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Pesticidal Use in Swampy and Derelict Agro System in Chammparan, District, Bihar-India - A Detrimental Menace to Fish Farming

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Abstract

In the new millennium and with the advent of high yielding varieties of paddy, the use of various pesticides, some of which may be in minute quantities are highly toxic to aquatic life. Fish culture, therefore, is not more compatible with paddy farming wherever the latest high yielding varieties of paddy are cultivated. Champaran (Bihar) is known to be an area of high quality yielding rice and are even exported to several countries. There are numerous swampy and derelict lentic water bodies in this area. In recent years, however, attempts are being made in the fish culture to utilize the vast swampy and derelict water area for immediate use for the benefit of the poor, without getting involved in to costly reclamation process. Despite of poor and unorganized capture fishery, the percent yield was estimated to be good. The fishes like *Channa, Heteropneust, Anabus, Clarius* and even some Carps are being cultured in the paddy fields as well as in the water bodies of this area. By virtue of their hardy nature and air breathing habits in many cases, they are excellent material not only for utilizing swampy and derelict water bodies but also in paddy fields as they permit high stocking density and respond to supplementary feeding. Their production potential is by and large directly proportional to inputs and intensity of operational management.

Despite of good inputs of these commercial fishes, the potential toxic compounds in various chemicals used for agricultural and other domestic purposes get distributed by a variety of means and accumulate concentrations in the soil and water. These accumulated organic compounds lower the DO level and does not support fish life. Fish species are far from being biochemical inert. As a matter of facts several pesticides are known to induce microsomal enzyme systems in the liver of fish. Physiology, biochemistry and pathology has enabled us to assess the toxicity of the water body with fish and in these circumstances, fish can be used as an indicator of water quality.

Key Words: ***Channa marulius, Swampy, Derelict, Pesticide, Mortality,*** LC_{50}

Introduction

East Champaran district has a wide range of paddy fields with several lentic water bodies, which remained unnoticed. In the area of paddy fields, unmanaged lakes and ponds which retain water for 4 to 8 months, aquaculture (especially the air breathing fishes) can be carried out. These water bodies are major sources of air breathing culture for the people of this economically and socially backward area. The culture of the fishes in the area which remain flooded even after the paddy is harvested and lentic water bodies after rainy season serve as an off season occupation for farmers of this area.

In the recent years, however, with the advent of high yielding varieties of paddy, the use of various pesticides, many of which even in minute quantities are highly toxic to aquatic life, has become widely prevalent. Champaran is known to be an area of high quality yielding rice, but apart from this, the people of this area are still suffering either from malnutrition or under-nutrition.

The effect of different chemicals is different and quite complicated to understand without scientific study. The potentially toxic compounds in the various chemicals used for agricultural and other domestic purposes are distributed by a variety of means and get accumulated in the soil and water. These accumulated organic compounds have to be decomposed. Some chemicals do not show the active toxicity to fish in the small concentration as they show in higher animals. It is totally incorrect to infer that this is due to the fact that fish lack some of the more common enzyme systems present in the mammals and that the chemical concerned to not therefore pose a serious hazard to them. On the contrary, fish species are far from being biochemical inert system and as a matter of fact several pesticides are known to induce system of microsomal enzyme system in the liver of fish. Thus, Fish can be used as an indicator of the quality of water which may end our search for an "acting model"

Determiation of median concentration (LC_{50}) value of a pesticide can be used to regulate the discharge of pesticide into nearby water system to protect aquatic life; whereas the safe concentration are actually fractions of LC_{50} values and therefore, would be useful in regulating their discharge.

Keeping all the above mentioned facts in mind, the present work has been aimed to find out the mortality rate and LC_{50} values of most common organophosphate (Abate) and carbamate pesticide (Baygon) individually for common fresh water air breathing fish *Channa-marulius* (Bloch), which lives in the swamps, and derelict water bodies having low oxygen and high CO_2 conditions, yet has a great nutrient values as well. Such studies are necessary for the maintaining of healthy stock of the fish in our inland water, which can ensure that the species preset are not adversely affected in any way by water pollutants.

