

# A Study on the Effects of Polychlorinated Biphenyl (Aroclor 1242) on an Aquatic Plant— *Spirodela oligorhiza* (Kurz) Helm

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The current concern about the presence of polychlorinated biphenyls (PCBs) in the environment has stimulated study of the toxic effects of these chemicals on various living organisms. There are some excellent reviews which have covered the problems associated with analysis of these chemicals (6); their occurrence and biological effects (5). Although there are a few reports (3, 4, 2) on the influence of these chemicals on certain photosynthetic diatoms and algae, there is none available on aquatic angiosperms.

## MATERIALS AND METHODS

*Spirodela* is a free floating aquatic plant commonly found in still waters and ponds. A mature colony consists of two large green fronds of approximately 3 mm long and 2 mm wide but tapering off at both ends. One or two roots are present on the under surface of each colony. Wild ducks usually feed on these plants.

For all experiments plants were grown from an inoculum of colonies surface sterilised with 5% solution of sodium hypochlorite. Plants were grown under aseptic conditions in a standard liquid plant culture solution (1) and kept in a growth room at 20°C and 18h photoperiod. At the beginning of each experiment a series of 100 ml flasks was set up - each flask containing 30 ml of sterile culture solution to which the required quantity of PCB was added except in the controls. To each flask four colonies of *Spirodela* were introduced and allowed to grow for 2 weeks.

PCB (Aroclor 1242\*) was dissolved in methanol to make up a stock solution of 20,000 ppm (w/v). This was serially diluted in the plant culture solution to make up the final concentration.

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\*Aroclor (R), registered trade name for polychlorinated biphenyls was a gift from the Monsanto Company, United States of America.

In the first two experiments only three high concentrations of PCB were used and these were 25, 50 and 100 ppm. There were two controls - one to study the effects of methanol (solvent) and the other for overall control. In both experiments there were five replicates of each treatment. The number of colonies was counted every third day up to 2 weeks (Fig. 1). The control of methanol had no noticeable effect on the growth of Spirodela.

In the remaining three experiments a series of concentrations ranging from 5 to 50 ppm was used and there were five replicates of each treatment for each experiment. Colonies were counted at the end of the experiment (15 days) and the fresh weight of each culture was determined. The results of five replicates for each experiment are averaged (Table 1).

#### RESULTS AND DISCUSSION

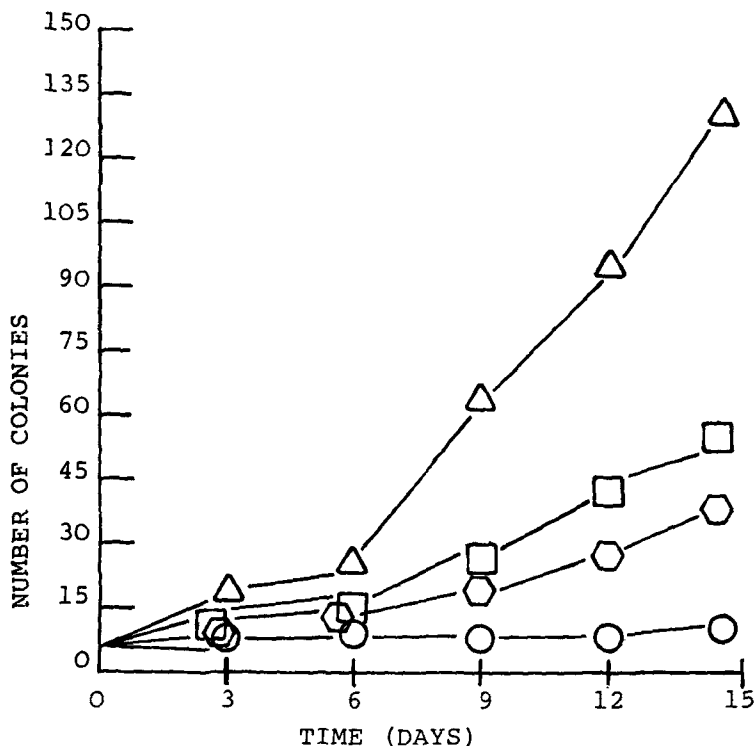


Fig. 1. Average number of colonies for each experiment using three different concentrations of PCB and a control.

Δ.....Control, □.....25 ppm, ⬡.....50 ppm and  
○.....100 ppm.

From Fig. 1 it is clear that each concentration of PCB was very effective in reducing the growth of Spirodela. 100

ppm was far too high and proved to be lethal. At concentrations of 25 and 50 ppm although there was some growth, the colonies were small and showed characteristic morphological differences from those of controls.

TABLE I  
RESULTS OF 3 EXPERIMENTS  
(Mean of 15 replicates)

PCB (ppm)	No. of Colonies* % control	Fresh Weight (mg) % control **
0	100	100
5	55	54
10	44	43
20	39	38
30	39	35
40	32	33
50	29	32

From Table I it can be seen that even at 5 ppm the growth was reduced as recorded by number of colonies and by fresh weight.

#### Morphological changes

The colonies grown in treated medium had smaller fronds indicating retarded growth. Each colony had a large number of small fronds, sometimes up to 10 in a colony indicating the failure of maturing frond to separate from each other. This feature was more prominent in the lower concentrations of PCB.

In PCB-containing media the fronds showed a characteristic pattern of chlorosis which appeared as white stripes alternating with green tissue. The stripes developed across the width of the fronds at right angles to the axis of growth. PCB seems to have affected chlorophyll synthesis. The effects of PCB on the ultrastructure of the frond cells of Spirodela is being studied.

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\*Average no. of colonies for 3 experiments in the controls were 128.

\*\*Average fresh weight of control for 3 experiments was 268 mg.

At this stage it is difficult to determine the effects of PCB on higher plants. But from the results reported here, at least in Spirodela it effectively reduces growth and interferes in chlorophyll synthesis either directly or indirectly. It is known that chlorinated biphenyls cause aberration in calcium metabolism in many species of birds (7) and inhibits chlorophyll synthesis in certain diatoms (3). The latter may be true for Spirodela.

It is also interesting to observe the failure of daughter colonies to separate from parent colonies and this phenomenon is being examined further.

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