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NON-TARGET EFFECT OF MALATHION AND 2, 4-D ON TEA-GARDEN SOIL ALGAE

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ABSTRACT

In agricultural fields during the past few decades, pesticides have been used frenziedly though it is not an appropriate measure of sustainable practice. Microalgae easily become the first, in the list of non target organisms that are affected by pesticides. The present investigation deals with the studies on the effects of selected pesticides - Malathion and 2, 4-D on algae from the Tea Garden soils. Malathion is an organophosphate insecticide and 2, 4-D (Dichlorophenoxy acetic acid) is a herbicide which are commonly used for agricultural protection in our country. In control, total 29 algal species were observed, out of which 16 belongs to Cyanophyceae, 9 Chlorophyceae and 4 Bacillariophyceae. The tested concentrations of pesticides were 50, 100, 200, 400 and 600 ppm. Among the two pesticides Malathion is found to be more toxic then 2, 4-D. The toxic level of Malathion is higher in Bacillariophyceae than Chlorophyceae followed by Cyanophyceae. In case of 2, 4-D the Bacillariophyceae shows the same trend but Cyanophyceae is more toxic than Chlorophyceae. In this observation *Lyngbya limnetica* and *Chlorella vulgaris* were appeared as most tolerant species for both the pesticides. On the other hand *Aulosira fertilissima, Calothrix marchica, Oedogonium gracillus, Closterium diane, Fragillaria brevistrata* and *Tabelaria fenestrata* were found to be very sensitive to both the pesticides.

KEY WORDS : Microalgae, Tea-garden soil, Malathion, 2, 4-D, toxic level

INTRODUCTION

The loss of yields from agricultural production due to the presence of pests has been treated over the years with synthetic pesticides, but the use of these substances negatively affects the environment and presents health risks for consumers and soil organisms (Albarto and Costa, 2019). The agrochemicals use in agricultural field affects the dynamic equilibrium of soils (Padhy and Rath, 2015), by eliminating a part of non-target useful soil flora and fauna (Galhano *et al.*, 2011).

Since the start of global 'green revolution' in 1960s, commercial agriculture pursues the use of high-yielding varieties of crops, which need constant input of agrochemicals such as chemical fertilizers, pesticides and organic fertilizers. In soil, many algae contribute greatly to the nitrogen economy and add the availability of crop nutrients and ensuring the better crop nutrient management (Manjunath *et al.*, 2016). They help in improving the soil structure and amend the chemical nature of soil which forms a rapidly multiplying cover crop of microscopic plants. Algal crusts on soil surface add organic matter, reduce evaporation from soil surface, and remove compaction.

Studies on the interaction of algal flora with agrochemicals have been widely conducted. Some remarkable contributions in this field are Islam, (2007); Ghadai *et al*., (2010); Kumar *et al*., (2012); Padhy *et al*., (2014); Chaurasia, (2014); Kumar *et al.*, (2016); Shao and Zhang, 2017; and Shinde, 2018.

AIM OF THE STUDY

Large-scale use of pesticidal chemicals in tea gardens also cause contamination of soil and water and cause effect on non target microorganisms

(Bhuyan and Sarma, 2004).Therefore the present investigation is carried out to test the non target effect of pesticides - Malathion and 2, 4-D on survival of tea garden soil algae.

MATERIALS AND METHODS

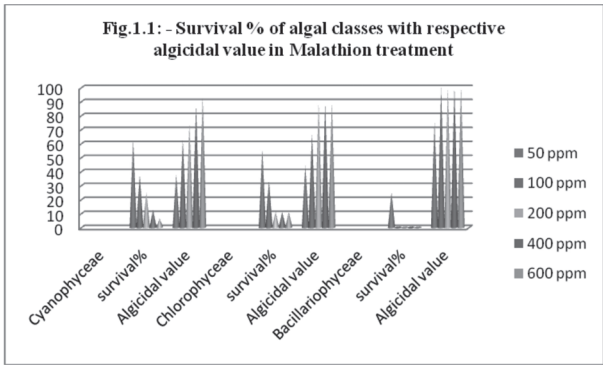
Surface soil samples were collected in rainy season of the year 2017 from Barduar Tea garden of Kamrup District Assam. Collections were done in random and at 10 -15 spots and at least 3 samples were collected. Soil samples were scooped out from the surface up to the depth of 5 cm (Singh, 1961). And a composite soil sample was prepared by mixing 10 gm of each the collected samples.

