Synergistic and antagonistic response of insecticide combinations on *Hapalosiphon stuhlmanii* (Cyanobacteria)

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Abstract

Synergistic and antagonistic response of insecticide combination Endosulphan and Methylparathion was studied by inspecting fresh weight and Chl-a concentration of *H. stuhlmanii.* Increasing concentrations of insecticides showed the antagonistic effect on the growth of alga.

KEYWORDS: Cyanobacteria, insecticides, interaction, Growth.

Introduction:

Cyanobacteria, a group of prokaryotic, oxygen-evolving, photosynthetic Gram-negative bacteria, survive in a wide variety of extreme environmental conditions. Most paddy soils have a natural population of cyanobacteria which provides a potential source of nitrogen fixation at no or low cost. These cyanobacteria are exposed to pesticides which are vital to the current agricultural practice. However, the use of these pesticides over the years has resulted in problems caused by their interactions with the biological systems in the environment and has toxic effects on cyanobacteria.

Many species are capable of not only surviving, but thriving in conditions previously thought to be inhabitable, tolerating desiccation, high temperatures, extreme pH, high salinity and pesticides illustrating their capacity to acclimate to extreme environments**.** Use of agrochemicals like pesticide and insecticides has become an integral part of the present day agriculture. Array of them are used to save the crops from pest damage but very little is known about their effect on non-target microorganisms like cyanobacteria. Although some strains of algae have been used to study the effect of herbicides and pesticides on them (Tomisck *et al*., 1957; Pillay and Tochan, 1970; Inger, 1970; Venkataraman and Rajalakshmi, 1971 a and b; Ahmad *et al.*, 1973; Singh, 1973; Hendrich *et al.*, 1976; Giriyappanavar, 2013).

However, there is little information available on the effect of these pesticides on algal communities (Abou-Waly *et al.*, 1991) and the susceptibility of cyanobacteria to toxicants such as herbicides, fungicides and heavy metals (Ferrando *et al.,* 1996). Present study is aimed to elucidate the differential effect of two pesticides on *H. stuhlmanii* treated with different concentrations of the pesticides and observed for changes in their Growth rates.

Materials and Methods:

Methods of isolation and culture of *H. stuhlmanii* is same as already have been described (Giriyappanavar and Bharati, 1989). The insecticides Endosulphan from the Scientific fertilizers Co. (P) Ltd. Coimbatore India; Methylparathion from the Bayer

(India) Ltd., Bombay were used. The stock solutions of insecticides were prepared in sterilized distilled water. From this stock solution, different concentrations were prepared. 10 ml of the algal suspension was inoculated in the medium (i.e. Allen and Arnon medium) that contained the graded concentrations of insecticides. Growth of algal strains was measured in terms of gms/10ml wet weight, on every seventh day and optical density on every eighth day. The cultures were maintained for 28 days under 28±2°C and illumination (2000 lux)

Results and discussion:

It is observed from the table-1 that individual treatment of Endosulphan on the percent fresh weight of *H. stuhlmanii* indicates that at 0.0001 ppm the weight increases considerably on the 7th day and suddenly decrease towards the 28th day. At other concentrations the effect is not well marked, although at 0.1 ppm there appears to be gradual decrease in the percent fresh weight.

Methylparathion also plays a similar role on the percent fresh weight of the alga and on 28th day it reduces from 0.0001 to 0.1 ppm. Significant growth is observed on 14th day at 0.1 ppm only (Table-1).

The interaction of both insecticides on the percent fresh weight of this alga indicates a synergistic effect on the 7th day except at 0.1 ppm and an antagonistic effect at 0.1 ppm. On the contrary the effect is antagonistic from 0.0001 to 0.01 ppm on the 14th day which becomes synergistic at 0.1 ppm. Only additive effect is observed at 0.01 ppm on the 21st day, while on the 28th day it is partially synergistic, partially antagonistic.

