VI. SUMMARY
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The present investigation, "Impact of some common pesticides on selected phytoplankters" encompasses the varied responses of three freshwater microalgae to different concentrations of five selected pesticides which are likely to be present in natural freshwater ecosystems. The pesticides under study included an organochlorine insecticide endosulfan, an organophosphorus insecticide ekalux, a herbicide fernozone, a fungicide indofil and a biopesticide nimbex. The test organisms selected were three Chlorophycean microalgae namely, Chlorella ellipsoidea, Gerneck, Chlorococcum humaticola, (Naeg.) Rabenhorst and Scenedesmus bijuga, (Turp.) Lagerheim. The impact of each pesticide on the population growth, productivity, pigment content and biochemical compounds of treated algae were estimated at equal intervals for a period of 21 days.
The first phase of the study was concerned mainly with isolation and development of pure microalgal cultures using serial dilution technique. During the second phase of the experiment, microalgae were exposed to five pesticides independently and their varied responses were studied in terms of different parameters. As the short-term experiments are likely to yield inaccurate and incomplete results, long-term experiments with duration of 21 days were conducted.

The results of the experiment revealed differential sensitivity of algal species towards each pesticide and the different modes of action of pesticides coming under various groups. The lower concentrations of all the pesticides induced a stimulatory effect on the growth of *Chlorococcum humicola*, (Naeg.) Rabenhorst, whereas in *Chlorella ellipsoidea*, Gerneck the pesticides other than indofil caused an increase in cell number at their lower levels. The population growth in *Scenedesmus bijuga*, (Turp.) Lagerheim was not activated even at the lowest concentrations of the pesticide, but was adversely affected at all the levels of pesticides applied.

The carbon production in microalgae seemed to be affected more than the cell number, at the time of application of pesticides. The pesticides endosulfan, fernoxone and nimbex stimulated productivity in *Chlorella ellipsoidea*, Gerneck and *Chlorococcum humicola*, (Naeg.) Rabenhorst at their lower concentrations. In the higher concentrations of pesticides, net carbon production was in some cases detected to be ‘zero’ and this was assumed to be due to the high respiratory rate of treated cells, indicating complete metabolisation of reserve food content.

The photosynthetic pigments such as chlorophyll *a, b, c* and carotenoids in the treated algae were affected in a varied manner by the activity of pesticides applied.
The lower concentrations showed a tendency to stimulate the pigment synthesis whereas the higher concentrations showed very low values.

The synthesis of biochemical compounds in microalgae treated with pesticides showed variation with respect to the control. Except for Scenedesmus bijuga, (Turp.) Lagerheim protein content in the algae was found to be higher when treated with lower concentrations of pesticides, but higher concentrations except in the case of fernoxone, clearly inhibited the protein synthesis in microalgae. Carbohydrate content was inhibited at higher concentrations of all pesticides, but the intensity of inhibition lowered by the termination of exposure period.

Statistical analysis of the data had been done using 3-way ANOVA and student's t test. The significance of observed differences was graphically represented in Trelli's diagram in terms of t statistic. In most cases the variations in the response of algae as a result of pesticide treatment were highly significant.

The bioaccumulation study based on the organochlorine insecticide endosulfan revealed that Chlorella ellipsoida, Gerneck had a high ability to absorb and accumulate the insecticide from the medium, compared to Chlorococcum humicola, (Naeg.) Rabenhorst.

The algal cells treated with pesticides showed morphological changes at their higher concentrations, such as cell deformities, difference in cell volume, degradation of pigments and cell aggregation.

96hr EC50 values were computed for two different parameters such as cell number and carbon production, using three different methods viz. Arithmetic method, Logarithmic method and Probit method. The results revealed that ekalux, the
organophosphorus insecticide was more harmful to the studied microalgae and fenoxone the least. It was also noticed that rate of carbon production was more affected than the cell number at the time of application of pesticides.

From the above results it had been proved that variations occur in the action of pesticides towards different organisms exposed to them, and these variations are liable to change at any stage of the experimental period. Generally with an increase in the concentrations of a pesticide, growth and related parameters of the exposed organisms showed an increased inhibition percentage, the highest concentration being more adverse. However, the algal cultures of *Chlorella ellipsoidea*, Gerneck and *Chlorococcum humicola*, (Naeg.) Rabenhorst in certain cases managed to recover from the toxic effect rendered by lower concentrations of the toxicants, but when treated with the higher concentrations, they showed reduced growth throughout the experimental period. It can be assumed that the stimulations that occurred in the lower concentrations of pesticides might be due to the action of the non-active ingredients present in the toxicants, which include organic solvents, emulsifiers, stabilizers and other such agents. Essential knowledge about the impact of these so-called non-active ingredients on algal physiology is lacking. Usually certain complicated interactions occur between/among a pesticide compound and its transformation or oxidation products, which may lead to favourable or unfavourable consequences. Endosulfan, the organochlorine insecticide exhibited changes in its mode of action probably due to the formation of such transformation products Thus it is generally believed that organochlorines are more toxic than organophosphorus insecticides. In the present study the organophosphate ekalux proved to be equally or
more toxic than the organochlorine insecticide endosulfan. The herbicide fernoxone was found to be the least toxic pesticide probably due to its hormonal activity and degradation capacity.

As the decreased growth rate of algal species exposed to toxicants would ultimately lead to low primary production and extinction of affected species, the pesticide contamination even at very low levels can affect the structural and physiological balance of an aquatic system. Many countries including India have taken a serious view of this matter, and much effort is being devoted to developing biological pest control programmes.