Materials and Methods

Healthy and living specimens of *Channa marulius* (Bloch) commonly known as 'saur' of 38.10 ± 3.25 gm. weight groups were collected from the swampy and derelict lentic water bodies of East Champaran district of Bihar, India.

After the collection, fishes were brought to laboratory and subjected to treatment, quarantine and acclimatization processes following he methodology given by APHA 1985. They were treated with Terramycin solution (15 mg/L) in laboratory tap water for 48 hrs. in round mouthed stainless steel drums (Donald *et al.* 1983) of 30 litre capacity. At the end of 48 hrs., the fishes were washed and then treated with $KMnO_4$ solution (2mg/L) to remove ectoparasites, fungi and other dermal infection. Mortality was noted during both treatment periods. Now the fishes were subjected to 3 days of quarantine and 7 days of acclimatization periods before being subjected to bioassay tests of all selected toxicants individually and were patterned following methods described by Doudoroff *et al.* 1951 and APHA 1985. The desired concentration range for toxic solution were done as described in APHA 1985 where as LC_{50} values were observed by interpolation method and probit analysis method (Finney 1981).

Results and Discussion

The LC_{50} values of two selected pesticides i.e. Abate and Baygon at 24, 48, 72 and 96 hrs. of exposure to *Channa marulius* (Bloch.) were determined individually by exposing the fish to various selected concentrations and mortality of such two replications at selected time intervals. No mortality in the fish was recorded either in control or in the fish exposed to 1.3 ppm Abate and 1.3 ppm Baygon concentrations.

Externally the response of the pesticides on the physical activities of the fish were looked almost similar, but the fish exposed to Abate were comparatively more sensitive than that of Baygon pesticide. The fishes, which were exposed to Abate ($0.0.0^1.0^4$) – tepamethyl-0-0' thiod-p-phenylene phosphorothioate) showed restlessness and hyper activity during initial stage followed by erratic swimming, erratic opercular movements and respiratory distress.

The fishes gradually become inactive, sank to bottom of the container followed by the death without any clear cut convulsions. Fishes secrete mucous on their body surface with a slight change in the colouration of the skin. However, the fish exposed to Baygon (Isopropoxy phenyl- Methyl carbonate) shows hyperactivity, vigorous swimming, jumping, loss of equilibrium, irritability, convulsions, coma and death. In few cases, haemorrhage, was noticed in the eyes. The mucous secretion on the body surface increases with an increase in the concentration and the formation of coagulated mucous coercing over the entire body surface just prior to death was a common feature in all the fish exposed to selected pesticides. Death was noted when the fish was not responding on prodding with a glass rod and not showing any respiratory movements.

From the result of bioassay tests, LC_{50} values at 24, 48, 72 and 96 hrs. exposure of Abate and Baygon to *Channa marulius* (Bloch) were determined individually by straight-line graphical interpolation method as well as probit analysis method.

The percent mortality of the fish in different concentrations of the respective pesticides are put on graph and the mortality data and LC_{50} values at the selected hours of exposure, with their slop values and regression equations are presented in Table 1 and 2 respectively.

Table 1. Mortality of *Channa marulius* at different concentrations of Abate and Baygon pesticides at 24, 48, 72 and 96 hrs. of exposure (Both percent and Probit kill)

