Depression of Primary Productivity by Aroclor 1232 in an Interspecific Lentic Algal Assembledge

John C. Kricher and Carol L. Bayer
Biology Department
Wheaton College
Norton, Mass. 02766

Introduction

Many biocides enter natural waters and it is of obvious interest to learn the effects of such stresses upon natural ecological communities. Recent studies (MOSSER et al., 1972, FISHER et. al., 1974, SHERIDAN and SIMMS, 1975) have begun to focus on assaying biocide effects in mixed algal cultures, both marine and freshwater, and both naturally occurring and gnotobiotic communities.

Our study was done in the laboratory using batch cultures taken directly from a reservoir. The cultures therefore represent a naturally occurring algal community, although we do not suggest that the laboratory conditions under which the study was conducted are representative of field conditions. The primary objective of our study was to determine whether or not the polychlorinated biphenyl Aroclor 1232 (Monsanto Co., obtained from Analabs) significantly affects carbon fixation by the algal assembledge. A second objective was to examine changes in the community structure brought about by the PCB stress.

Methods

All samples were collected from the Norton Reservoir in southeastern Massachusetts. The reservoir has an area of 189 ha and is shallow throughout. It is undergoing both natural and cultural eutrophication, the latter caused by input from a neighboring town's sewage treatment plant. All samples were taken from near a spillway where the reservoir joins the Rumford River. This location is farthest from the stream receiving effulent from the sewage treatment plant. Samples were taken at noon from surface waters to minimize the presence of zooplankton grazers. The 4 experiments were conducted between 10 July and 18 Aug., 1975.

Each sample consisted of 200 ml of surface water placed in a BOD bottle. Aroclor 1232 was added 30 minutes following collection of the samples. The final concentration of Aroclor 1232 was 1 ppm, and the PCB was dissolved in 0.1% acetone (HAWES et al., 1976 a, b). Samples were incubated at 25°C under 30 foot candles fluorescent light for 24 hours.

At 24 hours, light and dark bottles were established and all samples were innoculated with 5 microcuries of C^{14} bicarbonate. The samples were reincubated for 3 hours, then millipore filtered (pore diameter .45μm) and counted on a Unilux liquid scintillation system (HAWES et al., 1976 b). Data were expressed as $mgC/m^3/hr$.

Bulletin of Environmental Contamination & Toxicology,
Vol. 18, No. 1 © 1977 by Springer-Verlag New York Inc.

Each experiment was referred to as a run and each experimental category (i.e., control, acetone control, Aroclor) consisted of 5 light and 5 dark bottles (Runs K, L, R, T).

Population counts of algal genera were made using a Sedgwick-Rafter counting cell.

Results

In each of the four runs, the Aroclor 1232 treated samples displayed a dramatically lower rate of carbon fixation than the untreated Control samples, while the Acetone treated control samples displayed a slightly reduced rate of carbon fixation compared with the untreated Controls (Figure I). In all four runs, the reduction in carbon fixation in the Aroclor group vs. the untreated Control group was statistically significant (Table I). In one case (Run K), the Acetone Control group was significantly lower in carbon fixation than the untreated Control group.

TABLE I

Run	Control vs. Acetone	Acetone vs. Aroclor	Control vs. Aroclor
K	$p = .4 - .5$	$p < .001$	--
L	$p = .1 - .2$	$p = .3 - .4$	$p < .05$
R	$p = .02 - .05$	$p = .4 - .5$	$p < .01$
T	$p = .3 - .4$	$p = .2 - .3$	$p = .01 - .02$

Table I. Probability values for student's t Tests comparing means of experimental categories within each run.

Censuses of algal genera revealed distinctly different patterns of change over 24 hours between Controls and Aroclor 1232 treated samples (Table II). Scenedesmus increased by 6% in the Control group but decreased by 19% in the Aroclor group. Likewise, Pediastrum increased by 20% in the Controls but decreased 6% in the Aroclor group. Staurastrum decreased in both groups, but decreased more rapidly in the Aroclor group.

TABLE II

	0 Hours		24 Hours	
	Control	Aroclor	Control	Aroclor
Scenedesmus	116 (9%)	110 (12%)	123 (22%)	89 (18%)
Staurastrum	45 (20%)	32 (45%)	38 (45%)	25 (49%)
Pediastrum	16 (54%)	17 (20%)	20 (35%)	16 (39%)
Asterionella	26 (20%)	17 (45%)	25 (80%)	16 (54%)
Fragilaria	12 (28%)	8 (73%)	11 (36%)	12 (49%)

Table II. Means and coefficients of variability for algal genera at 0 and 24 hours. Figures given are in number of organisms per ml.

