# The Effect of Dursban Upon Fresh Water Phytoplankton

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The use of diethyl 3,5,6-trichloro-2-pyridyl phosphorothionate (Dursban) as a larvicide has increased in the past few years. It is a moderately persistent organophosphorus pesticide and has an adverse effect on fresh water phytoplankton. The recommended application rate of Dursban is 0.0125 lb/acre. ROBERTS and MILLER (1970) found that Dursban as the concentration of 0.4 ppm prevented the growth of fresh water Diatoms. HURLBERT et al. (1972), using shallow artificial ponds, found that Dursban applied at the rate of 0.025 lb/acre stimulated the growth of blue green algae. The results of the present paper describe the effect of small amounts of Dursban upon fresh water phytoplankton present in a large natural pond situated adjacent to the Canadian shore of Lake Huron. The experiments were carried out during the months of July and August in 1973 and 1974.

## METHODS AND MATERIALS

### Test Cylinders

Five cylinders were constructed from sturdy polyethylene sheeting 0.15 mm in thickness, open at both ends and approximately 0.6 m in diameter and 1.5 m in length. At one end lead weights were threaded through eyelets encircling the lower circumference of each cylinder. The other end was held open and supported above water level by a circular wire frame with four cork buoys placed at evenly spaced intervals. The length of the cylinders was adjusted to approximately 1.2 m by infolding the extra length over the top of the circular frame. The infold of the plastic over the metal was ringed with floats making a shallow collar which prevented spillage. These cylinders were placed at random throughout the pond.

The pond was approximately 30 mm long, 20m wide and 1.5 m deep. Prior to the application of Dursban to the cylinders in 1973, the phytoplankton population of the pond was observed and enumerated at four randomly selected locations for a period of four weeks. Seven of the more commonly occurring types of phytoplankton were quantitatively determined, namely: Ankistrodesmus sp., Ceratium sp., Closteriopsis sp., Dinobyron sp., Glenodinium sp., Tetraedron sp., and Diatoms.



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## Addition of Dursban to Test Cylinders

Analytical grade Dursban dissolved in 10 ml of xylene was added to four of the cylinders, giving equivalent application rates of 0.0125, 0.025, 0.125 and 1.25 lb/acre. This corresponded to a concentration within the cylinders of 1.2, 2.4, 24 and 240 ppb, respectively. Ten ml of the xylene carrier was added to the fifth cylinder as a control. The enumeration of the phytoplankton and Diatoms was carried out immediately prior to the addition of the Dursban and xylene carrier and at 2, 7, 9, 13, 15 and 17 days following the initial application.

## Enumeration of Phytoplankton

500 ml of water samples were taken from the surface of the pond and the cylinders. Following a thorough mixing, six drops of Lugol's iodine were added to a 100 ml aliquot of the sample. This was then left undisturbed for 24 hours to allow sedimentation to occur. 90 ml of the supernatant was then carefully removed, the sediment in the remaining 10 ml was shaken thoroughly, and the stained phytoplankton were quantitatively determined using a Palmer counting chamber.

## Determination of Dursban in Water

Dursban concentrations in the water were determined by the method described by DÜSCH et al. (1970) using gas liquid chromatography with electron capture detection.

# RESULTS AND DISCUSSION

The distribution of the most numerous types of phytoplankton present in the pond during the summer of 1973 is given in Table 1.

