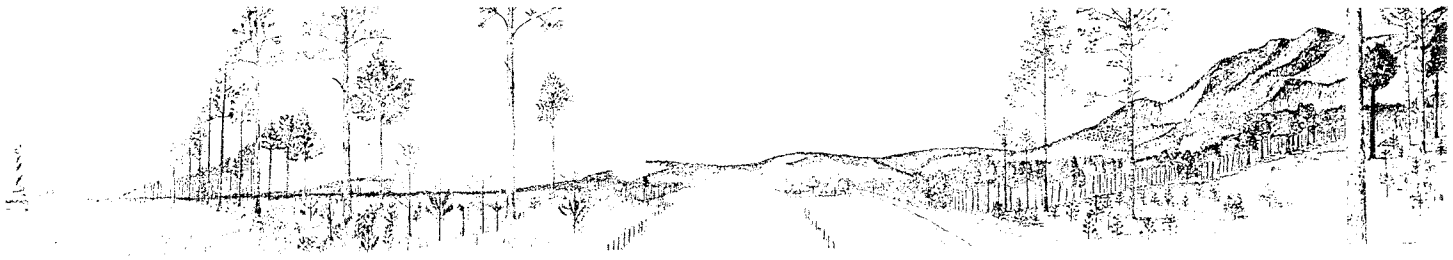

USDA Forest Service Research Note SE-139 October 1970

PERSISTENCE OF BIDRIN® IN TWO FOREST SOILS

Abstract.--A field study conducted on two forest soils, mineral and organic, indicated that high residues of the systemic insecticide Bidrin® were present in the upper 6 inches of soil for only 15 days following application. The rate of downward movement of the insecticide was fastest in the mineral soil. The total residue level during a 90-day period following application was approximately equal for both soils.

INTRODUCTION

The persistence of insecticides in soils is affected by many environmental factors; e.g., soil type, composition, pH, and moisture. This paper reports the results of an experiment to determine the effect of soil composition on the persistence of Bidrin® (3-hydroxy-N,N-dimethyl-cis-crotonamide dimethyl phosphate), an organophosphorous systemic insecticide, in two forest soils.

PROCEDURE

In May 1967, experimental plots were established in organic and mineral soils of a recent clearcut forest of eastern North Carolina. The characteristics of the two soils are described in table 1. A 12-inch-deep profile of the two soils showed that the mineral soil was divided into three horizons; i.e., 2 inches of black organic matter, 8 inches of black loamy sand, and 2 inches of white sand. The organic soil was divided into two horizons; i.e., 1 inch of loose, decomposed organic matter, and 11 inches of black organic soil. The organic soil was in an area which previously supported a mixed hardwood forest whereas the mineral soil previously supported a pond pine, Pinus serotina Michx., forest. Both forested areas were clearcut in 1966 and prepared for replanting by chopping and burning the plant debris. The topography of the land was flat and water drainage was facilitated by ditches bordering the perimeter of the clearcut area. Rainfall was measured during the period of investigation and both soils received equal amounts. The total rainfall recorded on both study soils is as follows: 1 day prior to treatment, 1.00 inch;

The author wishes to thank the Riegel Paper Company of Bolton, North Carolina, for their assistance in the research.

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0-15 days after treatment, 0.79 inch; 15-30 days, 3.09 inches; 30-60 days, 8.52 inches; and 60-90 days, 13.25 inches. Three plots (each 4 by 4 feet) were laid out on each soil; two of the plots were treated with insecticide and the other was an untreated control plot. Each of the treated plots was sprayed with an aqueous solution of technical Bidrin® at a rate of 2.4 grams per square foot.

Table 1.--Characteristics of two forests soils used for measuring Bidrin® residues

Soil	Sand	Clay	Silt	Organic matter	pH
			Percent		
Organic	45	30	25	63	6.0
Mineral	75	10	15	22	7.3

Soil samples were collected from the treated and control plots at 15, 30, 60, and 90 days after treatment. Sampling was done with a soil auger, and five cores (3/4-inch diameter, 6 inches long) were collected at random from each plot. The soil cores were sectioned into 1-inch layers and corresponding layers from the five cores were combined and stored in glass containers at -20° C.

