Bioactive Compounds in the Aquatic Environment
Loss of Methoxychlor from Autumn-shed Leaves into the Aquatic Environment

by

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The significance of the deposition of autumn-shed leaves into a lotic environment as an energy source for community metabolism has been stressed by several authors (1,2,3). This importation of detrital material serves as a major food source for many lotic fauna. The use of methoxychlor in forest and ornamental management has received particular attention due to its desirable properties as a replacement for DDT. Autumn-shed leaves into which some residual methoxychlor can be incorporated could possibly act as a partitioning reservoir in a lotic community, and serve as a source of methoxychlor for prolonged exposure to the invertebrate and microbial components. Therefore, the purpose of this laboratory investigation was to quantify the rate of elimination of parent methoxychlor from three species of deciduous leaves when present in an aquatic environment.

METHODS AND MATERIALS

Autumn-shed leaves of oak, Quercus alba L., beech, Fagus grandifolia Erch. and maple Acer rubrum L., were collected soon after their fall during the second week of October, 1971. Leaves utilized in this study were collected from a 10 m^2 area in Baker Woodlot near the Michigan State University campus. This woodlot was selected as a source of material due to its use as a preserved area which receives no pesticide applications. The leaves were then selected for surface area uniformity and sprayed with a solution of technical methoxychlor (89.5%, City Chemical Corp., New York) in acetone so that a resultant concentration of 10 ppm (parts per million) was obtained on the leaf surface.

Twenty leaves of each species were placed in each of three 45 l all-glass aquaria which were supplied with water from a continuous-flow dilution apparatus at a rate of 800 ml per minute. The diluent water had the following characteristics in the test aquaria: conductivity, 5.95 x 10^2 umhos/cm^2;

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phenophthalein alkalinity, 12 ppm as $CaCO_3$; brom-cresol methyl red alkalinity, 330 ppm as $CaCO_3$; total hardness, 347 ppm as $CaCO_3$; and pH, 7.9.

Four leaves of each species were collected from each aquaria at specified time intervals (0, 5, 10, 15 and 20 days). Three leaf discs were then taken with a 1.5 cm cork borer from each of the four leaves and this composite sample (3 leaf discs) was weighed to the nearest tenth of a milligram. The sample was then placed in a teflon-lined screw cap vial with five ml of redistilled hexane and macerated with a glass rod. One ul of this extract was injected into the gas chromatograph for quantitation. A Beckman GC-4 gas chromatograph equipped with a discharge electron capture detector was used for residue analyses. It was fitted with a 6 foot (1.83 m) x 1/16 in. (1.59 mm) borosilicate glass column packed with 11% QF-1 and 3% DC-200 on Gas Chrom Q (60 - 80 mesh), was operated at a column temperature of 220 C, and had a helium (99.995%) flow of 30 ml per minute. The injection temperature was 250 C and detector temperature 275 C.

RESULTS AND DISCUSSION

Methoxychlor residues for each species, when plotted against time, were linear with a negative slope and demonstrated a high degree of correlation, -.85, -.95 and -.95 for beech, maple and oak respectively (Figure 1). Half lives were calculated by transforming the residue values to logarithmic functions and using the rectified regression equation developed by GRZENDA (4):

$$\log Y = \log A - (\log B) K$$

where Y = concentration of methoxychlor in leaf tissue
A = regression intercept
K = days after initial application of methoxychlor onto leaves, and
B = relative rate of residue loss

There was a significant difference in the rate of elimination of the compound from beech leaves compared to the other two species at every sampling period. Methoxychlor had a half life of 7 days on beech as opposed to 26 and 24 days on maple and oak respectively. Conversely, there was no significant difference between oak and maple in their capacity to eliminate methoxychlor. The presence of a functional epicuticular wax layer in maple and oak could account for the differences in the retention of methoxychlor by these two species.

The differential loss of methoxychlor from the three deciduous species utilized in this study suggests that detrital input, in the form of autumn-shed leaves, into the lotic environment could serve as a partitioning reservoir for methoxychlor residue. This residue could then be incorporated into the aquatic community and possibly exhibit deleterious effects. This study could aid in the evaluation and interpretation of some stream pesticide monitoring programs where seasonal residue data have been obtained and is questionable in its validity.

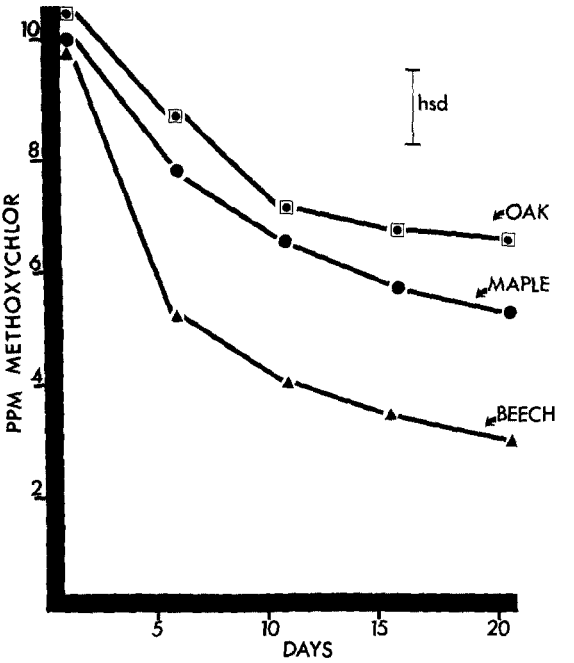

Figure 1. Loss of parent methoxychlor from three species of deciduous levels over time in a continuous flow system. Each point on the figure represents the mean of three replicates.

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