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COMPATIBILITY AND TOLERANCE OF *CYLINDROSPERMUM MUSICOLA* AND *CALOTHRIX MARCHICA* TO ENDOTAF, AN ORGANOCHLORINE PESTICIDE

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ABSTRACT:

The present investigation deals with the total nitrogen (%) fixed by two soil blue-green algae, *Cylindrospermum musicola* and *Calothrix marchica* at different concentrations of organochlorine pesticide, Endotaf. Total nitrogen fixed by studied blue-green algae at each concentration of Endotaf pesticide after 28 days of harvesting was estimated by conventional Micro- kjeldahl method. The results indicated a progressive decrease in the total nitrogen fixed by *Calothrix marchica* and *Cylindrospermum musicola* with the increasing concentrations of organochlorine, Endotaf pesticide. Furthermore, *Calothrix marchica* was emerged as most compatible and tolerant blue-green alga to the increasing Endotaf pesticide doses. On the other hand *Cylindrospermum musicola* was found to be highly susceptible as even at 2.5 ppm of Endotaf. At this concentration, 29.75% reduction in total nitrogen content was recorded over the untreated control in *Cylindrospermum musicola*. Further increase in Endotaf pesticide concentration i.e. from 250 ppm resulted into ceasing of growth and nitrogen fixation in the tested blue-green alga *Cylindrospermum musicola*. However nitrogen fixation of studied blue-green algae also increased at the lower doses of organochlorine pesticide, Endotaf upto 5 ppm. It was concluded that caution should be taken to determine the appropriate application dosage of these agro-pesticides before applying them into the crop fields. Since, it is essential to screen efficient blue-green algal strains those are capable of growing and fixing nitrogen at higher rate even in presence of recommended doses of the agrochemicals including pesticides, before their inoculation into the field.

Key words: -*Calothrix marchica*, Compatible, Tolerant *Cylindrospermum musicola*, Susceptible, Organochlorine pesticide, Endota

INTRODUCTION:

The present day global interest in biological nitrogen fixation is a direct consequence of biofertilizer particularly blue-green algae. It has been proved as the most efficient source of organic nitrogen. The blue-green algal contribution largely depends upon their establishment under field conditions and their growth and nitrogen fixing potential. These photosynthetic blue-green algae make a valuable contribution to the nitrogenous soil fertility by fixing atmospheric in the process of "Biological nitrogen fixation" (Tiwari *et al.*, 2005). The blue-green algae (cyanobacteria) contain nitrogenase and fix atmospheric nitrogen for which these are used as biofertilizer to maintain and improve soil status (Ahmed, 2001). They have tremendous potential in environmental management as soil conditioner, biofertilizer, biomonitors of soil fertility, water quality, feed for animals and protein supplements (Whitton and Pots, 2000).In agriculture, introduction of fertilizer responsive crop varieties has necessitated the use of enormous amounts of pesticides during production and storage. Agrochemicals are becomes indispensable for life systems and their number has grown phenomenally in recent times. Many chlorinated and organophosphorus pesticides, which are not readily soluble in water, are emulsified. These are dispersed in water as fine particles that are

attracted to surfaces. This affinity results in their accumulation through adsorption on to the surface of living organisms (Venkataraman *et al.*, 1994). The structure of food chain is influenced by the contaminants present in the medium. Along the food chain these compounds biomagnify and cause serious health hazards in livestocks and humans. One of the problem that has been noticed under field conditions is the destruction of blue-green algal populations by pesticide application intended to control the insects and pests of the various agricultural crops. These agrochemicals also damage wide variety of beneficial microorganisms because of their long persistence in the environment (Padhy, 1985). Therefore, pesticides used in routine applications in crop fields have important ecological effects in addition to those usually intended. Owing to this issue, the present investigation was carried on influence of oragnochlorine pesticide, Endotaf on the nitrogen fixation of two blue-green algae *Cylindrospermum musicola* and *Calothrix marchica* isolated from agro-practices areas of Kopargaon tahsil, Maharashtra state.

MATERIALS AND METHODS:

The effect of commercial grade pesticide, Endotaf (endosulfan, 35%) (Rallis India Ltd.) belonging to organochlorine group was studied on the nitrogen fixation of soil blue-green algae *Cylindrospermum musicola* and *Calothrix marchica*. Organochlorine, Endotaf attacks on central nervous system and make interference in α-amino butyric acid receptor activity of the pest. The pesticide application rate recommended to control various crop pests is 0.7 liter/ ha for endosulfan (Endotaf) which will provide a range of 5- 10 ppm in the agricultural crop field. Stock solution of this pesticide was prepared freshly for experiments in the sterilized medium and added to the BG-11culture medium (Rippka *et al.,* 1979) to obtain the desired pesticide concentrations of 2.5, 5, 10, 20, 50, 100, 250 and 500 ppm. The pH of the medium was adjusted to 7.5. After addition of nutrient solution to the culture, samples were agitated to ensure uniform distribution of the pesticide.

