IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(E): 2321-8851; ISSN(P): 2347-4580
Vol. 2, Issue 2, Feb 2014, 71-76

POLLUTIONAL IMPACT OF SOME SELECTIVE AGRICULTURAL PESTICIDES ON FISH *CYPRINUS CARPIO*

ASHIS KUMAR PANIGRAHI[1], NEELANJANA CHOUDHURY[2] & JAYANTA TARAFDAR[3]

[1,2]Fisheries and Aquaculture Ext. Laboratory, Department of Zoology, University of Kalyani, Kalyani, West Bengal, India

[3]Department of Plant Pathology, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India

ABSTRACT

Aquatic toxicity risks of agricultural pesticides to non-target organisms specially fishes are pivotal. The use of pesticides for an effective control of plant diseases has become crucial in the last decades in the agriculture system since it is estimated that pest infections cause yield reductions of almost 20% of crops worldwide. In the last decades, the use of pesticides in agriculture for disease control has become crucial. As known, fungicides, pesticides and other chemicals can enter to water bodies through rain water, food, irrigation water or rivers in many cases and may be hazardous for living systems. These chemicals influence metabolism at very low concentrations by altering enzyme activities and disrupting physiological balances.

Moreover, they are known to interfere with a number of processes as they have neurotoxic, hematotoxic, genotoxic, hepatic and renal effects on vertebrates. In our present study, behavioral changes and responses of the fish *Cyprinus carpio* to the Monocrotophos, agricultural effluent was observed. Fish were exposed to the agricultural effluent for 96 hrs. Effluent was added to the aquarium with different dilutions. Control fish showed normal behaviour and swimming in contrast the effluent exposed fish showed abnormal swimming, loss of equilibrium, fading of colour, coughing and opercular movements. There were rapid opercular movements followed by excited swimming and coughing in *Cyprinus carpio* because of improper ventilation or inconvenience in breathing. Quick expansion and contraction of opercular cavities serves the cleaning of debris accumulated on the gills. In *Cyprinus carpio*, the rate of movement of operculum found increased with the increase in concentration of effluent.

KEYWORDS: Monocrotophos, *Cyprinus carpio*, Toxicity, Dissolved Oxygen, Behavioral Changes, Mortality

INTRODUCTION

The aquatic environment is continuously being contaminated with toxic chemicals from industrial, agricultural and domestic activity (Begum, 2004). Agricultural pollution refers to biotic and abiotic by products of farming practices that result in contamination or degradation of the environment and surrounding ecosystems, and/or cause injury to humans and their economic interests. Pesticides are employed routinely in the integrated farming practice to protect crops and animals from insects, weeds and diseases. Liberal use of pesticides at different stages of crop production, starting from seed processing to storage of agricultural produce, is posing great danger to aquatic environment. Pesticides, the biologically active chemicals are used to a great extent for pest control but their spectrum of activity often extends far

beyond the pest. The pollution of aquatic environment with wide array of xenobiotic compounds has become a menace to the aquatic flora and fauna and is a problem of immediate concern.

These contaminants are let out into the water bodies from industrial and agricultural areas and as most of them are highly persistent, their levels fast reach to life threatening in terms of both space and time (Brack et al. 2002; Diez et al. 2002). Fish sensitivity to different pesticides could be explained by their relatively slow metabolism and elimination of these compounds (David et al. 2003). Monocrotophos is an organophosphate insecticide. It is acutely toxic to birds and humans, and for that reason has been banned in the U.S. and many other countries. Widespread bird kills, especially of Swainson's Hawks, have resulted from the use of monocrotophos. In 2009 the World Health Organization asked India to ban monocroptophos. Monocroptophos is believed to be the contaminant responsible for the death of 23 school children who ate the state-provided school lunch in the district of Saran in India in July 2013.

Depletion in dissolved oxygen content occurs in the water bodies when pesticides, chemicals, sewage and other effluents containing organic matter are discharged from agricultural and industrial origin. Pesticides in sublethal concentrations present in the aquatic environment are too low to cause rapid death directly but may affect the metabolism of the organisms, disrupt normal behaviour and reduce the fitness of natural population. The respiratory potential or oxygen consumption of an animal is the important physiological parameter to assess the toxic stress. As aquatic organisms have their outer bodies and important organs such as gills almost entirely exposed to water, the effect of toxicants on the respiration is more pronounced. Pesticides enter into the fish mainly through gills and with the onset of symptoms of poisoning, the rate of oxygen consumption increases.

