

# ABATE® INSECTICIDE RESIDUES IN STREAMS AND PONDS TREATED FOR CONTROL OF MOSQUITO LARVAE

JAMES S. BOWMAN AND EDWARD J. ORLOSKI

American Cyanamid Company, Agricultural Division, Princeton, New Jersey

Abate insecticide (O,O',O'-tetramethyl O,O'-thiodi-*p*-phenylene phosphorothioate) is a highly effective mosquito larvicide (McDuffie and Weidhaas, 1965). It is registered as Abate 4-E insecticide for use on non-crop lands at rates of 0.016 to 0.048 pounds active ingredient per acre (lbs. a.i./A.).

In support of this registration, residue studies were conducted to determine the rate of disappearance of Abate from water and mud, following applications to ponds and streams. These studies were conducted at sites located in New Jersey and California.

**METHODS OF APPLICATION AND SAMPLE COLLECTION.** Four ponds and four streams (or irrigation ditches) were selected for this study. Two ponds and two irrigation ditches were located near Stockton, California, and two ponds and two drainage ditches were located near Princeton, New Jersey. The size and depth of the ponds and the treated areas on the streams are given in Table 1.

Applications of Abate 4-E were made to the entire surface of each pond and to selected treatment areas of each stream using conventional spray equipment. One pond and one stream at each location received a single application at 1.0 lb. a.i./A. (20 times the highest anticipated use rate

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TABLE I.—Description of ponds and streams used in this study.

Streams	Location	Area Treated sq. ft.	Average Depth feet	Rate lbs. a.i./A.	Number of Weekly Applications
A	California	435	1	0.1	10
B	"	436	1	1.0	1
C	New Jersey	480	1	0.1	10
D	"	180	0.5	1.0	1
Ponds					
A	California	4,000	7.5	0.1	10
B	"	4,000	7.5	1.0	1
C	New Jersey	14,675	9	0.1	10
D	"	2,200	6	1.0	1

of 0.048 lb. a.i./A.). The remaining ponds and streams received ten consecutive weekly applications of Abate 4-E at 0.1 lb. a.i./A. This was done to simulate situations, such as irrigated fields, where several applications throughout the season are required to maintain mosquito control.

Samples of water and bottom mud were collected from the streams and ponds following the first, fifth and tenth applications. Sample collection stations were located on the streams at the treated area, 500 and 1500 feet downstream from the treated area. One-gallon water samples were collected from each site at 0 (pre-treatment), 0.25, 1, 2, 4, 8 and 24 hours after first, fifth and tenth weekly treatments. These samples were collected by allowing the surface water to flow into the mouth of one-gallon narrow mouth polyethylene bottles while moving them back and forth across the width of the stream.

An estimate of the flow rate of each stream or irrigation ditch was determined at the time of the first application. Since the amount of water in the New Jersey stream used for multiple applications fluctuated considerably during the ten-week test period, its flow rate was also determined at the time of the fifth and tenth applications. The flow rates were measured by selecting a section of the stream which offered representative dimensions with a measurable flow of water. The speed at which a floating object passed along a measured distance of stream was

determined, using a stop watch. Using the dimensions of the stream to calculate the volume of water (in gallons) over the measured distance, the flow rate was calculated in gallons per minute. These rates are given in Table 2.

Mud samples were collected from the sampling stations at 0 (pre-treatment), 1 and 7 days after the first, fifth and tenth weekly treatments. The samples were taken by scooping mud and debris at random from the bottom of the stream and compositing them in half-gallon containers with polyethylene liners.

From the ponds, one-gallon water samples were collected from both the surface and from one foot off the bottom at 0 (pre-treatment), 1, 8, 24 and 48 hours after the first, fifth and tenth treatments. Each one-gallon sample consisted of a composite of 8 one-pint samples collected at random over the area of the pond. Subsurface samples (one foot off the bottom) were collected using a narrow-mouth bottle mounted on a long stick in such a manner that it could be lowered to the desired depth in an inverted position. When turned upright by pulling a string attached to its neck, the bottle filled with water before being drawn to the surface.

Mud samples were collected from the bottom of the ponds at 0 (pre-treatment), 1 and 7 days after the first, fifth and tenth weekly applications. Samples collected at random from at least five locations were brought to the surface with a post hole

TABLE 2.—Abate insecticide residues in water from streams treated at 0.1 lb. Abate per acre at weekly intervals.

Location	Flow Rate (gal./min.)	Number of appli- cations	Sampling Site (ft. downstream)	p.p.b. Abate					
				Pre- treatment	Hours after treatment				
					0.25	1	2	4	
California	55	1	0	2 <sup>a</sup>	<10	17	<10	..	
			500	3	..	..	15	..	
			1500	11	..	..	<10	..	
	..	5	0	0	<10 <sup>b</sup>	<10	<10	..	..
				500	<10	..	..	..	..
				1500	<10	..	..	..	..
	..	10	0	0	11 <sup>b</sup>	11	<10	<10	<10
				500	<10	..	..	<10	<10
				1500	<10	..	..	<10	<10
New Jersey	1495	1	0	3 <sup>a</sup>	<10	..	..	..	
			500	4	..	..	..	..	
			1500	4	..	..	..	..	
	64	5	0	0	<10 <sup>h</sup>	27	<10	<10	..
				500	<10	..	..	..	..
				1500	<10	..	..	..	..
	48	10	0	0	<10 <sup>b</sup>	54	22	18	<10
				500	<10	..	..	<10	<10
				1500	<10	..	..	<10	<10

<sup>a</sup> Control samples taken prior to initial application.