Experiments were conducted by inoculating equal amounts of actively growing unialgal isolates of *Cylindrospermum musicola* and *Calothrix marchica* into cotton stopered conical flasks. For each treatment, triplicates were set up and incubated at 28±2^0 C under 16/ 8 hours light/ dark cycles with 2- 5 K Lux light intensity from white fluorescent tubes. Total nitrogen fixed by the each blue-green alga after 28 days at each concentration of Endotaf pesticide was estimated by conventional Micro-kjeldahl distillation method in the laboratory cultures.

RESULTS:

The pragmatic results regarding nitrogen fixed by *Cylindrospermum musicola* and *Calothrix marchica* at various dose level of studied organochlorine pesticide, Endotaf in laboratory cultures were depicted in Table- 1; Fig. 1 and was proved statistically significant. The results obtained during the present investigation revealed that, the blue-green alga *Calothrix marchica* was emerged as most compatible and tolerant to the increasing doses of Endotaf pesticide. To the contrary, *Cylindrospermum musicola* was found to be the highly susceptible as even at 5 ppm of Endotaf. At this concentration, 29.75% reduction in total nitrogen content was recorded over the untreated control in *Cylindrospermum musicola.*

Furthermore, total nitrogen content was consistently decreased with the increasing

concentrations of Endotaf pesticide over the control from 20 ppm of Endotaf in *Calothrix marchica*. At the highest concentration i.e. 500 ppm of Endotaf, 96.0% reduction in total nitrogen content was observed in *Calothrix marchica* than the untreated control.

On the other hand, nitrogen fixation by *Cylindrospermum musicola* was consistently decreased from 5 ppm of Endotaf pesticide over the control. Even at 100 ppm concentration of Endotaf, nitrogen fixation was reduced by 95.6% in *Cylindrospermum musicola* as compared to the control. Further increase in Endotaf pesticide concentration i.e. from 250 ppm resulted into ceasing of growth and nitrogen fixation in the tested blue-green alga *Cylindrospermum musicola*. (Table-1; Fig. 1)

DISCUSSION:

From the experimental results in general it was seen that, higher levels of pesticide application i.e. even 10 ppm of Endotaf adversely affected the occurrence and survivability of *Cylindrospermum musicola* and *Calothrix marchica* in the laboratory culture which are responsible for nitrogen fixation. Of which *Cylindrospermum musicola* was found to be the highly susceptible as even at 5 ppm of Endotaf. This finding is supported by Singh (1973) who reported *Cylindropermum* sp. severely affected by the Benzene Hexachloride, Lindane, Diazinon and Endrin pesticides and Satyendrakumar *et al.* (2000).

However, nitrogen fixation in studied blue-green algae was also increased at the 2.5 ppm and upto 5 ppm concentration of organochlorine, Endotaf pesticide respectively. These findings are coincides with the reports of earlier workers; Furadan, Kar and Singh (1978); Sevin, Adhikary *et al.* (1984)[32]; organo-chlorine, Pattnaik and Prakash Rao (1982);Monocrotophos and Butachlor, Sharma and Singh (2006); Rogor, Das (2008).

The reduction in total nitrogen content of the pesticide-adapted blue-green algal strains may occurred due to the inhibition of some stage(s) during the process of nitrogen fixation in the presence of higher concentrations of pesticides. Further stimulatory effect of Endotaf at lower concentrations on nitrogen fixation by blue-green algae under culture conditions may be due to the presence of nutrients in media that minimizes the toxicity of Endotaf (Kar and Singh, 1978; Sharama and Gaur, 1981).

Further it was accomplished that at the recommended doses of field application, the organochlorine, Endotaf pesticide had no deleterious effect on nitrogen fixation of *Cylindrospermum musicola* and *Calothrix marchica*. This finding was supported by the reports of Isalam *et al.* (2007) and Sardeshpande and Goyal (1982) on the subject of pesticidal effect on nitrogen fixation efficiency of blue-green algae.

CONCLUSIONS:

In general, tolerance and compatibility regarding nitrogen fixation exhibited by the tested blue-green algae to the organochlorine pesticide, Endotaf was found to be in the order of *Cylindrospermum musicola* > *Calothrix marchica.* Caution should be taken to determine the appropriate application dosage of these agro-pesticides before applying them into the crop fields. Since, it is essential to screen efficient cyanobacterial strains those are capable of growing and fixing nitrogen at higher rate even in presence of recommended doses of the agrochemicals including pesticides, before their inoculation into the field.