Concentration	Log concentration	No. of fish dead (24 hrs.)	% kill	Probit kill	No. of fish dead (48 hrs.)	%t kill	Probit kill	No. of fish dead (72 hrs.)	% kill	Probit kill	No of fish dead (96hrs.)	% kill	Probit , kill	Pesticide used
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.3	0.114	0	0	-	0	0	-	0	0	-	0	0	-	A
5.0	0.699	0	0	-	0	0	-	0	0	-	0	0	-	B
1.7	0.230	0	0	-	0	0	-	0	0	-	2	20	4.1584	A
6.5	0.813	0	0	-	0	0	-	0	0	-	0	0	-	B
2.2	0.342	0	0	-	0	0	-	3	30	4.4756	6	60	5.2533	A
8.5	0.929	0	0	-	0	.0	-	0	0	-	2	20	4.1584	B
2.9	0.462	0	0	-	0	0	-	5	50	5.2533	9	90	6.2813	A
11.0	1.041	0	0	-	0	0	-	1	10	3.7184	7	70	5.5244	B
3.7	0.568	1	10	3.7184	2	20	4.1584	9	90	6.2813	10	100	8.7190	A
14.3	1.185	0	0	-	0	0	-	4	40	4.7467	10	100	-	B
4.8	0.681	3	30	4.4756	7	70	5.5244	10	100	8.7190	10	100	-	A
18.6	1.269	2	20	4.1584	4	40	4.7467	8	80	5.8416	10	100	-	B
6.3	0.799	7	70	5.5244	10	100	8.7190	10	100	8.7190	10	100	-	A
24.1	1.382	6	60	5.2533	9	90	6.2816	10	100	-	10	100	-	B
8.1	0.908	10	100	8.7190	10	100	-	10	100	-	10	100	-	A
31.4	1.497	9	90	6.2816	10	100	8.7190	10	100	-	10	100	-	B
40.8	1.611	10	100	8.7190	10	100	-	10	100	-	10	100	-	A

No of fishes exposed 10 , A = Abate ; B = Baygon

The LC_{50} values obtained by two methods are found almost same as the difference in the values obtained for a particular pesticide at a particular hour of exposure are not found statistically significant in any case, but it is only the probit analysis method, by which we can get standard error and regression equation. Accordingly the mean LC_{50} values for 24, 48, 72 and 76 hrs. exposure are found to be 4.6385 ± 0.1084, 4.1318 ± 0.1060, 2.9036 ± 0.1078 & 2.1768 ± 0.1067 ppb for Abate and 24.0860 ± 1.0673, 21.3900 ± 1.057) 21.3900 ± 1.0517, 14.7465± 1.0682 and 9.5289 ± 1.0598 ± ppm for Baygon respectively (Table 2).

In the present study, the percent survival of the fish in both the pesticides decreased with an increase in the concentration of the pesticides, as the fish exposed to the lower concentrations showed less reaction than that of the fish exposed to higher concentration as evidenced by 100% mortality in highest concentration might be due to the hyper activeness of the pesticides exposed fish as reported by Herbert and Sharben 1964.

Table 2. LC $_{50}$ value obtained by different methods along wit regression equation for Abate and Baygon pesticides individually at 24, 48, 72 and 96 hr. of exposure to *Channa marulius*.

Pesticide	Hours of Exposure	LCs_{50} value by graphical method	LC_{50} value (+SE)	-y=y-bx+bx	Regression Line (b)	Variance (v)	Standard Error (SE)	Average LC_{50} value (mean of 3 & 4)
1	2	3	4	5	6	7	8	9
Abate	24	4.65	4.6270 +0.1084	Y=-0.8601 +7.9446x	7.9446	0.001234	0.0351	4.6385 +0.1084
	48	4.10	4.1629 +0.1060	Y=- 2.7130 12.0972x	12.972	0.000646	0.0254	4.1318 +0.1060
	72	2.90	2.9067 +0.1078	Y=1.7652 +7.7746x	9.1645	0.00108	0.0329	2.9036 +0.1078
	96	2.15	2.2039 +0.1067	Y=2.0787 +9.1645x	9.1645	0.0008	0.0283	2.1768 +0.1067
Baygon	24	24.10	24.0720 +1.0673	Y=7.6879 +9.3465x	9.3465	0.0008	0.0283	24.0860 +1.0673
	48	21.40	21.3800 +1.0517	Y=-12.4957 +13.5876x	13.5876	0.00048	0.022	21.3900 +1.0517
	72	14.75	14.7430 +1.0682	Y=-6.0206 +9.2384 x	9.2384	0.00082	0.0287	14.7465 +1.0682
	96	9.50	9.5499 +1.0598	Y= -7.1635 +12.1877x	12.1877	0.00064	0.0252	9.5289 +1.0598

The abnormal behaviour of the fish exposed to various concentrations of Abate and Baygon as observed above indicates that abate is acting more like a respiratory poison whereas baygon acts as neurotoxicant causing nerve paralysis. A slight change in body colourations are in agreement with the findings of several workers such as Toor *et al.* 1973, Lunn *et al.* 1976, Haider and Inbaraj 1986, Ray and Munshi 1988 and Kumar 1989. Most of these workers have also reported excess muscus secretion on the body surface of the pesticides induced fish. "Coagulation film anoxia" in the fish is also well known from the wo.ks of Ellis 1973 and Jones 1964. Hence in the present study, formation of a coagulated mucous film on the body surface may be one of the important factors responsible for death of the fish as it would interfere with the gas diffusion process of the respiratory function and other vital processes of the body.