Algal species present in the control soil sample and in samples subjected to different concentration of Malathion and 2, 4-D were studied in Bold Basal medium (Nichols and Bold, 1965). The concentrations of the pesticides used in this study were 50, 100, 200, 400 and 600 ppm. A stock solution of individual pesticide was prepared in sterilized distilled water under aseptic condition and then desired amount added to separate experimental flask with 10 gm soil samples and 90 ml culture medium to get required concentration for the experiment. The experiment was carried out in triplicate and the data were plotted for the means of results. All the flasks were maintained under a light and dark cycle of 14-10 hours with illumination from fluorescent tube (1000 lux.) (Dixit and Tewari, 1992). The temperature was maintained at 25 ºC ± 2 ºC and cultures were hand-shaken regularly. The appearing algal forms were identified periodically from 12 days to 20 days of incubation period (Tarar and Shewale, 1984; Prescott, 1961; Bellinger and Sigee, 2010).

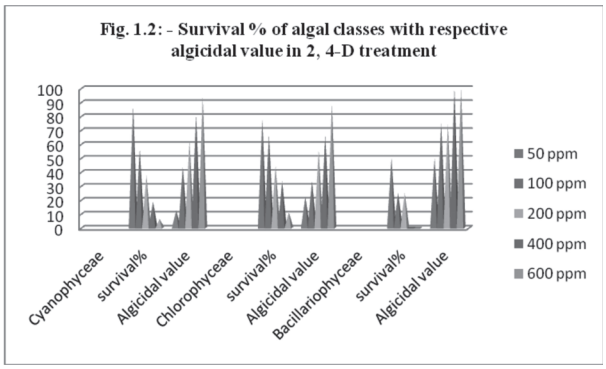
The tolerance percentage of algae was calculated on the basis of the numbers of algal species present in the respective treatments. The algicidal value was estimated based on the number of algal species eliminated by pesticidal treatment (Marie *et al.*, 1981).

RESULTS AND DISCUSSION

In control a total 29 algal species were observed, out of which 16 belong to Cyanophyceae, 9 Chlorophyceae and 4 belongs to Bacillariophyceae. The appearances of algal species in the pesticides treated cultures are given in tabular form (Table 1) and the tolerance percentage of algal classes with respective algicidal values are shown in Figure 1 & 2.



In Malathion treatment the Cyanophyceae was found to be comparatively more resistant than Chlorophyceae and Bacillariophyceae that is evident from the mean survival percentages and algicidal potentials (Fig. 2). However, an opposite result was observed in case of 2, 4-D treatment where Chlorophyceae were found to be more resistant than Cyanophyceae and Bacillariophyceae.



The Cyanophycean forms like *Lyngbya limnetica, Chrococcus minor;* Chlorophycean forms like *Chlorella vulgaris, Chlorococcum humicola* showed higher tolerance to these pesticides. On the other hand the forms like *Aulosira fertilissima, Nostoc linkia, Calothrix*

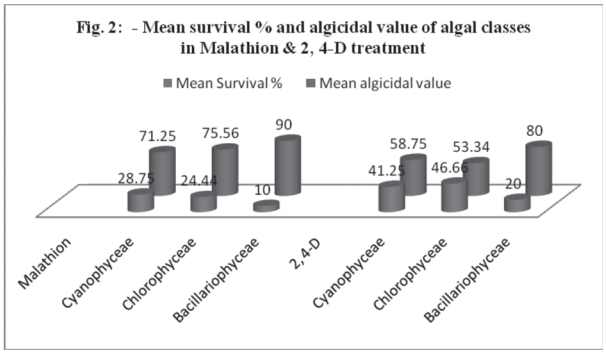


Table 1. Lists of Algal Species appeared in Control and 2, 4-D, Malathion treated soil samples

