ADVANCES IN BIORESEARCH, Vol 1 [2] DECEMBER 2010: 131 - 138

http://www.soeagra.com
ISSN 0976-4585

RESEARCH PAPER

Comparative Study of Acute Toxicity of BHC and Furadan on *Mesocyclops leuckarti* (Claus 1857) by LC_{50} Analysis

Poonam N. Kurve, Govind V. Kulkarni, * Kalpana D. Phal
Department of Zoology and *Deparment of Statistics
B. N. Bandodkar college of Science,
Dnyandweep, Chendani Bunder Rd, Thane 400 601
Email:phalkalpana@hotmail.com,kurveng@yahoo.com

ABSTRACT

An acute toxicity of two pesticides BHC and FURADAN was studied on a cyclopoid copepod, Mesocyclops leuckarti. At five different durations of exposure hours, doses of different concentrations were administered to these animals, and their mortality rates were recorded. With the help of statistical analysis and various plots on these data , the effect of these pesticides were studied and LC_{50} were determined. It was concluded that BHC is more toxic than FURADAN.

***KEYWORDS**: Confidence interval (CI) , Hazard rate , $LC_{50,}$ Mesocyclops leuckarti, Weibull distribution.*

INTRODUCTION

In modern agricultural methodology, application of pesticides has been a regular practice to control destruction of crops by pests. However, as a secondary effect there pesticides cause adverse effect on living community around. Many of the pesticidal compounds are non-degradable and hence, accumulate in ecosystem resulting into water pollution and soil pollution.

Water pollution due to drains of chemical in nearby water body show various consequences on aquatic organisms [1]. Planktonic organisms being small in size face a threat to their life. Further, they form important component of aquatic food chain. Due to biomagnifications, the situation aggravates and lethal effect on macro-organisms is also observed [2-9]. The Statistical analysis of the percent mortality for two pesticides were carried out to compare their toxicity. LC_{50} was determined for both pesticides. Traditional way to determine was probit analysis. We fitted Weibul's distribution and compared two pesticides for their toxicity by both the methods[6].

METHODS AND MATERIALS

Experimental organisms i.e. *Mesocyclops leuckarti* were collected from freshwater body (Makhmali lake, Thane) by using net of mesh size 30μm and then cultures in laboratory by phased fertilzation technique. The cultures of these organisms were maintained in glass tank. Adult males and females were taken from this stock culture and were used for LC_{50} experiments (Table -1).

Stock solutions of BHC and Furadan were also prepared in distilled water and dilutions were made as per requirements. Beakers of 50ml capacity containing 40ml pre-fertilized medium of required concentrations of pesticides BHC and Furadan from 0.01ppm to 15ppm were used. For LC_{50} studies experimental organisms were exposed to the above said concentrations for time intervals of 2hrs, 24hrs, 48hrs, 72hrs and 96hrs.

Different concentrations (to which experimental organisms were exposed) were decided on the basis of observations of experiments carried out for determining survival period.Ten adult animals were used for each concentration as well as for each time of exposure and the experiments were carried out in triplicates.

RESULTS AND DISCUSSION

The number of respondents to the pesticides was recorded. Experiments were carried out for different exposure hours namely 2 hours, 24 hours, 48 hours, 72 hours and 96 hours for doses of different concentrations of both pesticides. Percentage mortality was recorded (Table 1).

2 Hours Exposure

On exposure to BHC for two hours no mortality was seen up to 0.06ppm concentration while in Furadan, zero mortality was only up to 0.03ppm. In BHC, 40% mortality was recorded from 5ppm to 8ppm concentration and Furadan, it was at 1ppm to 3ppm. There was a sudden rise in mortality from 12ppm to 13ppm i.e. from 46.33% to 66.33% for BHC while for Furadan, similar rise in mortality was seen from 46.66% at 5ppm to 53.66% at 6ppm concentration.

24 Hours Exposure

In case of BHC, 10% mortality was at 0.01 and 0.02ppm concentrations while in Furadan, 10% mortality was seen from 0.01ppm to 0.03ppm. 46.66% mortality was recorded at 2ppm concentration for BHC and 0.9ppm for Furadan. at 3ppm BHC, there was a sudden rise in mortality up to 60% and for Furadan, the rise was to 56.66% at 1ppm.