Ten grams of each layer of soil were combined with 10 ml. of distilled water to make a slurry. Methylene dichloride (10 ml.) was added and the mixture shaken vigorously for 20 minutes on a wrist-action mechanical shaker. The methylene dichloride phase was filtered through fluted filter paper into a separatory funnel. This extraction was repeated twice. The methylene dichloride–water mixture was dried over anhydrous sodium sulfate, placed in a flask with a 3-ball Snyder column, and concentrated to 10 ml. or less on a steam bath. Hexane was added and exchanged for methylene dichloride during the concentration procedure. The hexane solution was then analyzed for Bidrin® by the enzyme inhibition–spectrophotometric method described by the Agricultural Research Division, Shell Chemical Company.[1] The data were analyzed statistically by the honestly significant difference procedure; i.e., Tukey's w-procedure as described by Steel and Torrie.[2]

RESULTS AND DISCUSSION

The influence of two soils on Bidrin® persistence is given in table 2. Only at the 15-day sampling was a major difference recorded in residue levels between the two soils. The soil from the control plots did not contain any trace of Bidrin®. At this time, the mineral soil contained sig-

[1] Shell Chemical Company. Method MMS-40/64. Manual of methods. Agricultural Chemical Division, New York, N. Y. 1964.

[2] Steel, R. G. D., and Torrie, J. H. Principles and procedures of statistics. 481 pp. New York: McGraw-Hill Book Company, Inc. 1960.

nificantly more residues in the lower 3 inches than did the corresponding portion of the organic soil. Throughout the remainder of the 90-day period, residue levels were approximately the same for each soil, the upper 2 inches containing the highest residues. Except for the 60- and 90-day sampling of the organic 2-inch layer where no residue was recorded, there was a steady decrease in the residue level of the upper 2 inches. After 15 days there was no significant residue in the lower 4 inches of either soil type. The data indicate a significant difference among the total residues present at each of the sampling days.

Table 2.--Bidrin® residues found in the first 6 inches of two forest soils during a 90-day period after treatment

Soil layer	Days after treatment			
	15	30	60	90
	p.p.m.			
Organic soil				
1 inch	0.068	0.048	0.024	0.012
2 inches	.066	.019	.000	.000
3 inches	.033	.010	.008	.000
4 inches	.012	.000	.005	.004
5 inches	.023	.010	.000	.000
6 inches	.007	.006	.011	.000
Total residue	.209	.093	.048	.016
Mineral soil				
1 inch	.066	.040	.033	.008
2 inches	.067	.032	.017	.001
3 inches	.056	.009	.004	.008
4 inches	.045	.007	.002	.001
5 inches	.065	.001	.006	.002
6 inches	.045	.000	.000	.003
Total residue	.344	.089	.062	.023

The initial high residue found in each of the first 6 inches of mineral soil at 15 days indicates that the insecticide moved downward at a greater rate than in the organic soil. This is possible because the mineral soils contained lower percentages of clay and organic matter which, according to Getzin and Chapman,[3] have a higher adsorption capacity than silt and sand. Apparently the insecticide was bound to the clay and organic matter in the upper 2 inches of organic soil after 15 days and thereafter either slowly degraded or dispersed to layers below 6 inches.

[3]Getzin, L. W., and Chapman, R. K. Effect of soils upon the uptake of systemic insecticides by plants. J. Econ. Entomol. 52: 1160-1165. 1959.

The cumulative total residue level, excluding that at 15 days, was approximately equal for both soils (organic soil = .157 p.p.m., mineral soil = .174 p.p.m.).

The lack of persistence of Bidrin® in mineral and organic soils could be related to several mechanisms. The amount of rainfall after 15 days was far greater than from 0 to 15 days after treatment. Because Bidrin® is highly water soluble, it is possible that the insecticide was diluted and leached downward in the soil. Most organic soils contain a higher microbial population than mineral soils. Although the microbial population was not identified or measured, it is possible that Bidrin® was rapidly degraded in the organic soil by microbial agents.

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