MATERIALS AND METHODS

The fish were brought from a local fish farm and acclimatized to the laboratory conditions in well aerated water for one week. They were brought to laboratory carefully in plastic bags to avoid any injury and disinfected by giving a bath for two minutes in 0.05% KMnO solution. The water used for acclimatization and experimentation was the same as used in the toxicity experiments. During this period the fish were regularly fed, but the feeding was stopped for two days prior to the experiment. 10 samples each of similar size (~5 cm) and weight (~10 g) were cultured in aquarium (size 3 × 1 × 1 lt) of 10 lt capacity for 30 days. Experiment was conducted under natural photoperiod and temperature in the month of August and September. Physicochemical characteristics of water were as follows: temperature 28 ± 2°C, pH 7.4 ± 0.5, Dissolved oxygen 7.2 ± 0.5 mg/L and total hardness as $CaCO_3$, 115.24 ± 1.3 mg/L measured after APHA (1992). Five different dilutions of organophosphate pesticide was added to aquariums (Table 1).

While two batches of ten fish were kept in normal water to be used as control (Table 2). Fishes were exposed to the Monocrotophos for 96 hrs. The fishes were exposed to 0.015, 0.038, 0.062, 0.126 and 0.252 ppm doses of the fungicide. During experiment no food was supplied to the fishes. Mortality in each group was recorded and dead fishes were removed immediately to prevent contamination. At the end of each hour, samples (50 ml) were collected and the amount of oxygen present was estimated by Winkler's method (Golterman and Clymo, 1969). The difference in the rate of oxygen consumption between the control and the test fish denotes the effect of the toxicant on oxygen consumption. The behavioral responses were noted during first 24, 48, 72 and 96 h of exposure. The water in test aquaria was changed every 24 hours and was supplied with full aeration. The Physico-chemical characteristics of test water and agricultural effluent have been analyzed during experimentation (APHA, 1992).

RESULTS AND DISCUSSIONS

Fishes exposed to lethal concentration of agricultural effluent for a short-term exposure were studied in terms of general behavior, rate of survival and mortality. The effects of pollutants are generally characterized on survival, reproduction or growth due to physiological alteration in the animal. The physical, chemical and biological components of the environment play an important role in manifestation of biological response to pollutants. The toxicity of particular pollutants depend upon many factors such as animal weight (Pickering 1968), developmental stages (Kamaldeep and Joor 1975), period of exposure and temperature, pH, hardness of water and dissolved content of the medium (Mc. Leese 1974 and Brungs 1977). When *Cyprinus carpio* were introduced to the effluent added water, they get excited and were swimming rapidly with random movements. While in control, fish were swimming with normal movement. Similar results were reported earlier by Anderson and Weber (1975) when guppies were exposed to dieldrin.

There were rapid opercular movements followed by excited swimming and coughing in *C. carpio* because of improper ventilation or inconvenience in breathing (Table 3). While in control fish the opercular movements were normal and it was clearly seen when compared with experimental fish. Coughing was not observed in control fish. Quick expansion and contraction of opercular cavities serves the cleaning of debris accumulated on the gills. In *C. carpio*, the rate of movement of operculum is found increased with the increase in concentration of effluent. Similar results were also observed in Coho salmon treated with fenitrothion by Bull and McInerney (1974). A thick coat of mucus was observed all over the body of the fish, making the fish slimier. While in control the fish were also with normal mucus coat on their body. In sublethal exposures, the fish body becomes lean towards abdomen position as compared to control owing to reduced amount of dietary protein consumed by the fish at pesticide stress, which was immediately utilized and was not stored in the body weight (Kalavathy et al. 2001).

These findings are in collaboration with those of Murshigeri and David, 2005 and others viz., Dube and Hosetti, 2010, Rao et al. 2003 and Parma de Croux et al. 2002. As the effluent concentration increased, the dissolved oxygen content of water decreased. Lloyd (1961) reported that the toxicity of several poisons to rainbow trout increased in direct proportion to decrease in oxygen concentration of water (Figure 1). The results clearly shows that the percentage mortality increased due to decrease in dissolved oxygen in water with an increase in toxicant concentration and also the duration of exposure.

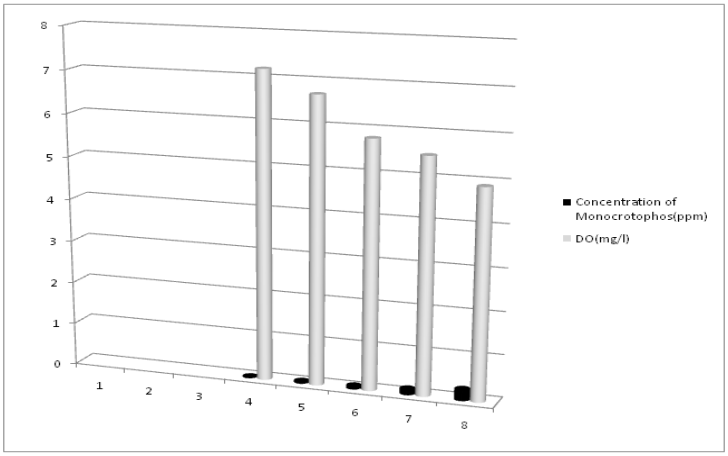

Figure 1: Graphical Representation of Concentration of a Monocrotophos (ppm) vs Dissolved Oxygen (mg/l) Content of Water

CONCLUSIONS

Monocrotophos is highly toxic to *Cyprinus carpio* and sub-lethal doses cause decrease in dissolved oxygen content of the water body resulting in abnormal behavioral changes in fingerlings.