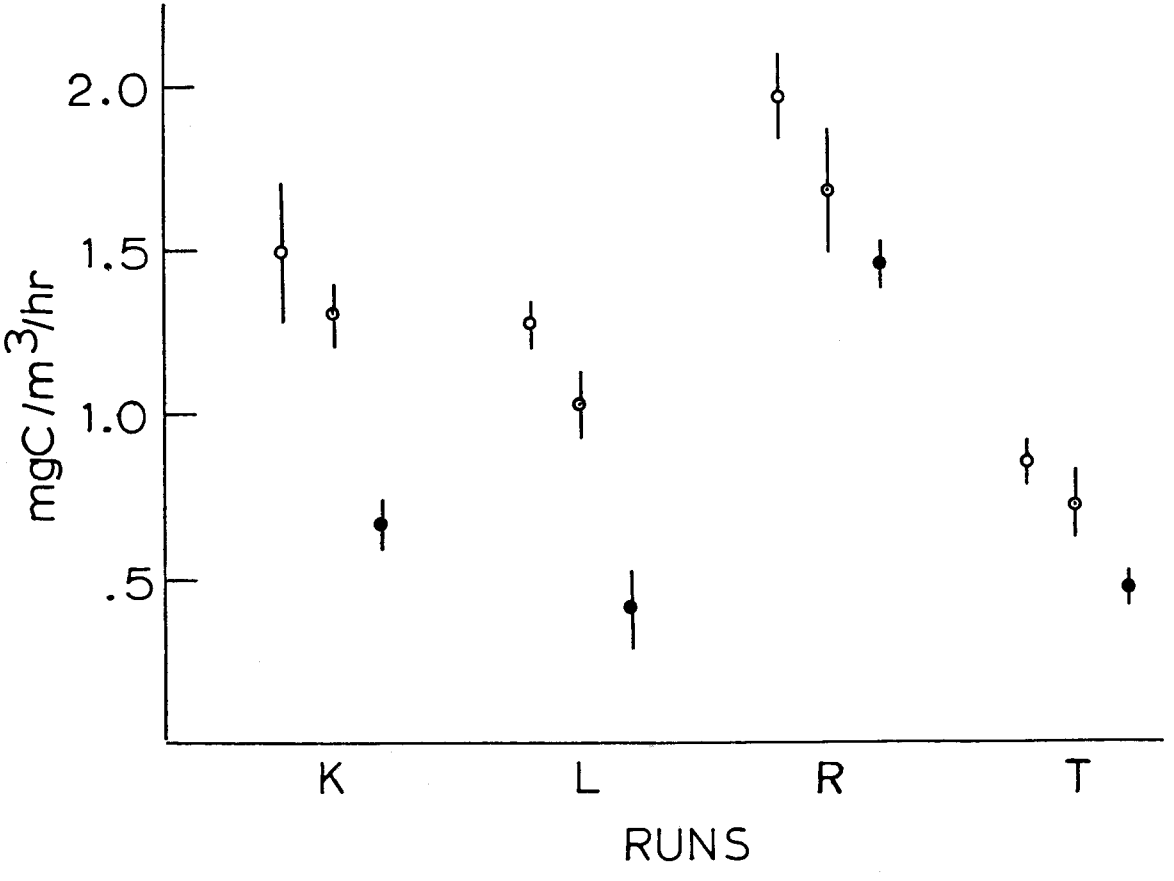

Figure I. Effect of 1 ppm Aroclor 1232 in four separate experiments. Open circles are controls, circles with dots are acetone controls, and darkened circles are Aroclor 1232. Data points represent means and intervals are standard errors.

Discussion

These data, while preliminary, do indicate clearly that Aroclor 1232 at 1 ppm (in acetone) exercises a depressant effect upon carbon fixation in this particular algal assembledge. While not frequently statistically significant, the presence of acetone clearly acted as a mild depressant of productivity, and the results observed for the Aroclor 1232 samples may in fact represent a synergistic effect of acetone and Aroclor 1232.

Acknowledgements

This research was supported by grants from Research Corporation and Wheaton College.

References

HAWES, M.L., J.C. KRICHER, and J.C. UREY. Bull. Envir. Contam. Toxicol. 15, 14 (1976 a).

HAWES, M.L., J.C. KRICHER, and J.C. Urey. Bull. Envir. Contam. Toxicol. 15, 588 (1976 b).

FISHER, N.S., E.J. CARPENTER, C.C. REMSEN, and C.F. WURSTER. Microbiol. Ecol. 1, 39 (1974).

MOSSER, J.L., FISHER, N.S., and C.F. WURSTER. Science, 176, 533 (1972).

SHERIDAN, R.P. and M.A. SIMMS. Bull. Envir. Contam. Toxicol. 13, 565 (1975).