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Research Paper

Toxic Effect of Organophosphate, Pyrethroids and Organochlorine Pesticides on *Spirulina Platensis* Growth Rate

Environment

KEYWORDS : *Spirulina platensis,* pesticides, toxic, pollution, LOEC, NOEC

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ABSTRACT

Spirulina platensis, a blue green algae of aquatic ecosystem has economic importance for therapeutic purpose. To raise productivity of agricultural crops increased usage of pesticides causing environmental pollution. In this study, toxic effect of five pesticides such as chlorpyrifos, dimethoate, cypermethrin, lambda-cyhalothrin and benzene-hexa-chloride were tested on Spirulina platensis . At the concentration of (0.5, 1, 5, 10 and 15 ppm) growth rate was observed for each pesticide and compared with control. No Observed Effect Concentration (NOEC) of chlorpyrifos and dimethoate were 0.5 ppm, Lowest Observed Effect Concentration (LOEC) was 1 ppm and Maximum Acceptable Toxic Concentration (MATC) was 0.707 ppm. Benzene-hexa-chloride and lambda-cyhalothrin did not show significant values for NOEC and LOEC at treated concentrations. NOEC, LOEC and MATC values for cypermethrin were respectively 5 ppm, 10 ppm and 7.07 ppm. The absence of algae from water can be used as a bio-indicator, where pesticides are above toxic level.

INTRODUCTION

Cyanobacterium *Spirulina platensis*, with high nutritional value like protein, carbohydrates, essential fatty acids, Vitamins, minerals, carotenes, chlorophyll *a* and phycocyanin used as a food supplement for humans and animals. Due to nutritional, ecological and economic properties *Spirulina platensis* has been the area of research. Its production mainly depends on culture conditions provided to it **(Ciferri, 1983; Ali and Saleh, 2012)**.

Pesticides are widely used in agricultural areas to improve crop productivity. Their application caused serious environmental problem mainly in aquatic environment and toxic to non target organisms present in aquatic ecosystem. Pesticides such as organochlorine (benzene hexa chloride), Organophosphorous (chlorpyrifos and dimethoate) and pyrethroids (cypermethrin and lambda-cyhalothrin) are used to control wide range of pests. Different studies reported that pesticides are toxic to algae **(Ware, 1983; Aktar et al.,2009)**.

A large use of pesticides in the agricultural field has contaminated water bodies of the ecosystem. The toxic concentration of pesticides is ultimately affecting flora and fauna of aquatic environment. *Spirulina platensis,* blue green algae has economic significance for therapeutic purpose.

In the present study *Spirulina pletensis* culture was selected to estimate the toxicological effect of pesticides (chliorpyrifos, benzene hexa chloride, cypermethrin, dimethoate and lembda-cyhalothrin) on it. NOEC, LOEC and MATC was calculated .The concentration of pesticides should be used at a level to protect these primary producers which play an important role in food chain, manage this ecosystem and protect environment for all creature.

MATERIALS AND METHODS

Experimental model

The strain of *Spirulina platensis* was obtained from department of Biotechnology, Jiwaji University, Gwalior (M.P.) India. The culture was maintained in Zarrouk's medium **(Zarrouk, 1966)** in culture room at 30°C and illuminated fluorescent tubes light (50 µmol/m^2 sec^2 at surface of the vessels with 12/12 dark–light rhythm).

Prepration of culture medium for pesticides exposure

Spirulina was grown in the Zarrouk's medium (ZM) and $NaHCO_3$ was added after autoclaving and pH was adjusted to 9 with 1N NaOH. *Spirulina platensis* was cultured in five different concentrations (0.5, 1, 5, 10 and 15 ppm) of each pesticide (chlorpyrifos, benzene hexa chloride, dimethoate, cypermetrin and lambda-cyhalothrin). Each treatment contained three replicate flasks including control.

Incubation and maintenance of the culture

The culture of *Spirulina platensis* was incubated and maintained in a culture room and Sample flasks were shaken twice a day manually during the course of the experiments.

The growth rate in the culture media was monitored by measuring an increase in carbohydrate, chlorophyll-a content and protein content in the presence of different pesticide concentrations. The specific growth rate (μh^{-1}) was calculated by following formula **(Guillard, 1973)**:

$\mu = \log (N_2/N_1) \times (2.303/t)$

Where, $t = T_2 - T_1$,

N_1 initial optical density at time T_1,

N_2 final optical density at time T_2.

