

Original Article

Effect of 2, 4-dichloro phenoxyacetic acid (2, 4 D) Pesticide on fresh water Fish Channa gachua of Loni Dam, Tq.Kinwat District Nanded

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Abstract

The commonly used pesticide like 2, 4-dichloro phenoxyacetic acid was used for evaluation and effect on fresh water fish Channa gachua. In present study static bioassay test is used for evaluation of toxicity of fresh water fish, Channa gachua. In present study static bioassay test is used for evaluation of toxicity. The fishes were exposed to different concentration of 2,4-dichloro phenoxyacetic acid for 96 hrs. The static bioassay result revealed that the LC₅₀ of 2, 4-dichloro phenoxyacetic acid is 5.50 ppm. The present study investigates the acute toxicity of the widely used herbicide 2, 4-dichloro phenoxyacetic acid (2, 4-D) on the freshwater fish Channa gachua, collected from Loni Dam, Kinwat (District Nanded). Static bioassay experiments were conducted by exposing test fishes to graded concentrations of 2, 4-D for 24, 48, 72, and 96 hours. Mortality rates were analyzed using graphical, probit, and Dragstedt-Behren's methods to determine the median lethal concentration (LC₅₀). Results revealed a progressive decrease in LC₅₀ values with increased exposure duration, with the 96-hour LC₅₀ calculated at 5.50 ppm, indicating time- and dose-dependent toxicity. The findings suggest that even at comparatively lower concentrations, 2, 4-D poses significant risks to non-target aquatic species, highlighting its potential to disrupt aquatic ecosystems. Establishing safe exposure limits for pesticides is essential to safeguard fish biodiversity and maintain ecological balance in freshwater habitats.

Keywords: Loni Dam, Channa gachua, 2, 4-dichloro phenoxyacetic acid, Pesticide.

Introduction

In both urban and agricultural settings, pesticides are widely used, and their combinations are commonly employed to increase crop pest treatment efficacy and lower costs. The methods employed for pesticide application (spraying and dusting) enable them to enter the aquatic ecosystem (Elezović et al., 1994). Among the several ways that pesticides can get into surface waters, runoff from irrigation or precipitation is the most significant in terms of peak concentrations. All levels of biological organization may be directly impacted by the exposure, and the group of species that are impacted primary producers, microbes, invertebrates, or fish depends mainly on the toxicant's method of action. The aquatic environment is continuously being contaminated due to powerful toxic chemicals generated by human, industrial, agriculture and domestic activities. Pesticides are the xenobiotic substances that have been used in India for long time. The most of the insecticides are so hydrophobic that they can be easily absorbed by soil particles and can migrate to natural water systems such as river, lake and pond through the runoff, causing severe aquatic pollution (Ding and Wu 1993, Odonaka et al. 1994). Pesticides can enter aquatic ecosystems through the air and water after being released into the environment. Airborne processes include volatilization following application with subsequent atmospheric transport that may result in the deposition of chemicals in distant habitats, as well as wind drift during pesticide spraying (spray drift). Due to the widespread use of pesticides and the fact that they are intended to damage biota, there is a significant chance that non-target groups will also experience negative environmental effects. Veron JEN. (2000).

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Chemicals other than required by organisms, especially toxic like pesticides pose a health hazards to non-target species and thus gain much importance in screening of the Pesticide. Evaluation of the toxicity of pesticides contribute much towards arriving at better means of use and also involving new formulation, which would give results. Consequently these xenobiotic molecules have been found in natural water systems and they have a great impact on the environmental quality (Li and Migita 1992). They become accumulated in aquatic organisms and can enter in the food chain (Svensaon et.al., 1994). Evolution of the toxicity of pesticides contribute much towards arriving at better means of use and also involving new formulation, which would give result. Hence the present investigation is carried out to toxicity of the pesticide 2, 4-dichloro phenoxy acetic acid tested Hence an attempt was made to observed toxicity of fresh water fish, *Channa gachua*. In effect pesticide 2, 4-dichloro phenoxyacetic acid at 5.0 ppm

Material and Method:-

In present investigation, fishes were collected from Loni Dam Kinwat and taken to the lab. After being checked for any pathological symptoms, these fish were submerged for two minutes in a diluted bath of 0.1% potassium permagnate (KmnO₄) to prevent any skin infections. After being cleaned with water, the fish spent a few days in glass aquariums getting used to the lab environment. The fish were fed live earthworms as part of their acclimatization diet. The food supply was cut off 24 hours before the experiment. Fish that weighed roughly 7+2 gram and were almost identical in size (9+2 cm) were chosen for the Different concentrations were made from stock solution as per dilution method suggested by APHA (1998). Fresh stock solutions were used for each exposure.

Static bioassay experiments were conducted as suggested by Doudoroff et al., (1951). The animals were starved during the exposure time. A total of thirteen concentrations were tested. Ten fish were subjected to a 50-liter test solution for each concentration. The purpose of this setup was to keep the fish weight to water volume ratio in the studies nearly constant. Six iterations of each experiment were conducted. At 24-, 48-, 72-, and 96-hour intervals, the number of fish killed in each concentration was noted. LC₅₀ values for various time intervals and the average mortality in each concentration were computed for

2, 4-dichloro phenoxyacetic acid were calculated by three different methods. (i) Statistical (probit analysis Finney, 1971) (ii) Dragstedt and Behren's (1975) (iii) Graphical method.

1. Statistical Method:-

This method makes use of probity analysis (Finney, 1971). A double logarithmic grid was used to depict the values against pesticide concentration after the present mortality was transformed into probity mortality. For that exposure period, the pesticide concentration at which a 50% probity kill occurred was found to suit the straight passing through line.