48 Hours Exposure

10% mortality was seen from 0.01ppm to 0.03ppm in BHC while for Furadan, at 0.01ppm concentration the mortality was 16.66%. At 0.8ppm 43.33% mortality was seen BHC while in case of Furadan 46.66% mortality was at 1ppm and 2ppm concentrations. For BHC, there was 53.33% mortality at 0.9ppm showing the 50% mortality to be between 0.8 and 0.9ppm doses. On the other hand, sudden rise in mortality from 46.66% yto 60% was seen at 3ppm concentration.

72 Hours Exposure

26.66% mortality was seen at 0.01ppm to 0.03ppm concentrations of BHC while for Furadan, at 0.01ppm only 23.33% mortality was seen. At 0.1ppm concentration of BHC the mortality was 46.66% while at 0.2ppm it went up to 53.33% indicating 50% mortality to be between 0.1ppm to 0.2ppm concentrations. In case of Furadan, 50% mortality was seen at 0.4ppm and 0.5ppm concentrations.

96 Hours Exposure

As high as 40% mortality was seen at 0.01ppm concentration of BHC whereas, for Furadan, it was only 23.33%. In BHC, mortality went to 46.66% at 0.03 and immediately to 53.33% at 0.04ppm concentration. In case of Furadan, at 0.05ppm 46.66% mortality was seen which went up to 53.33% at 0.06ppm.

Weibull distribution was the best fit to this data. Parameters of the distribution were estimated. 95% CI for estimated parameters were also calculated. Three exposure hours were used to carry out statistical analysis. The probability plots (Fig.1), Hazard plots, (Fig.2) and survival plots (Fig.3) were also plotted using Statistical software MINITAB16.

Estimated parameters were written along with the graph. Central line of probability plots represents probability of failures at various doses. Other 2 lines are upper and lower confidence limits for failure probabilities. LC_{50} is that dose at which half of the animals have died. Median of the distribution was used to determine LC_{50}. LC_{50} and 95%CI (Table 2 and Table 3) are determined. The Weibull fits were compared with probit analysis fit (Table 4 and Table 5). Hazard rates at various doses depicted very interesting results. They were decreasing for both pesticides for smaller dose. As the dose was increased they became constant. This behaviour of hazard rates indicated that initially weaker animals did not sustain even a small dose, so they were died. This rate was slowly decreased and attained a stabilized value further, indicating that animals get used with that stabilized dose, hence showed no toxic effect thereafter.

- The fit of three parameter Weibull distribution was good to the data rather than conventional methods like probit analysis.
- LC_{50} was inversely proportional to the exposure hours for both pesticides.
- LC_{50} for FURADAN was greater than that for BHC.
- Hazard rates were decreasing for a low dose for all exposure hours and both pesticides.
- At certain high level of the dose Hazard rates were stabilized for all exposure hours and both pesticides.
- At all exposure hours BHC showed more toxic effect than FURADAN.

CONCLUSION

Application of chemical pesticides should be avoided .In unavoidable circumstances FURADAN is preferred than BHC. For Government/local bodies or Non Government authorities this study would be very much useful , especially for maintaining ecosystem of sweet water resources.