NOEC (No Observed Effective Concentration), LOEC (Lowest Observed Effective Concentration) and MATC (Maximum Acceptable Toxicity Concentration) values were estimated at 96h when compared to controls **(Suter, 1990)**.

Obtained data were analyzed with statistical method ANOVA to obtain significant changes in growth rate at different pesticides concentrations when compared to control, with statistical analysis software (Minitab 15 for windows). The significance of differences between mean values was determined by paired t-test at Confidence level of 95 % and p value 0.05 was preferred.

RESULTS AND DISCUSSION

As shown in Figure 1 and Table 1; the initial exposure of chloropyrifos and dimethoate did not affect *S.platensis.* After 96 hours, specific growth rate of algal cells were reduced above 0.5 ppm on exposure to chlorpyrifos and dimethoate. Chlorpyrifos concentrations of 1 and 5 ppm significantly ($p< 0.05$) reduced the growth rate and above 5 ppm growth was almost inhibited. Similarly, the significant ($p< 0.05$) reduction in growth rate was observed at 1, 5 and 10 ppm of Dimethoate concentrations. For chlorpyrifos and dimethoate no observed effect concentration (NOEC) were estimated 0.5 ppm and lowest observed effect concentration (LOEC) were 1 ppm.

The alga was treated with cypermethrin concentrations; initially there is no significant ($p<0.05$) chance in specific growth rate at 0.5, 1 and 5 ppm. Specific growth rate of *Spirulina platensis* was significantly reduced at the 10 ppm. An estimation of NOEC and LOEC were 5 ppm and 10 ppm respectively.

When tested with benzene hexa chloride and lambda-cyhalo-

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thrin pesticides there was no significant ($p<0.05$) reduction in specific growth rate. Toxic concentrations 0.05, 1, 5, 10 and 15 ppm did not show toxicity on specific growth rate of algal population when compared to control.

MATC (Maximum Acceptable Toxicity Concentration) was calculated with the help of LOEC and NOEC values for each pesticide. The estimated MATC for chlorpyrifos and dimethoate were 0.707 ppm. MATC value for cypermethrin was observed 7.07 ppm. In this way pesticides concentration were taken to estimate toxic value for *Spirulina platensis*.

Table 1. Specific growth rate of *Spirulina platensis* at different concentrations of pesticides

	Chlorpyrifos	Dimethoate	Cypermethrin	Lambda-Cyhalothrin	Benzene Hexa Chloride
Conc.(ppm)	Specific growth rate (day $^{-1}$)				
Control	0.137 ± 0.011	0.158 ± 0.010	0.133 ± 0.010	0.138 ± 0.011	0.143 ± 0.014
0.5	0.145 ± 0.010	0.150 ± 0.013	0.138 ± 0.003	0.134 ± 0.010	0.154 ± 0.008
1	0.114 ± 0.010*	0.109 ± 0.012*	0.136 ± 0.011	0.143 ± 0.011	0.148 ± 0.011
5	0.031 ± 0.004*	0.093 ± 0.007*	0.143 ± 0.009	0.151 ± 0.011	0.152 ± 0.006
10	-	0.089 ± 0.014*	0.104 ± 0.007*	0.140 ± 0.011	0.142 ± 0.006
15	-	0.078 ± 0.002*	0.088 ± 0.003*	0.135 ± 0.002	0.147 ± 0.002

Note: All values are means ± SD, where n=3

*significantly different with control ($p<0.05$)

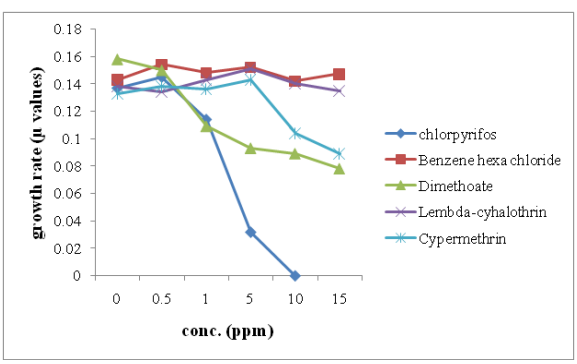

Figure 1. *Spirulina platensis,* specific growth rate curve for different concentrations of pesticides (96 h).

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