Control	Concentrations of Malathion (PPM)					Concentrations of 2, 4-D (PPM)				
	50	100	200	400	600	50	100	200	400	600
CYANOPHYCEAE										
Chrococcus minor Nageli	+	+	+	+	-	+	+	+	+	-
Gleocapsa alpicola Kutz.	-	-	-	-	-	+	-	-	-	-
G. atarta (Turp.) Kutz	-	-	-	-	-	+	+	+	-	-
Microcystis aeruginosa Kutz.	+	+	+	-	-	+	+	+	+	-
Anabaena orientalis Dixit	+	+	-	-	-	+	+	+	-	-
A. variabilis Kutz	+	-	-	-	-	+	+	-	-	-
Nostoc linkia Bornet	-	-	-	-	-	+	-	-	-	-
N. mascorum Ag.	+	-	-	-	-	+	+	-	-	-
Aulosira fertilissima Ghose	-	-	-	-	-	-	-	-	-	-
Lyngbya limnetica	+	+	+	+	+	+	+	+	+	+
Oscillatoria chlorina Kutz.	+	+	-	-	-	+	+	+	-	-
O. salina Biswas	+	-	-	-	-	+	-	-	-	-
O. willei Drouet	+	-	-	-	-	+	-	-	-	-
Phormidium autumnale Gomont	+	+	-	-	-	+	+	-	-	-
P. fragile Gomont	-	-	-	-	-	+	-	-	-	-
Calothrix marchica Lem.	-	-	-	-	-	-	-	-	-	-
CHLOROPHYCEAE										
Chlorella vulgaris Beijer	+	+	+	+	+	+	+	+	+	+
Chlorococcum humicola Nag	+	+	-	-	-	+	+	+	+	-
Gleocystis ampla Kutz.	+	-	-	-	-	+	+	+	-	-
Closterium diane Eihreb.	-	-	-	-	-	-	-	-	-	-
Ulothrix moniliformis Kutz.	-	-	-	-	-	+	+	-	-	-
Scendesmus dimorphus Kutz.	+	+	-	-	-	+	+	+	+	-
Spirogyra elliptica Jao	+	-	-	-	-	+	-	-	-	-
Oedogonium gracilius Tiff.	-	-	-	-	-	-	-	-	-	-
Vaucheria sp.	-	-	-	-	-	+	+	-	-	-
BACILLARIOPHYCEAE										
Fragillaria brevistriata Grun	-	-	-	-	-	-	-	-	-	-
Navecula viridula Kuez.	-	-	-	-	-	+	-	-	-	-
Gomphonema parvulum Kutz.	+	-	-	-	-	+	+	+	-	-
Tabellaria fenestrate Kutz.	-	-	-	-	-	-	-	-	-	-

- =absent; + = present

marchica, Oedogonium gracilius, Closterium diane, Fragilaria brevistriata, Tabelaria fenestrata were found to be very sensitive to these pesticides in the tested concentrations.

The results of this investigation indicate that 2, 4-D is less harmful than Malathion. The present observation is supported by findings of Relyea (2005) who also observed 2, 4-D as less harmful to algae.

In this observation *Aulosira fertilissima* was appeared as most sensitive form which is in conformity with the findings of Tandon *et al.* (1988); Choudhury & Sarma (2001); Choudhury *et al.* (2017).

CONCLUSION

From this observation it may occlude that the algae from the tea garden soils show variable response to both the pesticides. The higher concentrations of pesticides have greatly affected the survival of algae in agricultural fields. So we may suggest to avoiding the use of high doses of chemical pesticides in agricultural practices including tea-gardens to save the non-target beneficial soil micro-algal.

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