Table - I

Conc. Of Pesticide	Percent mortality at different time intervals									
	BHC					Furadan				
	2 hrs	24 hrs	48 hrs	72 hrs	96 hrs	2 hrs	24 hrs	48 hrs	72 hrs	96 hrs
0.01	0	10	10	26.66	40	0	10	16.66	23.3	23.33
0.02	0	10	10	26.66	40	0	10	20	23.33	40
0.03	0	13.33	10	26.66	46.66	0	10	20	26.66	40
0.04	0	13.33	16.66	36.66	53.33	10	13.33	26.66	26.66	40
0.05	0	13.33	16.66	40	53.33	10	13.33	26.66	36.66	46.66
0.06	0	20	26.66	40	60	10	20	26.66	36.66	53.33
0.07	3.33	20	26.66	43.33	60	16.66	20	26.66	36.66	53.33
0.08	3.33	20	26.66	46.66	60	16.66	20	30	36.66	60
0.09	3.33	20	30	46.66	63.33	16.66	26.66	30	36.66	60
0.1	16.66	20	30	46.66	63.33	20	26.66	30	40	60
0.2	20	26.66	30	53.33	66.66	20	26.66	40	43.33	63.33
0.3	20	26.66	30	53.33	66.66	23.33	26.66	40	46.66	63.33
0.4	20	30	33.33	56.66	66.66	23.33	30	40	50	70
0.5	20	30	33.33	60	66.66	26.66	30	40	50	70
0.6	26.66	30	36.66	60	70	30	43.33	43.33	53.33	70
0.7	26.66	33.33	40	60	70	30	43.33	43.33	56.66	70
0.8	30	33.33	43.33	63.33	70	30	46.66	43.33	56.66	70
0.9	30	36.66	53.33	63.33	73.33	30	46.66	43.33	56.66	76.66
1	30	40	53.33	66.66	73.33	40	56.66	46.66	70	76.66
2	33.33	46.66	53.33	66.66	73.33	40	56.66	46.66	70	76.66
3	33.33	60	53.33	70	73.33	40	56.66	60	70	80
4	36.66	60	56.66	70	73.33	46.66	56.66	60	80	83.33
5	40	60	60	70	73.33	46.66	56.66	60	80	86.66
6	40	63.33	60	76.66	76.66	53.66	66.66	76.66	80	86.66
7	40	63.33	66.66	76.66	76.66	56.66	66.66	76.66	80	86.66
8	40	63.33	66.66	76.66	76.66	60	70	76.66	80	86.66
9	43.33	63.33	66.66	76.66	76.66	60	70	76.66	80	86.66
10	43.33	66.66	66.66	80	80	60	70	80	83.33	86.66
11	43.33	70	76.66	80	86.66	63.33	70	80	83.33	86.66
12	46.33	76.66	76.66	83.66	86.66	70	70	80	83.33	90
13	66.33	76.66	83.33	83.66	86.66	70	80	80	83.33	90
14	66.33	76.66	83.33	83.66	86.66	76.33	80	80	83.33	90
15	66.33	80	83.33	86.66	90	76.33	80	80	86.66	90

Table 2 Comparison of LC_{50} for both methods :BHC pesticide

Exposure hrs	Weibull Distribution			Probit Analysis		
	LC_{50}	Lower 95%CI	Upper 95%CI	LC_{50}	Lower 95%CI	Upper 95%CI
2	4.99854	4.41858	5.65463	11.1718	8.41646	13.9270
24	5.19961	4.74105	5.70251	6.36712	5.16138	7.57286
48	3.24084	2.87420	3.65425	4.82763	3.61332	6.04195
72	1.64402	1.43492	1.88358	0.627322	-1.02723	2.28188
96	1.44362	1.21122	1.72062	--	-5.29472	0.656888

Table 3 Comparison of LC_{50} for both methods: FURADAN pesticide

Exposure hrs	Weibull Distribution			Probit Analysis		
	LC_{50}	Lower 95%CI	Upper 95%CI	LC_{50}	Lower 95%CI	Upper 95%CI
2	4.66225	4.17218	5.20988	7.37328	6.01741	8.72914
24	3.46020	3.04201	3.93588	5.28761	3.89935	6.67587
48	2.12544	1.76737	2.55605	4.53750	3.10616	5.96885
72	1.41773	1.19217	1.68597	2.07107	0.712457	3.42969
96	1.19017	1.04137	1.36024	--	-2.96599	0.628353

Table 4

Exposure hrs	Chi-Squre Weibull	D.f	P value	Chi-Squre Probit	D.f	P value
2	6.53043	9	0.686	9.7702	9	0.369
24	12.6875	13	0.472	19.1527	13	0.118
48	3.28362	12	0.993	14.7166	12	0.257
72	2.20229	13	1.000	14.6463	13	0.330
96	3.77794	10	0.957	8.19754	10	0.610

