Indian Journal of Entomology 85(Special Issue) May 2023: 139-141 eRef. No. NWRABNRG28 DoI. No.: 10.55446/IJE.2023.1177

USE OF CHIRONOMID LARVAE AS BIO-MONITORING AGENT TO ASSESS WATER POLLUTION

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ABSTRACT

In environmental monitoring of water bodies, the morphological deformities of chironomid larvae offer a useful way of estimating sediment toxicity. Laboratory and field studies have indicated a link between morphological deformities of chironomids and the concentrations of toxic substances present in sediments. Midge larvae are able to metabolize organic contaminants, but the breakdown products may also be responsible for morphological abnormalities. The frequency and severity of mouth part deformities of bloodworm and the relationship of deformities to river hydrology have been investigated.

Key words: *Chironomus*, Damodar, deformities, larva, pollution, water body, midge, bloodwarm, mouth part, sediment toxicity

In environmental monitoring of water bodies, the morphological deformities of chironomid larvae offer a useful way of estimating sediment toxicity, unlike other indicator endpoints (e.g. death rate or development time) which can be influenced by non-toxic stressors (Vermeulen, 1998). It has been suggested that pollutants present at collection sites are responsible for such deformities (Warwick, 1990). Laboratory and field studies have indicated a link between morphological deformities of chironomids and the concentrations of toxic substances present in sediments (Dickman and Rygiel, 1996; Janssens de Bisthoven et al., 2001). It has also been shown that sediments contaminated with trace metals and other pollutants harbour chironomids whose chromosomal activity levels are reduced and it could reflect lowered metabolic activity and inhibited RNA synthesis (Hudson and Ciborowski, 1996). The aim of this study is to analyse the frequency and the severity of mouthpart deformities of *Chironomus mayri* (Majumdar, et al., 2009) larvae in river Damodar, West Bengal, India and the relationship of deformities to river hydrology. Parallel laboratory experiments were designed to test the hypothesis that pesticides are the causal agents of deformities in chironomids and that their frequency is dose-related.

River Damodar originates in the Khamarpat hill and runs about 541 km to meet river Hooghly. In the upper reaches, it flows over the plateau followed by a flat alluvial plain in the south east and eastward towards the Bay of Bengal. Samples of water and sediments were taken following Bhattacharya et al. (2006). These sites are influenced by the discharges of different industries of Durgapur and Asansol (Dey, 1990). The larvae and physico-chemical data were taken at every fortnight throughout 2011 from all the five sampling stations. Sediments were collected following Urk et al. (1992) and Dickman et al. (1992). Water sample was studied by Water Quality Analyzer Elico- PE138. Larvae were subjected to laboratory rearing and mounted after (Wirth and Marston, 1968). Both imagines and immature were identified after Chaudhuri et al. (1990, 1992) and Majumdar et al. (2009). After dissection, cephalic capsules were slide mounted and deformities were classified using a protocol that assigned each specimen to a specific morphological class (modified from Bisthoven et al., 1998):

- Class 1 (CL.1 – specimens without any morphological deformity).
- Class 2 (CL.2 – specimens with weak deformity): one additional or missing tooth, one or two round teeth, weak asymmetry, one bifid tooth, two joined teeth.
- Class 3 (CL. 3 – specimens with strong deformity).

For *C. mayri* the incidence of mentum deformities is higher. Deformed specimens amount to 56.82% (400 of 704 specimens) of which 7.95% was classified as CL.3. The relationship between deformity and larval instar of each *C. mayri* specimen was determined by biometric analysis. 96.75% of deformed specimens belonged to instar IV and the remaining 3.25% to instar

Table 1. Deformity incidence *C. mayri* instars in each sampling station

	Sampling station	Total sample	CL. 1	CL. 2	CL. 3	Total deformities
Instar I	1	0	0	0	0	0
	2	0	0	0	0	0
	3	2	2	0	0	0
	4	0	0	0	0	0
	5	0	0	0	0	0
Instar II	1	27	26	1	0	1
	2	36	34	2	0	2
	3	43	37	5	1	6
	4	40	38	2	0	2
	5	20	18	2	0	2
Instar III	1	62	37	21	4	25
	2	125	33	81	11	92
	3	163	22	119	22	141
	4	82	25	51	6	57
	5	104	32	60	12	72

III (Table 1). The Chi-square test showed a significant relationship between the sampling stations and the incidence of deformities. The frequency of CL.1 was higher than expected at St.1 and lower at St.3. The frequencies of CL.2 and CL.3 were higher than the expected at St.3; moreover CL.2 was lower frequency than expected at St.2 ($\chi = 49.83$, $p < 0.01$).

C. mayri, showed higher rates of larval mouth part deformities than which can be attributed to the normal genetic variability in populations of uncontaminated sites which are generally <1% (Warwick, 1980; Wiederholm, 1984). It showed the highest incidence of deformities throughout the study. Deformed specimens occurred more abundantly in collection site 3, where water current was rather slow. High heavy metal concentrations have been reported in river Damodar sediments (Bhattacharya et al., 2006) that may lead to the larval mouthpart deformities. However the relationship between pollution load and extent of deformities are yet to be established and need further investigations.

ACKNOWLEDGEMENTS

Author thanks Prof. P K Chaudhuri and Prof. A Mazumdar for their suggestion throughout the work and Principal of Hooghly Women's College for providing laboratory facilities.

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(Paper presented: February, 2021;
Peer reviewed, revised and accepted: April, 2022; Online Published: May, 2023)
Online published (Preview) in www.entosocindia.org and indianentomology.org (eRef. No. NWRABNRG28)