<sup>b</sup> Represents 7 days after fourth and ninth applications.

digger, and subsampled until a composite one-half gallon sample was obtained.

All water samples were refrigerated and mud samples were frozen until analyzed.

**ANALYTICAL METHOD.** The colorimetric procedure of Blinn and Pasarela, 1966, was used to analyze all the samples. In this method, Abate insecticide is hydrolyzed to 4,4'-thiodiphenol; reaction with 4-aminoantipyrine and periodate produces a color which is measured at 485 m $\mu$ . One additional step was necessary with the water samples, that of rinsing the polyethylene bottle with anhydrous alcohol to effect a quantitative transfer of Abate. Recovery data were developed to validate the method for Abate at concentrations of 10–200 parts per billion (p.p.b.) in water and 0.1–6.0 parts per million (p.p.m.) in mud. Average recoveries were 70 percent and 80 percent respectively, with a sensitivity of 10 p.p.b. with water and 0.1 p.p.m. with mud.

**RESULTS AND DISCUSSION.** The results with water from streams show Abate insecticide residues were detectable only in the first few hours after treatment and then only where slow flow rates were observed. In studies where ten weekly applications of Abate were made (Table 2) there was no apparent accumulation of Abate at the site of application or sampling points downstream. Where a single application of Abate at 1.0 lb. a.i./A. was made (Table 3) residues were detected downstream during the first two hours. There were no detectable residues in samples taken at the three sampling sites of each study seven days after the fourth and ninth applications.

In the pond studies with multiple applications at 0.1 lb. a.i./A., only trace residues were found in surface water and in water taken at a depth within one foot of the bottom of the pond (Table 4). At the exaggerated single application rate of 1.0

TABLE 3.—Abate insecticide residues in water from streams treated at 1.0 lb. Abate per acre.

Location	Flow rate (gal./min.)	Sampling site (ft. downstream)	Pre- treatment	p.p.b. Abate				
				Hours after treatment				
				0.25	1	2	4	8
California	73	0	7	<10	<10	<10	<10	<10
	..	500	11	47	21	<10	<10	<10
	..	1500	9	28	17	<10	<10	<10
New Jersey	404	0	13	<10	..	<10	..	..
	..	500	13	<10	<10	<10	..	..
	..	1500	6	<10	<10	34	<10	<10

lb. a.i./A. (Table 5), initial residues of 105 p.p.b. were observed in the surface water of the New Jersey pond with residues diminishing to 16 p.p.b. after seven days. In the California study, high initial residues were detected in both surface and subsurface water. However, the concentration diminished quite rapidly to levels of approximately 10 p.p.b. at 24 hours.

Mud samples taken from the ponds and at each sampling site of the streams at 0, 24 and 168 hours after ten applications at a rate of 0.1 lb. a.i./A. showed no detectable residues in any of the samples (Table 6).

**SUMMARY.** The disappearance of Abate insecticide residues from streams and

ponds located in California and New Jersey was determined. After ten weekly applications were made to streams at 0.1 lb. a.i./A., no apparent accumulation of Abate occurred in water or mud samples from the site of application or at sampling stations downstream. Similar treatments to ponds demonstrated only trace residues, which were found in surface and bottom water samples during the first 24 hours after treatment.

At the exaggerated rate of 1.0 lb. a.i./A., Abate insecticide residues could not be detected at any of the sampling stations four hours after treatment of streams and only trace quantities one week after treatment of ponds.

TABLE 4.—Abate insecticide residues in water from ponds treated at 0.1 lb. Abate per acre at weekly intervals.

Location	Number of applications	Sampling depth (feet)	Pretreatment	p.p.b. Abate			
				Hours after treatment			
				1	8	24	48
California	1	0	5 <sup>a</sup>	..	..	..	..
		6.5	5	..	..	..	..
	5	0	<10 <sup>b</sup>	<10	..	..	..
		6.5	<10	..	..	..	..
	10	0	<10 <sup>b</sup>	..	<10	<10	<10
		6.5	11	..	13	11	..
New Jersey	1	0	7 <sup>a</sup>	..	..	..	..
		8	7	..	..	..	..
	5	0	<10 <sup>b</sup>	<10	..	..	..
		8	16	..	..	..	..
	10	0	..	23	<10	<10	..
		8	..	<10	<10	<10	..

<sup>a</sup> Control samples taken prior to application.

<sup>b</sup> Represents 7 days after fourth and ninth applications.

TABLE 5.—Abate insecticide residues in water from ponds treated at 1.0 lb. Abate per acre.

Location	Sampling depth (feet)	p.p.b. Abate						
		Hours after treatment						
		Pretreatment	1	8	24	48	168	504
California	0	11	311	17	<10	<10	10	..
	6.5	11	54	<10	10	<10	<10	..
New Jersey	0	3	105	103	49	45	16	<10
	8	7	<10	<10	<10	27	<10	<10

TABLE 6.—Abate insecticide residues in mud from streams and ponds treated at 0.1 lb. Abate per acre at weekly intervals.

Location		Number of applications	Sampling site (ft. downstream)	p.p.m. Abate		
				Hours after treatment		
				Pretreatment <sup>a</sup>	24	168
California	Pond	10	..	0.10	<0.1	<0.1
	Stream	10	0	0.08	<0.1	<0.1
			500	0.06	<0.1	<0.1
			1500	0.08	<0.1	<0.1
New Jersey	Pond	10	..	0.10	<0.1	<0.1
	Stream	10	0	0.06	<0.1	<0.1
			500	0.06	<0.1	<0.1
			1500	0.08	<0.1	<0.1

<sup>a</sup> Control samples taken prior to tenth application; represents 7 days after ninth application.

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