Table 5

Exposure hrs	Chi-Squre Weibull	D.f	P value	Chi-Squre Probit	D.f	P value
2	2.53709	11	0.996	5.62035	11	0.897
24	2.50267	10	0.991	21.5833	10	0.017
48	2.03382	8	0.980	.5591	8	0.228
72	2.20229	13	1.000	15.2824	13	0.17010
96	3.22743	10	0.976	27.5728	10	0.002

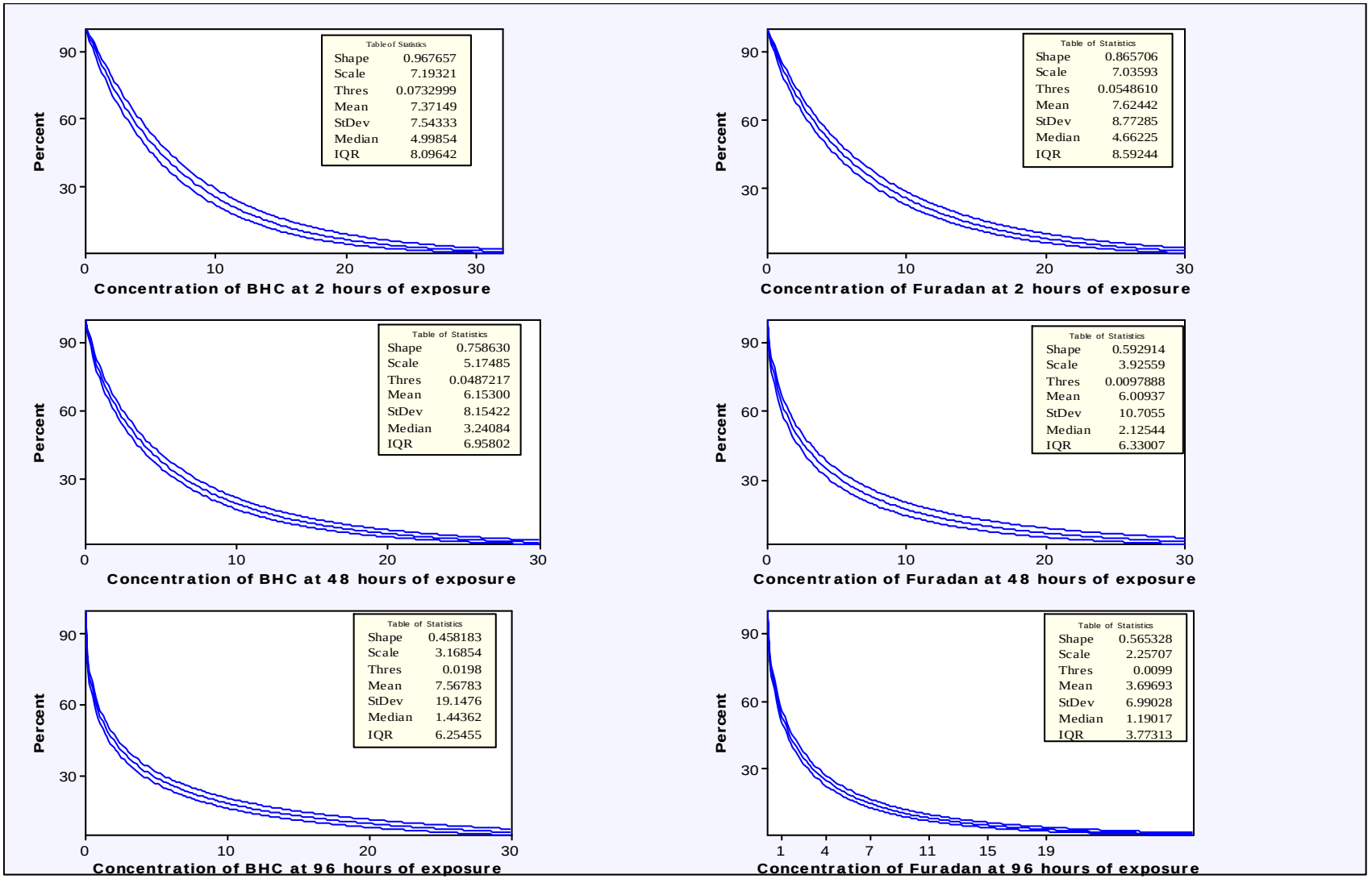