TABLE 1

Number of Algal cells per ml. in pond, BAIE DU DORE, Summer, 1973

| | June 25 | | | July 10 | | | July 16 | | | July 23 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALGAE | No. of Samples | Mean | Range | No. of Samples | Mean | Range | No. of Samples | Mean | Range | No. of Samples | Mean | Range |
| ANKISTRODESMUS spp. | 4 | 28 | 20 - 42 | 4 | 116 | 58 - 161 | 4 | 477 | 200 - 847 | 4 | 301 | 148 - 398 |
| CERATIUM sp. | - | - | - | 4 | 19 | 1 - 50 | 4 | 10 | 3 - 17 | 4 | 73 | 15 - 116 |
| CLOSTERIOPSIS sp. | 4 | 24 | 3 - 39 | 4 | 151 | 93 - 200 | 4 | 210 | 20 - 422 | 4 | 71 | 20 - 125 |
| DIATOMS ( combined ) | 4 | 13 | 7 - 27 | 4 | 4 | 3 - 6 | 4 | 66 | 13 - 128 | 4 | 17 | 11 - 23 |
| DINOBYRON sp. | 4 | 13 | 7 - 20 | 4 | 8 | 5 - 10 | 4 | 0.8 | 0.3 - 1.4 | 4 | 2 | 1.1 - 3.4 |
| GLENODINIUM sp. | 4 | 11 | 5 - 23 | 4 | 104 | 73 - 140 | 4 | 39 | 7 - 70 | 4 | 14 | 3 - 34 |
| TETRAEDRON sp. | 4 | 0.7 | 0.3 - 1.0 | 4 | 0.5 | 0.3 - 1.0 | 4 | 4 | 2 - 5 | 4 | 4 | 1 - 7 |

It can be seen that there is a marked variation in the number of phytoplankton present during the four week period. This reflects the normal life cycle of the particular types reported.

The phytoplankton observed in the test cylinders were Ankistrodesmus falcatus, Ankistrodesmus spiralis, Ceratium sp., Dinobyron sp., Glenodinium sp., Gonatozygon sp., Scenedesmus dimorphus, Tetraedron sp., Trachelomonas sp. and Diatoms. Figures 1 and 2 show the effect of 1.2 and 240 ppb Dursban on Ankistrodesmus falcatus and Tetraedron sp., respectively, during the summers of 1973 and 1974 from their period of growth to their decline. The effects of 2.4 and 24 ppb Dursban were intermediate.

The results have been expressed in percentage change from the original algal population. It can be seen that a concentration of 1.2 ppb will effect the growth of phytoplankton. Similar results were obtained with other phytoplankton mentioned above, with the exception of Ceratium sp. Its growth was not influenced by Dursban in a concentration as high as 240 ppb.

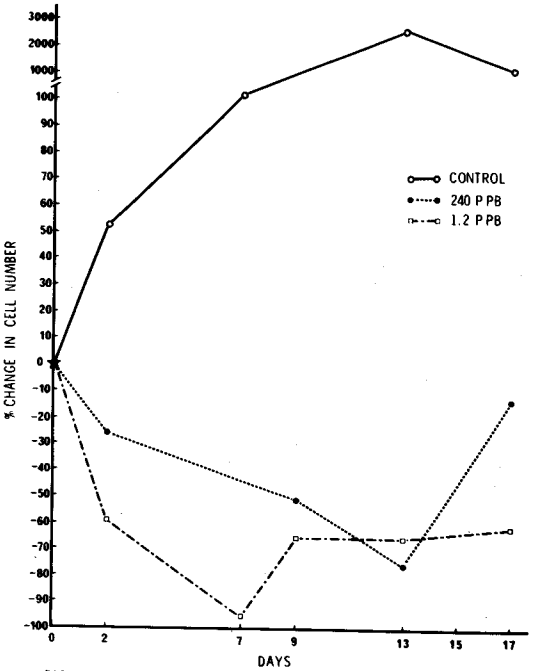
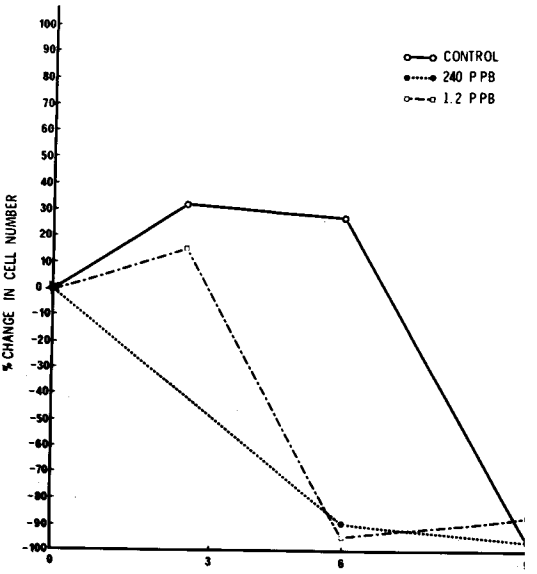