2. Graphical Method:-

The dose-response curves were fitted by plotting percentage mortality Vs pesticide log concentration for fix period in single graph. Lines were fitted and concentration of pesticide at which there was 5 mortality was noted to represent the LC₅₀ at 24, 48, 72 and 96 hr exposure.

3. Dragstedt-Behren's Method (1975): -

In this method cumulative mortality was determined at different concentrations of pesticide and percent mortalities were calculated from cumulative mortalities values. LC₅₀ values were calculated by adoption the formula

$$LC_{50} = A + \frac{50 - a}{b - a} \times 2$$

When the log is applied to this formula, the following formula is produced

$$\text{Log } LC_{50} = \text{Log } A + \frac{50 - a}{b - a} \times \text{Log } 2$$

Where A is the concentration of pesticides with a death rate less than 50%.

a = Mortality rate less than 50%.

b = the mortality rate that is little over 50%.

'A', 'a', and 'b' were the results of applying cumulative mortality for two pesticides at 24, 48, 72, and 96 hours to the recorded observations.

The cumulative percentage mortality is calculated by adding the live and dead number of cumulative mortality and the number of dead animals is divided by live and dead number which is further multiplied by 100.

The LC₅₀ values were calculated making use of the formula at 24, 48, 72 and 96 hours for pesticides.

Determination of safe level or Safe concentration or presumably harmless concentration: The LC₅₀ values are useful in the final evaluation of classifying Safe level' or 'Tolerable level' of pollution to the aquatic biota and this will pave the way in establishing 'limits and level of susceptibility' by the biotic components. An estimate of the presumably harmless (safe) concentration of the pesticide can be calculated using the following formula (Hart et al. 1945).

$$C = \frac{LC_{50}}{48hrs} \times \frac{A}{S^2}$$

Where C=presumably harmless concentration. A=Application factor, (0.3)

$$S = \frac{LC_{50}/24hrs}{LC_{50}/48hrs}$$

Table: - Showing LC₅₀ and average LC₅₀ values calculated by three method to Channa gachua

Sr.no	2,4-dichloro phenoxyacetic acid	Time of exposure	Grafical method	Probit analysis	Drasted and Behrens method	Avarage LC ₅₀ Values
1		24	7.0 ppm	6.87 ppm	2.20 ppm	6.63 ppm
2		48	6.4 ppm	6.41 ppm	8.22 ppm	6.15 ppm
3		72	5.8 ppm	5.75 ppm	7.60 ppm	6.58 ppm
4		96	5.3 ppm	5.26 ppm	7.01 ppm	5.50 ppm

Results and Discussion:-

To determine the toxicity of 2, 4-dichloro phenoxyacetic acid, a static bioassay test was chosen for this inquiry. In this bioassay test mortality was found at 5.0 ppm in 2,4-dichloro phenoxyacetic acid. The LC₅₀ of 2, 4-dichloro phenoxyacetic acid was determined three methods which represented. In present investigation the average LC₅₀ values and safe concentration of 2,4-dichloro phenoxyacetic acid 6.63, 6.15, 6.58 and 5.00 ppm for 24, 48, 72 and 96 hrs respectively. The similar results were reported Pickering et al., (1966), Ivaprasad Rao et al., (1980), Swarup et al. (1981), Arora et al., (1971), Arora et al. (1971), Pankaj et al. (2004), Joyti and Narayan 1996), Singh and Narain (1982), Anandswamp et al. (1981), Reddy Omati (1977, Vasait et al. (2005) studied toxic evaluation of ganophosphate insecticide monocrotophos on the edible fish species amacheilus botai for a period of 7 and 14 days and showed that the LC₅₀ values were 49.6 and 42.0 ppm respectively. The observed result dicates that the mortality of the test fish to monocrotophos was dose pendent. Sivaprasad Rao et al. (1980) studied toxicity of methyl parathion on freshwater teleost. Tilapia mossambica and reported that the LC₅₀ value was 0.266 ppm. Prashanth (2006) studied impact of cypermethrin on protein metabolism of freshwater fish, Cirrhinus mrigala and showed that the LC value was 5 mg/1 for days. Abdul Naveed, et al. (2006) studied toxically of libocin on the activities of glycolytic and gluconeogenic enzyme of fish, Channa punctata and showed that the LC50 values was 19.19 ppm for 48 hours. Sivakumar et al. (2006) studied acute toxicity of chromium on behavioral changes in freshwater fish, Mystus vittatus, for period of 24, 48, 72 and 96 hours and reported that the LC50 values were 82.79, 72.11, 64.42 and 61.67 mg/l respectively.

Prashanth, et al. (2003) studied effects of cypermethrin on toxicity and oxygen consumption in the freshwater fish, Cirrhinus mrigala and reported that the LC50 value was 5.13 mg/l for 96 hours. Prabhakara Rao and Radhakrishnaiah (2006) studied pesticidal impact on protein metabolism of the freshwater fish, Cyprinus carpio (Lin) and reported that the 48 hour LC, 50 values of furadan, endosulfan, chloropyrifos and mixture of this three were 20.5, 2.2, 0.12 and 7.5 mg/ 1 respectively. Paraskar et al., (2005) studied effects of cypermethrin on three selected freshwater fish, C. orientalis, C. batrachus and H fossilis and reported that the LC values were 1.5, 2.5. And 3.5 ppm respectively. Veena Sakthivel and Gaikwad (2002) studied tissue histopathology of Gambusia affinis Baird and Girad under demecron toxicity and reported that the LC value was 0.34 ppm. The above 50 literature of toxicology also clears that LC₅₀ values decreases with increase in exposure period suggesting that Even at lesser concentrations, the herbicide becomes harmful as exposure time increases.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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