Devi *et al.* 1981 have reported 96 hrs. LC_{50} value for technical grade endosulfan and 35% EC for *Channa punctatus* to 4, 8 and 2.5 ppb respectively with regression equation, Y = 7.75 X - 15.8 Y + 2.58 X-1.16 respectively. Haider and Inbaraj 1986 have reported 24, 48, 72 and 96 hr. Lc50- values of technical grade Endosulfan and Malathion to be 11.26-11.43, 9.68-9.82, 7.56-7.96 & 5.78 – 6.13 mg/L respectively. Other workers notably Srivastava and Srivastava. 1988 observed 7.30 ppm for *H. fossils.* Singh *et al.* 1984 found 1.52 to 5.0 mg/L and 4.5 to 5.0 mg/L for *C. punctatus* and *H. fossilis*.

The present findings, when compared with the findings of the earlier workers, reflect that the pesticides of commercial formulations are generally more toxic than their technical grades. Thus, it can safely be presumed that the ingredients other than actual pesticides present in the commercial formulation may contribute towards synergism by enhancing the toxicity of the actual pesticides.

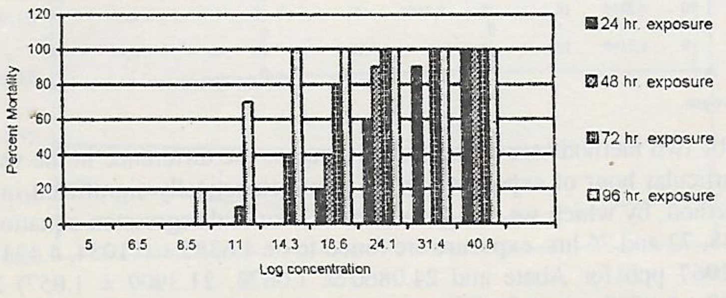

Figure 1.Percent Mortality of *Channa marulius* at different concentration of Abate pesticide

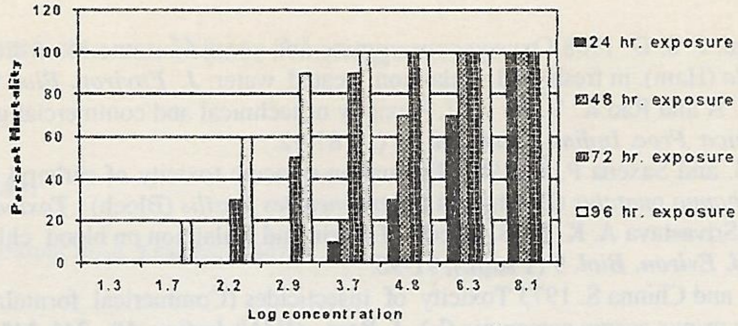

Figure 2.Percent Mortality of *Channa marulius* at different concentration of Baygon pesticide

Conclusions

The pesticide toxicity of Abate and Baygon on the fish *Channa marulius* (Bloch) at various hrs. of exposure and at different concentrations resulted that the mortality was high at higher concentrations and is concentration dependent. Though, fish showed some similar characteristics at higher concentration, yet Abate seems to act as a respiratory poison, whereas Baygon acts as neurotoxicant. The result of LC_{50} reflects that the commercial formulation of the pesticides are more toxic than their technical forms. Hence, it can be presumed that ingredients present in the commercial pesticides may contribute towards synergism by enhancing the toxicity of the actual pesticides. Both these pesticides Abate and Baygon are extremely harmful to fish. Therefore, some restrictions would be required to be put on their use and a periodical check up of water quality by the Government or some private agency would be obtained. Further the discharge of agricultural wastes to near by water system should be regulated so that the menace of these pesticides should be minimized.

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