimethoate (D), the moulting process was stressful resulting in incomplete moults in few cases. Three of the prawns moulted on the 21st day, five moulted on the 22nd day and mortality was observed in two prawns on 29th day, without moulting.(Plate 4) In the tank containing both the pesticides in the proportion 1C:1D, only six prawns moulted on the 27th day and mortality observed in four prawns (Plate 5). In the tank containing both the pesticides in the proportion 1C:3D, mortality was observed in five prawns, incomplete moulting occurred in four prawns by the 28th day and only one moulted completely on the 29th day (Plate 6). In the prawns exposed to Chlorpyrifos and Dimethoate in the proportion 3C:1D respectively, mortality was observed in all prawns with incomplete moults, except for three prawns which moulted by the 28th day (Plate 7).The prawns kept for depuration did not survive beyond 30 days.

4. Discussion

The moulting process in crustaceans is under the control of regulatory hormones, secreted by the eyestalk X-organ which secretes moult -inhibiting hormone (MIH) and a pair of Y-organs, located in the cephalothorax which is responsible for ecdysteroids (Gade and Marco,2006).MIH inhibits the production of ecdysteroids. Toxicants in the water often affect aquatic fauna, pesticides accumulation in crustaceans (Kumar et al., 2010; Key and Fulton, 1993) and hamper their growth, resulting in delayed moulting as reported by Snyder and Mulder, 2001. In the present investigation, prawns from the control tank moulted normally whereas prawns exposed to the pesticides Chlorpyrifos and Dimethoate showed incomplete moulting accompanied with behavioural disturbances like erratic movements, mucous secretion, isolation and in some even mortality ,also the moults showed faster decomposition (Weis and Rao,1992; and Omkar and Shukla, 1985). It was observed that Dimethoate potentiated the action of Chlorpyrifos, causing more harm than when present individually indicating positive synergism. Thus, it may be concluded that pesticides exhibit adverse effects in crustacean growth and moulting. Such results are also reported by Montagna and Collins, 2007. The crustacean fishery industry faces huge loss and use of pesticides needs to be monitored and curtailed to bare minimum.

Table 1: Moulting pattern in *M. rosenbergii* under the effect of pesticides Chlorpyrifos and Dimethoate after exposure for 28 days

		21days	22 days	23 days	24 days	25 days
Control	Moulted		8		2	
	Dead					
Chlorpyrifos	Moulted				6	
(C)	Dead					
Dimethoate	Moulted	3	5			
(D)	Dead					
C+D (1:1)	Moulted					
	Dead					
C+D (1:3)	Moulted					
	Dead					
C+D (3:1)	Moulted					
	Dead					

		26 days	27 days	28 days	29 days	30 days
Control	Moulted					
	Dead					
Chlorpyrifos	Moulted	1				
(C)	Dead	3				
Dimethoate	Moulted					
(D)	Dead				2	
C+D (1:1)	Moulted		6			
	Dead		4			
C+D (1:3)	Moulted			4	1	
	Dead				5	
C+D (3:1)	Moulted			3		
	Dead					7

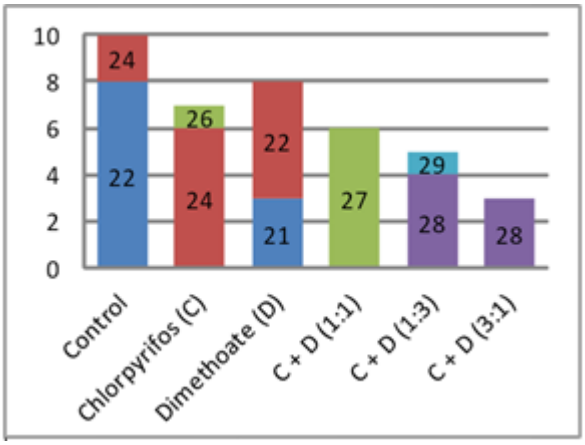

Figure 1: Number of prawns moulted during 28 days exposure to various treatments.