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REFERENCES:

Tiwari, O.N., Singh, B.V., Mishra, U., Singh, A.K., Dhar, D.W. and Singh, P.K. (2005). Distribution and physiological characterization of cyanobacteria isolated from arid zones of Rajasthan. *Tropical Ecology,* 46(2): 165-171.

Ahmed, S.U. (2001). Nitrogen fixing potential of cyanobacteria isolated from rice field soils of Nagaon sub- division Assam. *Phykos,* 40(1 and 2): 53-59.

Whitton, B.A. and Potts, M. (2000). The Ecology of Cyanobacteria, Pub. Kluwer Acad. Pub, Netherlands.

Venkataraman, L.V., krishnakumari, M.K. and Suvarnalatha, G. (1994). Algae as a tool for biomonitoring and abatement of pesticide pollution in aquatic system. *Phykos,* 33(1 and 2): 171-193.

Padhy, R.N. (1985). Cyanobacteria and pesticides. *Residue reviews,* 95: 1-44.

Rippka, R., Derulles, J., Waterburry, J., Herdman, M. and Stanier, R. (1979). Genetic assessments, strain histories and properties of pure cultures of Cyanobacteria. *J. Gen. Microl.*, 111: 1-61.

Singh, P.K. (1973). Effects of pesticide on blue green algae. *Arch Mikrobiol.* 89**:** 317-320.

Satyendra Kumar, Jetley, U.K. and Tanseem Fatma. (2000). Tolerance of *Spirulina platensis* and *Anabaena* sp. to endosulfan, an organochlorine pesticide. *Annals of Plant Physiology*, 17(5): 45-52.

Kar, S. and Singh, P.K. (1978). Toxicity of carbofuran to blue-green alga *Nostoc muscorum.* Bull Environ. *Contam. Toxicol.*, 20(5): 707-714.

Adhikary, S.P., Dash, P. and Pattnaik, H. (1984). Effect of the carbamate insecticide Sevin on *Anabaena* sp. and *Westiellopsis prolifica. Acta Microbiol.*, 31(4): 335-338.

Pattnaik, H. and Prakash Rao, M. (1982). Effect of pesticides on growth and nitrogen fixation of blue-green algae. In *Proceedings of a National Symposium on Biological Nitrogen Fixation*, New Delhi. Page 670.

Sharma, S.G. and Singh, S.P. (2006). Effect of monocrotophos and butachlor on N-fixing cyanobacteria and associated biochemical activities. *Ann. of Plt Prot. Sci.*, 14(1): 78-85.

Das, M.K. (2008). Differential response of cyanobacteria to an organo-phosphate pesticide, rogor (dimethoate 30 Ec). *Nature Environment and pollution technology*, 7(1): 55-61.

Kar, S. and Singh, P.K. (1978). Toxicity of carbofuran to blue-green alga *Nostoc muscorum.* Bull Environ. *Contam. Toxicol.*, 20(5): 707-714.

Sharma, V.K. and Gaur, Y.S. (1981). Nitrogen fixation by pesticide-adapted strains of paddy field cyanophytes. *Intl. J. Ecol. Env. Sci.*, 7: 117-122.

Islam, M.Z., Begum, S., Ara, H. and Waliullah, T.M. (2007). Effect of furadan on the growth and nitrogen fixation by blue green algae. *J. Bio-sci.*, 15: 23- 35.

Sardeshpande, J.S. and Goyal, S.K. (1982). Effect of insecticides on the growth

and nitrogen fixation by blue green algae. In: *Proc. of National symposium.*

Table 1: Total nitrogen (%) fixed by *Cylindrospermum musicola* and *Calothrix marchica* at different concentrations of Endotaf pesticide. (Harvested after 28 days of incubation)

Concentrations of Endotaf pesticide (ppm)	**Total Nitrogen (%) fixed by *Cylindrospermum musicola***	**percent increase (+) or decrease (-) as compared to Control**	**Total Nitrogen (%) fixed by *Calothrix marchica***	**percent increase (+) or decrease (-) as compared to Control**
0.00 (Control)	4.64		4.24	
2.5	4.74	+2.1	4.42	+4.2
5	3.26	-29.7	4.31	+1.6
10	2.42	-47.8	3.94	-7.0
20	1.92	-58.6	3.10	-26.8
50	1.00	-78.4	2.76	-34.9
100	0.20	-95.6	1.82	-57.0
250	--	--	1.00	-76.4
500	--	--	0.17	-96.0

Fig. 1: Tolerance of *Cylindrospermum musicola* and *Calothrix marchica* to Endotaf pesticide.