



E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2016; 4(4): 1364-1366
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Received: 25-05-2016
Accepted: 26-06-2016

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Acute toxic effects of acephate on freshwater fish *Puntius sophore* (Hamilton)

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Abstract

The present study deals with the acute toxic effects of an organophosphate insecticide Acephate on freshwater fish *P. sophore*. The fish were exposed to Acephate to determine the LC₅₀ values. The static bioassay experiments were carried out by Finney's method (1971). The fish was exposed to different concentrations of Acephate and the result showed the LC₅₀ values at 24, 48, 72 and 96 hours were 1762 ppm, 1509 ppm, 1281 ppm and 1117 ppm respectively.

The results of the present investigation depict that Acephate has very low toxic effects on the fish *P. sophore*.

Keywords: Acute toxicity, acephate, *P. sophore*, LC₅₀

1. Introduction

Water is the fundamental unit for each and every organism living on the earth. All the aquatic organisms are bioindicators of water pollution but one of the most important bioindicators amongst them are the fishes. In recent years the use of pesticides in the agricultural fields increased tremendously for the purpose of fulfilment of the increasing human needs, such as food, medicines, clothing, cosmetics etc. causing decreased quality of water bodies like, rivers, lakes, streams and ponds. This contaminated water affects on the aquatic fauna including fishes.

Among the different groups of pesticides organophosphates are being used commonly as insecticides due to their facilitation properties like less persistent and rapid biodegradability in nature [18, 19]. Acephate is an organophosphate foliar spray insecticide of moderate persistence with residual systemic activity of about 10-15 days at the recommended use rate. It is used for control of a wide range of biting and sucking insects, especially aphids, including resistant species in fruit, vegetables (e.g. potatoes and sugar beets), vine and hop cultivation and in horticulture (e.g. on roses and chrysanthemums grown outdoors) [21]. As no studies have been conducted on the toxicity of Acephate on different organisms and indicated as a potent neurotoxicant [26]. It is also found to be mutagenic [3], carcinogenic [2] and cytotoxic [10]. However, this compound is considered relatively non-toxic to fish with a median lethal concentration (LC₅₀) for Goldfish of 9550 mg/l. and Rainbow trout > 1000 mg/l. over 96 hours [5]. Acute toxicity of pesticide refers to the chemicals ability to cause injury to animals from a single exposure, generally of short duration. The acute toxicity test of the pesticides to fish has been widely used to acquire rapid estimates of the concentrations that caused direct, irreversible harm to test organisms [9]. The most common acute toxicity test is acute lethality and LC₅₀ customary to represent the lethality of a test species in terms of mortality and time. LC₅₀ is the concentration of the chemical that results in the 50% death rate of the test organisms [20].

P. sophore commonly known as pool barb is a member of Cyprinidae family under the order Cypriniformes. It is widely distributed in India, Afghanistan, China, Bangladesh, Bhutan, Myanmar, Nepal and Pakistan [11, 16]. In Navapur region (Dist. Nandurbar, Maharashtra) it is commonly called as "Tebla" by the local tribal (Adiwasi) community. This fish species has good market demand as a food fish due to its high nutritive value with good protein content [1, 7, 8, 12, 16]. It has been reported as a crucial source of micronutrients essential in preventing malnutrition and vitamin and mineral deficiencies in rural communities, particularly of vulnerable groups such as poor women and children [14, 15, 22, 23].

A very little work has been carried out regarding toxicity of the experimental fish. In the present investigation the lethal concentrations of the pesticide Acephate on *P. sophore* was determined.

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2. Materials and Methods

To study the acute toxicity of Acephate, freshwater fish *P. sophera* were collected from Rangawali River and Manekpur Tapi backwater. The fishes were captured from the local fishermen from those particular regions. These fishes were collected in the 25 litre plastic drums provided with the artificial aerator, and brought them alive to the laboratory. After bringing them safely to the laboratory the fishes were kept in plastic troughs and giving bath with 0.05% KMnO₄ solution to avoid injury and infection. Thereafter they were transferred to the glass aquaria for the process of acclimatization to the laboratory condition for at least two weeks. During the process of acclimatization the fishes were fed daily with fish food (Taiyo) were bought from the market. The fishes then kept in the plastic troughs having 10 litres of water and each trough contains 10 fishes. The control and experimental fishes were exposed to the pesticide Acephate at 1200 ppm to 2400 ppm, 1000 ppm to 2200 ppm, 800 ppm to 2000 ppm and 600 ppm to 1800 ppm concentration of Acephate for 24, 48, 72 and 96 hours respectively and the data were collected and analyzed by the probit analysis method of Finney (1971). The study was carried out from July - 2015 to January - 2016