In general synergistic effect is greater on the 7th day as it gradually turns to antagonistic effect from 14th day to 28th day on the percent fresh weight of *H. stuhlmanii*

The effect of endosulphan on the Chl-a content of *H. stuhlmanii* is given in the table-2 it is evident that on the 7th day has a constant effect which is also true to the treatment of Methylparathion on the 7th day where the Chl-a content does not change much. At all concentrations of both Endosulphan and Methylparathion treated individually the Chl-a content does not vary much. There is approximately a similar effect at all other concentrations throughout the experiment.

The observation is supported when both the insecticides applied simultaneously on percent Chl-a content of *H. stuhlmanii.* From table-2 it may be said that except at 0.01 ppm on the 21st day and 0.0001 ppm on the 28th day where the effect is synergistic, all other concentrations from the 7th to 28th day are antagonistic.

Therefore Endosulphan and Methylparathion interact to produce an antagonistic effect on the percent Chl-a content of *H. stuhlmanii.*

Conclusion:

However, the effect of pesticides on the populations of nitrogen-fixing cyanobacteria in rice fields also depends on pesticide concentrations, and the water regimes of flooding or non-flooding associated with paddy rice fields. Effects of Endosulphan and Methylparathion on the non target microbes like *H. stuhlmanii* are found to be devastating and may lead to shrink the nitrogen fixation and its availability to commercial crops resulting in stumpy yield.

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TABLE-1

Effect of two insecticides on the Chl-a of *H. stuhlmanii* (ugl^{-1})

Days	7th day	14th day	21st day	28th day
CONTROL	**0.100**	**0.130**	**0.155**	**0.245**
Conc.(ppm)				
Endosulfan				
0.0001	900	098	094	046
0.001	103	123	110	120
0.01	118	083	104	067
0.1	117	111	121	080
Methylparathion				
0.0001	108	120	144	094
0.001	970	084	117	071
0.01	109	127	135	071
0.1	108	638	613	359
Endosulfan + Methylparathion				
0.0001	113	129	152	095
0.001	107	109	108	069
0.01	120	132	140	094
0.1	970	086	068	049

Interaction of insecticides on the Chl-a of *H. stuhlmanii* (ugl^{-1})

Days	Concentration (ppm)	Observed values (%)	Expected values (%)	Difference
	0.0001	113	972	+859
	0.001	107	999	+892
7th day	0.01	120	129	+09
	0.1	970	126	-844
	0.0001	129	118	-11
	0.001	109	103	-06
14th day	0.01	132	105	-27
	0.1	086	708	+622
	0.0001	152	135	-17
	0.001	108	129	+21
21st day	0.01	140	140	0
	0.1	068	742	+674
	0.0001	095	043	-52
	0.001	069	085	+16
28th day	0.01	094	048	-46
	0.1	049	295	+246

All values are expressed as percent of control.

TABLE-2

Effect of two insecticides on the Chl-a of *H. stuhlmanii* (ugl^{-1})

Days	7th day	14th day	21st day	28th day
CONTROL	0.287	0.462	0.714	1.358
Conc.(ppm)				
Endosulfan				
0.0001	054	085	123	118
0.001	066	100	106	126
0.01	044	062	117	087
0.1	066	077	084	064
Methylparathion				
0.0001	044	123	117	126
0.001	044	092	100	083
0.01	044	108	140	096
0.1	010	027	031	039
Endosulfan + Methylparathion				
0.0001	054	139	152	039
0.001	066	108	112	114
0.01	054	139	140	104
0.1	022	027	036	096

Interaction of insecticides on the Chl-a of *H. stuhlmanii* (ugl^{-1})

Days	Concentration (ppm)	Observed values (%)	Expected values (%)	Difference
7th day	0.0001	057	024	-30
	0.001	066	029	-37
	0.01	054	019	-35
	0.1	022	07	-15
14th day	0.0001	139	105	-34
	0.001	108	092	-16
	0.01	139	067	-72
	0.1	027	021	-06
21st day	0.0001	152	144	-08
	0.001	112	106	-06
	0.01	140	164	+24
	0.1	036	026	-10
28th day	0.0001	039	149	+110
	0.001	114	105	-09
	0.01	104	084	-20
	0.1	096	025	-71

All values are expressed as percent of control.