Fig 1: Probability Plot for Failuers of *Mesocyclops Leuckarti* and 95% CI

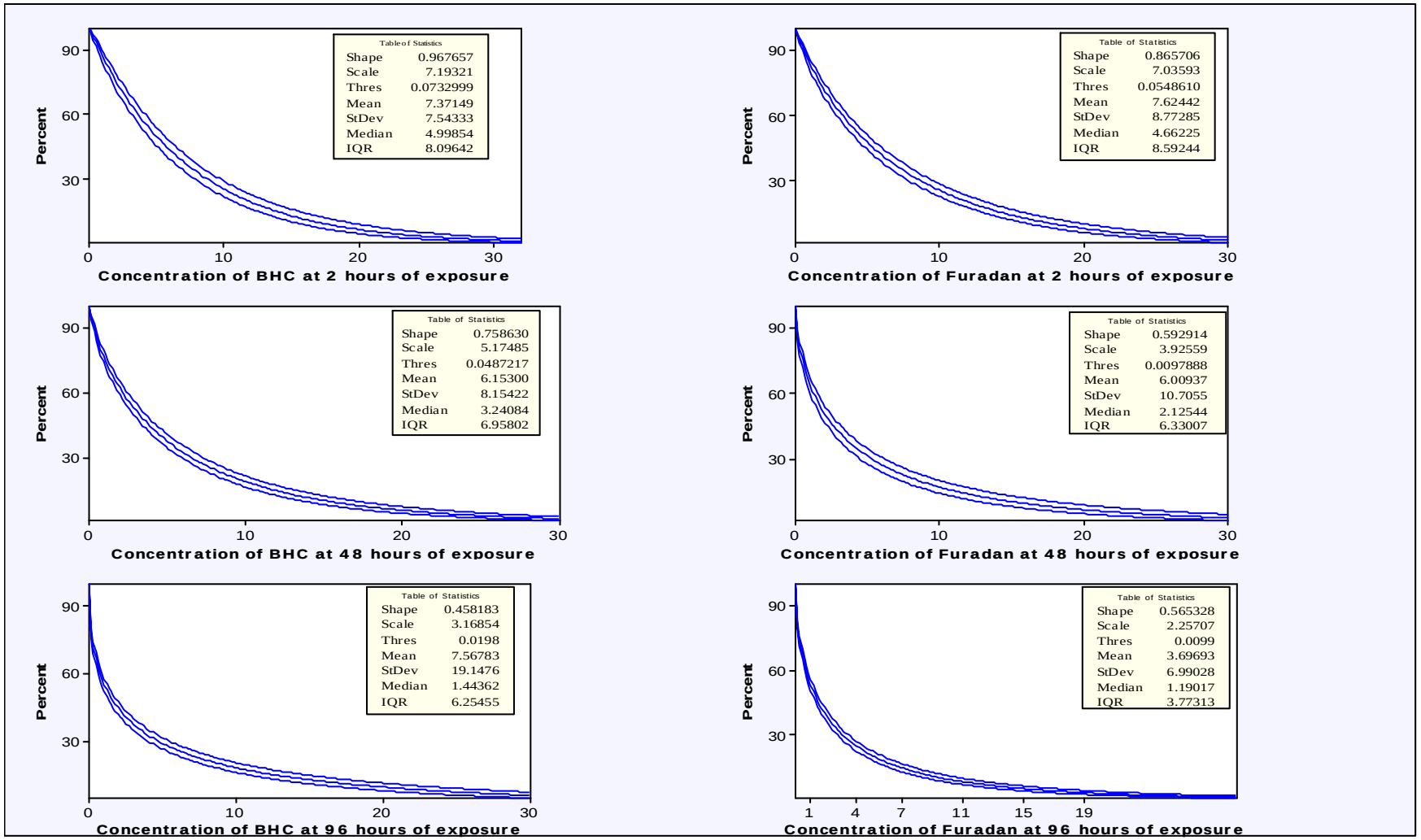

Fig2:Survival Plot for Mesocyclops Leuckarpii. 95% CI

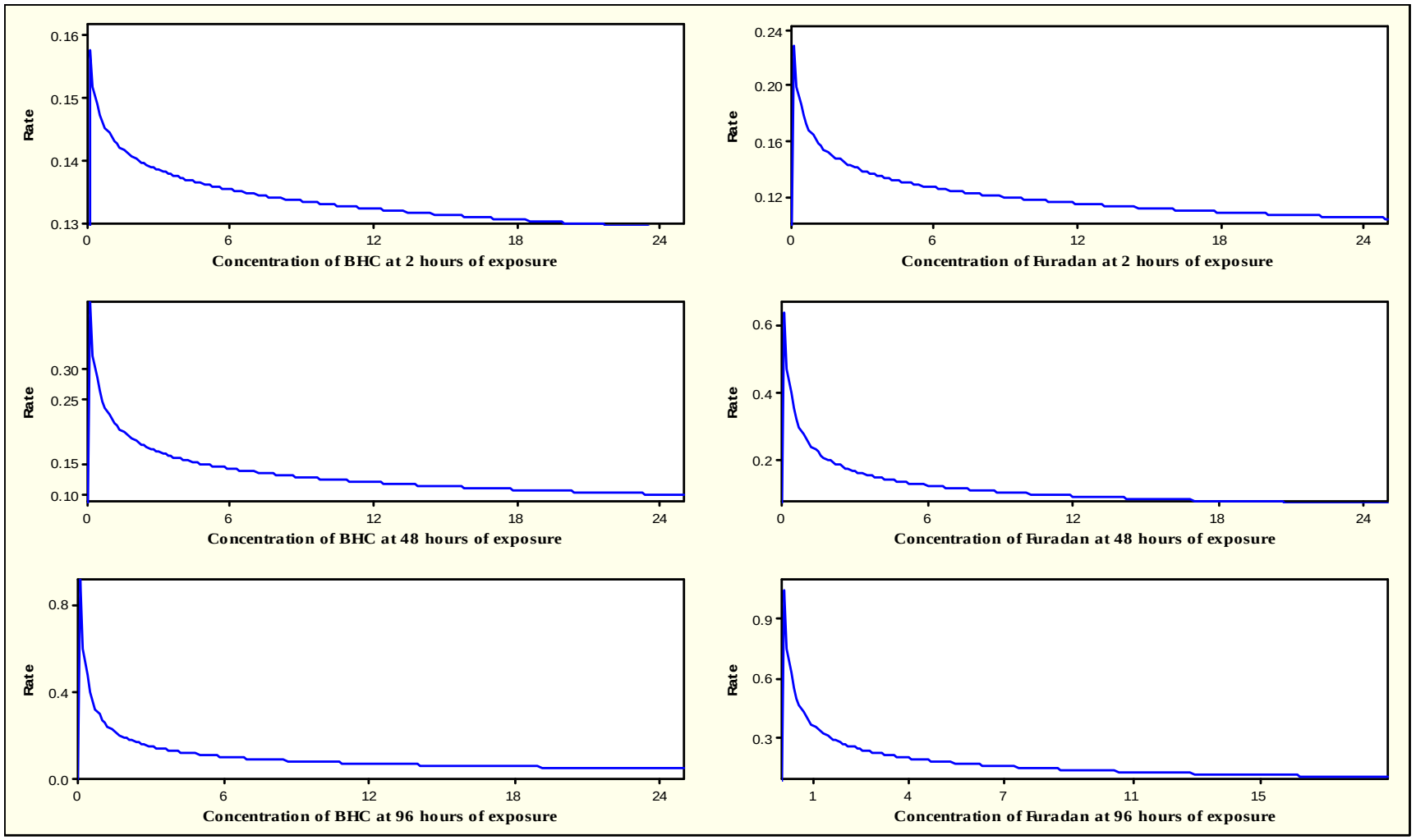

Fig 3: Hazard Plot for Mesocyclops Leuckarpii

ACKNOWLEDGEMENT
Authors are very much grateful to the Principals of B. N. Bandodkar college for providing laboratory facilities and other aids in doing all research work related to this paper. Further authors have declared no conflict of interest of any type.

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