FIG.1 GROWTH OF ANKISTRODESMUS FALCATUS IN DURSBAN
( 1973 July 31 - Aug. 17 )




GROWTH OF ANKISTRODESMUS FALCATUS IN DURSBAN
( 1974 Aug. 13 - Aug. 27 )

LUDWIG et al. (1968) found that Dursban had no effect on the local ecological habitat of a salt marsh as represented by shrimp, minnows, crabs, fish and birds. However, the authors did not discuss the action of Dursban on phytoplankton. An aerial application rate of 0.025 lb/acre resulted in an average concentration of 3.8 ppb Dursban residue in their water samples after one hour, but no residue was detectable seven days later.

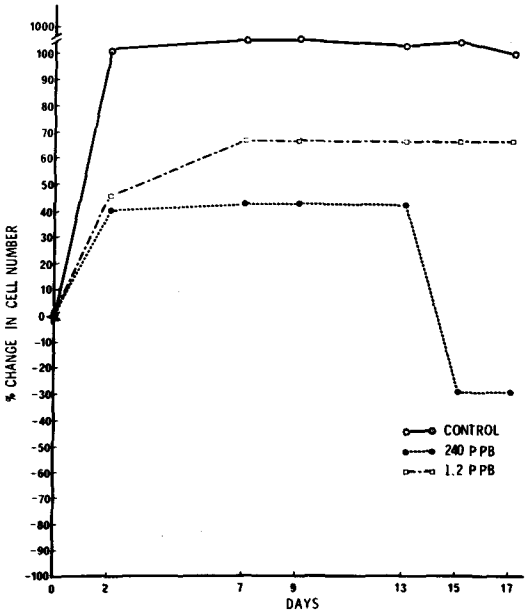
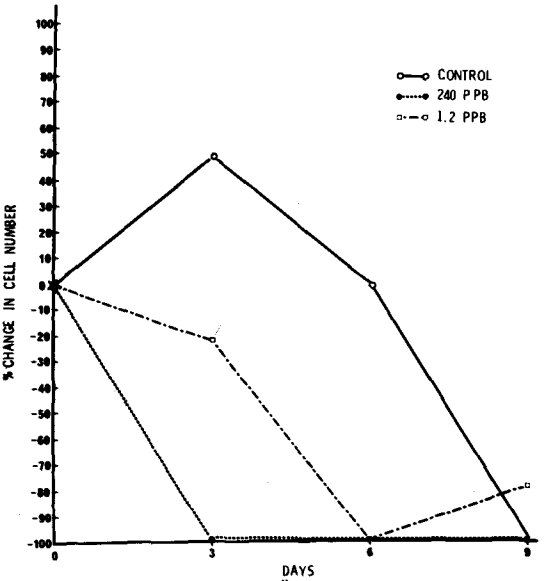



FIG.2 GROWTH OF TETRAËDRON sp. IN DURSBAN
( 1973 July 31 - Aug. 17 )




GROWTH OF TETRAËDRON sp. IN DURSBAN
( 1974 Aug. 13 - Aug. 27 )

In the present study the decline of Dursban within the test cylinders is given in Table 2.

Table 2

Residues of Dursban in water of test cylinders

| Dosage lb / acre | Residues of Dursban ( ppb ) after | | | | | |
|---|---|---|---|---|---|---|
| | 2 days | 5 days | 7 days | 11 days | 13 days | 15 days |
| Control | N.D.* | N.D. | N.D. | N.D. | N.D. | N.D. |
| 0.012 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| 0.025 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| 0.25 | 3.3 | 1.9 | 1.4 | N.D. | N.D. | N.D. |
| 2.50 | 61.0 | 7.2 | 4.4 | 3.5 | 1.5 | N.D. |

N.D.= not detectable

It was found that there was a rapid decline in the concentration of Dursban within the test cylinders. However, the effect upon phytoplankton was still apparent after a period of seventeen days following the initial application (see Figs. 1 and 2).

From the above results it would appear that Dursban in very low concentrations does have an effect upon phytoplankton in fresh water, and this effect is present for a considerable period of time following the initial application. The effect produced is variable and dependent upon natural growth cycles of the phytoplankton concerned. However, this inhibition of growth is most noticeable during their active growth phase.

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