3. Results

The results were recorded as 10% to 90% mortality during the experiment, no mortality was found in control fishes at 24, 48, 72 and 96 hours. The LC₁₀ values of the pesticide at different concentration of Acephate were 1219 ppm, 980.2 ppm, 782.1 ppm and 622.3 ppm at 24, 48, 72 and 96 hours respectively, and the LC₅₀ values found to be 1762 ppm, 1509 ppm, 1281 ppm and 1117 ppm at 24, 48, 72 and 96 hours respectively. The toxicity of the Acephate pesticide is very low to the fish *P. sophera* and it was considered to confer low toxicity to the fishes.

Table 1: LC₁₀ and LC₅₀ values of Acephate exposed to freshwater fish *P. sophera*

Sr. No.	Exposure period In hours	LC ₁₀ values	% mortality	LC ₅₀ values	% mortality
01	24	1219	10%	1762	50%
02	48	980.2	10%	1509	50%
03	72	782.1	10%	1281	50%
04	96	622.3	10%	1117	50%

Table 2 *P. sophera* exposed to different concentrations of Acephate

Sr. No.	Concentration in ppm and mortality observed							
	24 hrs	Mortality	48 hrs	Mortality	72 hrs	Mortality	96 hrs	Mortality
01	1200	1	1000	1	800	1	600	1
02	1400	2	1200	3	1000	3	800	2
03	1600	4	1400	4	1200	4	1000	4
04	1800	5	1600	5	1400	6	1200	5
05	2000	6	1800	7	1600	7	1400	7
06	2200	8	2000	8	1800	8	1600	8
07	2400	9	2200	9	2000	9	1800	9

4. Discussion

In the present study the fish *P. sophera* was exposed to Acephate and showed 50% mortality at 1117 ppm during 96 hrs exposures. Acephate is harmful to humankind when it is used for long run. The study is a small piece of work which strongly suggests that Acephate is a harmful pesticide when used for long years. Its residues make hazardous effects to the vital organs of fish, amphibians, mammals etc [4]. Signs of toxicity in terrestrial animals poisoned with Acephate include muscular weakness, tremors, reduced activity [24]. The LC₅₀ of Acephate in the *Poecilia sphenops* was found to be 25 mg/l (4). However, 100% mortality occurred in the treatments of 101.25 mg/l. at 5.0% and 151.88 mg/l. at 20.0% for Acephate after 24 h of exposure [25].

The earlier studies revealed that the LC₅₀ of a chemical for a species may vary under different environmental condition like time of exposure size and outer impacts. Several reports were given for different LC₅₀ values of various pesticides on freshwater fish Santhakumar and Balaji (2000), Mathivanam (2004) and Ramasamy *et al.* (2007) studied the effect of various pesticides and recorded LC₅₀ values.

5. Conclusion

In the present study LC₅₀ values of Acephate were 1762 ppm, 1509 ppm, 1281 ppm and 1117 ppm for 24, 48, 72 and 96 hrs respectively. Though the Acephate is very low toxic to the fish its long term use can affect fish as well as other living organisms. Hence, it is concluded that the minimum use of the Acephate pesticide in the field of agriculture will be used by the farmers to bring awareness.

6. Acknowledgements

Authors are thankful to Dr. A. G. Jaiswal, Principal, A.S.S. and S.P.S's, Arts Commerce and Science College, Navapur Dist. Nandurbar, Maharashtra, Dr. D. P. Jaiswal, Head, Department of Zoology, A.C.S. College Navapur for providing all the facilities to conduct this research work. Thanks are due to the University Grants Commission for providing the financial assistance in the form of Rajiv Gandhi National Fellowships, UGC, New Delhi to carry out the present work.

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