Plate 1: Normal moult of *Macrobracium rosenbergii*

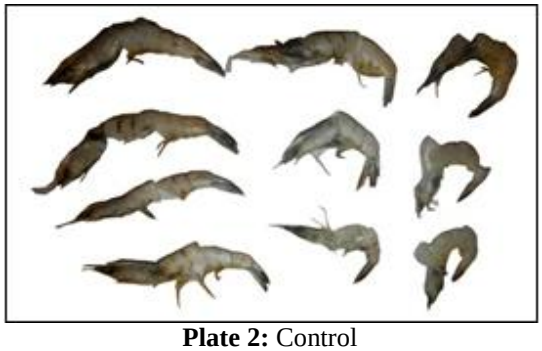

Plate 2: Control

Plate 3: Chlorpyrifos (C)

Plate 4: Dimethoate (D)

Plate 5: C + D (1:1)

Plate 6: C + D (1:3)

Plate 7: C + D (3:1)

References

[1] Bacon M.G. and Woodbrunk K.B. (1995) Ecotoxicology of chlorpyrifos, reviews Environ. Contam. Toxicol. Vol 44:1-93.
[2] Fest C. and Schmidt K.J.(1982) The Chemistry of Organophosphorus Pesticides Springer-Verlag Pub. Berlin, Heideberg rev. 2nd edn.NY.pp1019
[3] Gade G. and Marco H.G. (2006) Structure, function and mode of action of select arthropod neuropeptides. Stud. Nat. Prod/ Chem. No 33:69-140
[4] Hosamani N., Reddy S.B., and Raddy R (2017) Crustacean molting: Regulation and effects of environmental Toxicants. J Mar. Sc. Res. Dev. September 2017, 7(5);236 doi; 10.4172 / 2155-9910.1000236
[5] Key P. B. and Fulton M.H. (1993) Lethal and sub lethal effects of chlorpyrifos exposure on adult and larval stages of the grass shrimp, Palaemonetes pugio. J. Environ. Sci. Health 28(5) 621-64.
[6] Kumar, A., Correll, R. Grocke, Bajet, C. (2010) Toxicity of selected pesticides to freshwater shrimp, Paratya australiensis (Decapoda: Atyidae): Use of time series acute toxicity data to predict chronic lethality. Ecotoxicol. Environ. Safety, March 2010, Vol73 (3): 3602-360.
[7] Montagna M.C and Collin P.A. (2007) Survival and growth of Palaemonetes argentius (Decapoda: Caridea) exposed to insecticides with Chlorpyrifos and Endosulphan as active insecticides.
[8] Omkar V. B. and Shukla G. S.(1985a) Dichlorvas intoxication in a freshwater prawn *Macrobrachium lamarrei* (H. Milne Edwards) Ecotoxicol Environ. Safety 9:392-396.
[9] Reddy A.K.(2005) The biology of giant freshwater prawn *Macrobrachium rosenbergii* (de Man) In: giant freshwater prawn-seed production and culture. 6th-17th Sept., 2005, CIFE, Mumbai:1-8.
[10] Saravanan Subramanium, Biju Sam Kamalam J. And John Sampat Stephen Kumar, (2008) Moulting and behaviour changes in freshwater prawn. Shellfish News 25 Spring/Summer, 2:13-16
[11] Snyder MJ and Mulder EP (2001) Environmental endocrine disruption in decapod crustacean larvae: Hormone titres, cytochrome P450 and stress protein responses to Heptachlor exposure. Aqua. Toxicol. 55:177-190

[12] Weis J. S. and Rao K. R., (1992) Effects of pollution on moulting and regeneration in Crustaceans. Am. Zool. Vol. 32(3).:495-500
[13] World Health Organisation (1978) Geneva Environmental Health Criteria no.6,-Principles and methods for evaluating the toxicity of chemicals. Geneva, Switzerland.
[14] Wilkinson C.K. (1976) Insecticide synergism (Metcalf R.L and McKelve J.J. Jr. Eds.) in the future of insecticide: needs and prospects. Wiley Pub. N. Y. elements. Arch. Environ. Contam. Toxicol. Feb 2007 Vol.53:371-378.