ACKNOWLEDGEMENTS

The authors are thankful to the University of Kalyani and to the Bidhan Chandra Krishi Viswavidyalaya for financial and technical assistance to carry out the research work.

REFERENCES

1. P. D. Anderson and L. J. Weber, "Toxic response as a quantitative function of body size", Toxicol. Appl. Pharmacol., 33, 471, 1975.
2. APHA, (1992). Standard methods for the examination of water and waste water 18th Edition.
3. G. Begum, "Carbofuran insecticide induced biochemical lalterations in liver and muscle tissues of the fish *Clarias batrachus (Linnaeus)* and recovery response", Aquat. Toxicol.: 66,83–92, 2004.
4. W. Brack et al., "Effect-directed fractionation and identification of cytochrome P450A-inducing halo-generated aromatic hydrocarbons in contaminated sediment", Environ. Toxicol. Chem., 21: 2654-2662, 2002.
5. W. A. Brungs et al., "Effect of pollution on freshwater fish", J. WPCF., 49: 1425-1492, 1977.
6. J. Bull, and J. E. McInerney, "Behavior of juvenile coho salmon (Oncorhynchuskisutch) exposed to sumithion (Fenitrothion), and organophosphate insecticide", J. Fish. Res. Bd. Canada., 31, 18-67, 1974.
7. M. David et al., "Toxicity evaluation of cypermethrin and its effect on oxygen consumption of the fresh water fish, *Tilapia mossambica"*, Indian J. Envi-ron. Toxicol., 13: 99-102, 2003.
8. S. Diez et al., "Organotin contamination in sediments from the western Mediterranean enclosures following ten years of TBT regulation", Water Res., 36: 905-918, 2002.
9. B. N. Dube, and B. B. Hosetti, "Respiratory distress and Behavioral anomalies of Indian Major carp *Labeo rohita (Hamilton)* exposed to Sodium cyanide", Recent Research in Science and Technology, 2(2): 42-48, 2010.
10. H. Golterman and C. Clymo, "Methods for the chemical analysis of fresh water", Blackwell Scientific Publications. Pp. 116, 1969.
11. K. Kalavathy et al., "Toxic effects of the pesticide dimethoate on the fish, *Sarotherodon mossambicus"*, J. Ecol. Res. Bio., 2: 27-32, 2001.
12. K. Kamaldeep and H.S. Joor, "Toxicity of pesticides to embryonic stage of *Cyprinus carpio* (Linn.)", Indian J. Exp. Biol., 15: 193-196, 1975.
13. R. Lloyd, "Effect of dissolved oxygen concentrations on the toxicity of several poisons to rainbow trout (*Salmogairdneri*)", J. Exp. Biol., 38: 447-455, 1961.

14. D.W. Mcleese, "Response of lobster, *Homarus americanus* to odour solution in the presence of bleached kraft mill effluent", J. Fish Res. Board Can.,30: 279-283, 1974.
15. S. B. Mushigeri and M. David, "Fenvalerate induced changes in the Ach and associated AChE activity in different tissues of fish, *Cirrhinus mrigala* (Hamilton) under lethal and sublethal exposure period", Environ. Toxicol. Pharmacol., 20: 65-72, 2005.
16. M. J. Parma de croux et al., "Inhibition of plasma cholinesterase and acute toxicity of monocrotophos in Neotropical fish, *Pro-chiloduslineatus*(Pisces, Curimatidae)", Bull. Environ. Contam. Toxicol., 69: 356-362, 2002.
17. Q.H. Pickering, "Some effects of dissolved oxygen concentrations upon the toxicity of zinc to the blue gill *Lepomismacrochirus"*, Water Res., 2: 187-194, 1968.
18. J. V. Rao et al., "Toxicity of chlorpyrifos to the fish, *Oreochromis mossambicus"*, Bull. Environ. Contam. Toxicol., 70: 985-992, 2003.

APPENDICES

Table 1: Fishes Exposed to Different Dilutions of Agricultural Effluents

No. of Fish Exposed	Concentration of Effluent (Ppm)	No. of Fish Dead	No. of Fish Survived	Percentage Mortality
10	0.015	0	10	00
10	0.038	0	10	00
10	0.062	2	8	20
10	0.126	5	5	50
10	0.252	6	4	60

Table 2: Fishes Kept in Normal Water for Control

No. of Fish Exposed	Concentration of Effluent (ppm)	No. of Fish Dead	No. of Fish Survived	Percentage Mortality
10	00	0	10	00
10	00	0	10	00

Table 3: Physical Reactions of *Cyprinus carpio* to Monocrotophos

Sl. No.	Behavioral Changes
1	Irritation
2	Fast opercular movement
3	Violent action of fins
4	Loss of equilibrium
5	Mucus covering