SUSCEPTIBILITY STATUS OF *MESOCYCLOPS LEUCKARTI* CLAUS OF DELHI REGION AGAINST TEMEPHOS AND PIRIMIPHOS METHYL

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ABSTRACT

Studies were undertaken to determine the susceptibility status of *Mesocyclops leuckarti* Claus collected from Delhi Region against two organophosphorus insecticides viz. temephos (abate) and pirimiphos methyl (acetellic). The LC_{50} and LC_{90} values of technical temephos were 0.5023 ppm and 3.9927 ppm, and for temephos sandgranules (2%), were 2.5168 ppm and 20.2099 ppm respectively. The higher LC_{50} and LC_{90} values of temephos sandgranules may be due to the slow release of the insecticide. These values against technical pirimiphos methyl were estimated to be 0.0799 ppm and 0.3877 ppm respectively. Pirimiphos methyl was more effective than temephos. The results obtained indicate the precipitation of temephos resistance in test *Mesocyclops* species.

INTRODUCTION

Mesocyclops leuckarti Claus is the most widely distributed cyclopid copepod species prevalent in India and is believed to be actively involved in the transmission of guineaworm disease in the areas of disease endemicity[1]. Vector control has been reported to be the most effective tool for the control of guineaworm disease. Use of chemical compounds having low mammalian toxicity and a long residual effect have been advocated for treatment of the cyclops breeding water-locations for reasons of safety. Susceptibility tests carried out against various cyclops species using different organochlorine, organophosphate and carbamate compounds revealed their susceptibility to various modern insecticides. However, only temephos (−0, 0, 0, 0-tetramethyl 0,0-thiodi-*p*-phenylene phosphorothioate) has been found to be a compound of choice and it has been used effectively for guineaworm control programmes, owing to its low mammalian toxicity, long residual action and absence of any undesirable effect or unpleasant odour in the treated waters[2–4]. In India, temephos is being widely used in the guineaworm endemic areas under the Guineaworm Eradication Programme since its inception in 1980. Besides, use of this chemical has also been recommended under the Urban Malaria Control Scheme as a larvicide in waters meant for human consumption. Keeping in view the widespread use of temephos in Guineaworm Eradication Programmes, National Malaria/Filaria Control Programmes and in agriculture, it was thought desirable to determine the susceptibility status of *M. leuckarti* to temephos and pirimiphos methyl (0-2-dimethylamine-6-methylpyrimidine-4-yl 0,0-dimethyl phosphorothioate), another safe organophosphorus compound, which has also been found to be a potent mosquito larvicide. Accordingly, laboratory bioassays were carried out to determine the susceptibility status of *M. leuckarti* to temephos and pirimiphos methyl. The results have been communicated in this paper.

MATERIALS AND METHODS

The susceptibility tests were carried out aganist *M. leuckarti* collected from different localities of Delhi and its bordering states. Technical grade and sand granule forms of temephos (procured from the Cynamid India Ltd.) and only technical grade pirimiphos methyl (procured from the Imperial Chemical Industries) were used. Serial dilutions of the insecticides were prepared using absolute ethyl alcohol. Tests were performed as per WHO standard methods recommended for the estimation of susceptibility status of mosquito larvae[5]. Only mature and healthy individuals of both the sexes were used in the bioassays. Each set of experiments was repeated at least 6 times with four replicates, using the habitat water collected from the cyclops breeding sites. The water was kept for 24 h at an ambient temperature of 27 ± 1°C before conducting the experiment. The data collected were subjected to log-probit analysis[6].

Table 1 *Probit analysis of data giving susceptibility status of Mesocyclops leuckarti Claus to temephos and pirimiphos methyl*

Insecticide	Formulation	Regression coefficient values	$\chi^2(df)$	Regression equation	LC_{50} with fiducial limits (in ppm)	LC_{90} with fiducial limits (in ppm)
Temephos	Technical	1.41 ± 0.04	7.53(3)	$Y = 2.581 + 1.422x$	0.4987–0.5023–0.5050	3.9551–3.9927–4.0307
	Sand granules	1.41 ± 0.14	18.53(3)*	$Y = 1.603 + 1.415x$	2.4963–2.5168–2.5374	19.9893–20.2099–20.4329
Pirimiphos methyl	Technical	1.87 ± 0.15	4.25(2)	$Y = 1\ 447 + 1.867x$	0 0795–0.0799–0.0804	0.3850–0.3877–0.3903

* Heterogeneity of response was more than significant at $P > 0.05$.

RESULTS AND DISCUSSION

The probit analysis of the data referring to the susceptibility status of *M. leuckarti* to pirimiphos methyl and temephos are given in table 1. The LC_{50} and LC_{90} values estimated with technical grade temephos were 0.5023 ppm and 3.9927 ppm respectively, whereas in the case of sandgranules the values recorded were 2.5168 ppm and 20.2099 ppm respectively. The higher values of LC_{50} and LC_{90} of temephos sandgranules for this species may be due to the slow release of the insecticide in this particular formulation. The LC_{50} and LC_{90} values of pirimiphos methyl against this species were 0.0799 ppm and 0.3877 ppm respectively.

To ascertain the homogeneity of dose response the χ^2 test was applied in the case of individual insecticides/formulations. Tests conducted with temephos sandgranules exhibited a high degree of heterogeneity in the test population of cyclops with respect to the insecticide — $\chi^2 = 18.53(3)$. However, against technical grade temephos and pirimiphos methyl such a phenomenon could not be observed.

The present results show that pirimiphos methyl is more potent when compared to temephos against test species. At LC_{50} and LC_{90} levels it was 6.28 and 10.29 times more effective than temephos (technical grade) and 31.49 and 52.12 times more effective than temephos (sandgranules). LC_{50} and LC_{90} values calculated for the sandgranules of temephos were 5.01 and 5.06 times higher respectively than technical grade temephos.

The LC_{50} and LC_{90} values of temephos obtained in the present study, exhibited comparatively higher values than reported by earlier workers. Muller[2] reported LC_{50} and LC_{90} values of 0.002 and 0.006 ppm respectively against *Cyclops varnalis* in Nizeria in 1970. Susceptibility tests carried out in 1974–75 by Sharma *et al*[3] using *M. leuckarti* material collected from the Delhi region revealed LC_{50} and LC_{90} values of 0.0007 ppm and 0.007 ppm respectively. These values are 717.5 and 570.4, and 3595.4 and 2887.1 times lower than that obtained with technical grade and 2% sandgranules of temephos, respectively in the present study.

The present results suggest the development of temephos resistance in *M. leuckarti* population in and around Delhi. This may be attributed to the cross-resistance spectrum of different organophosphorus insecticides being used in public health and agriculture. The present results indicate that there is a need to undertake identical studies in guineaworm-affected areas where temephos is being used for the control of vector cyclops species in order to monitor the development of insecticide resistance. If the vector species display resistance to temephos, the use of pirimiphos methyl merits serious consideration.

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