FACTORS AFFECTING THE STABILITY OF THE CARBAMATE INSECTICIDE, RE11775

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ABSTRACT. RE11775 has limited stability in water, which is dependent on temperature, light, and microorganisms. The insecticide rapidly dissipates under field conditions, which is a particularly favorable property with respect to the current concern of regulatory agencies over pollution.

INTRODUCTION

The carbamate insecticide, RE11775 (m-sec-butylphenyl N-methyl-N (phenylthio) carbamate), has remarkable activity against larvae and adults of organophosphorus-resistant strains of mosquitoes (Schaefer and Wilder, 1970). Because of this promising biological activity, it was of considerable interest to obtain chemical stability data. No analytical method was available, but bioassay techniques allowed us to study the effects of temperature and sunlight under laboratory conditions and to obtain preliminary residue data following the treatment of a sewage-holding pond, an alfalfa field, and a pasture.

GENERAL METHODS. Bioassays were conducted as described by Gillies *et al.* (1968). Pyrex jars were silanized (to prevent or minimize adsorption) by methods previously described (Schaefer and Dupras, 1969).

PROCEDURES AND RESULTS

STABILITY OF RE11775 SOLUTIONS TO SUNLIGHT. Duplicated series of concentrations of RE11775 in silanized, pyrex jars, each containing 100 ml of tap water, were placed at 80° F in the dark and outside, in a tray of water, in direct sunlight. After 8 hours all of the samples were analyzed for RE11775 concentration by bioassay. The results are shown in Table 1. Over 60 percent of the RE11775 was lost in 8 hours in sunlight while loss was much less in darkness.

HYDROLYTIC STABILITY OF RE11775 IN RELATION TO TEMPERATURE. Silanized glass jars containing 0.1 ppm RE11775, in 100 ml of tap water, were held for 0, 24, 48, and 72 hours at 10°, 24°, and 38° C in darkness. Triplicate jars were held under each condition. After the respective holding times, the concentrations of RE11775 were determined by bioassays. The results are shown in Table 2. It is apparent that under summer field water temperature conditions (24°–38° C) stability is quite limited.

STABILITY OF RE11775 IN POLLUTED WATER. Since polluted water sources, e.g., dairy drains and sewage-holding ponds, frequently produce large numbers of *Culex* species, chemical control is often necessary. Since RE11775 is very effec-

TABLE 1.—Stability of RE 11775 solutions in sunlight and darkness

	Percent Reduction in RE11775 After 8 Hours				
Initial concentration (ppm)	.1	.07	.045	.030	.020
Dark (80° F.)	0	0	32	30	20
Sunlight	64	61	62	63	70

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TABLE 2.—Effect of temperature on the hydrolytic stability of RE11775

Percent of Initial RE11775 Concentration (0.1 ppm)			
	Holding Time (Hours)		
Temperature (° C.)	24	48	72
10	100	100	73
24	20	5	0[1]
28	0	0	0

[1] 0 = less than 0.003 ppm.

tive against *Culex* larvae, knowledge of its stability in polluted water habitats is important.

A 0.94 acre sewage-holding pond (184 x 227 ft. x 30 in. depth) near Caruthers, California, was selected as a test site; this pond is a secondary holding pond for raw (untreated) sewage. One pint of RE11775 2 lb AI/gal EC was poured into the inlet to give a theoretical initial concentration of 0.1 ppm. After 8, 24, and 48 hours, samples containing water and organic matter were taken from each of the pond corners and the midpoints of each side, and an effluent water sample was taken from the overflow pipe. The samples were transported to the laboratory and bioassayed. A set of samples taken at the same points just prior to treatment showed no toxicity. Table 3 shows post-treatment concentrations of RE11775 in the samples.

It is apparent that RE11775 dissipates rapidly in the sewage water; only 10 percent of the theoretical concentration was present at 8 hours. A similar test with Dursban®, using the same pond, showed almost 100 percent of the theoretical concentration at eight hours (Schaefer and Dupras, 1970).

TABLE 3.—Concentration of RE11775 (PPM) in samples collected from a sewage-holding pond

	Post-Treatment Time (Hours)		
Sample	8	24	48
1C[1]	.0090	0.0[3]	0.0
2S[2]	.0075	0.0	0.0
3C	.0095	0.0	0.0
4S	.0100	0.0	0.0
5C	.0080	0.0	0.0
6S	.0078	0.0	0.0
7C	.0077	0.0	0.0
8S	.0083	0.0	0.0
Effluent	.0105	0.0	0.0

[1] C = one of pond corners.
[2] S = one of midpoints of a pond side.
[3] 0.0 = less than .003 ppm.

In order to explain the rapid decrease in RE11775 in the sewage water, further laboratory tests were conducted. The stability of RE11775 in water collected from the sewage-holding pond was compared to that in tap water; duplicate glass silanized jars containing 100 ml of sewage-pond water or tap water were treated with .03, .02, and .01 ppm of RE11775 and were held at room temperature for 8 and 24 hours and then bioassayed. The results are shown in Table 4. These data show that the short half-life of RE11775 in the pond test was due to the effect of sewage water.

It appeared that the lack of stability of RE11775 in the sewage water must have been due to the effects of microorganisms, rather than to water quality. To study the latter possibility, another laboratory test was conducted as described above

TABLE 4.—Stability of RE11775 in sewage water and in tap water

	Percent of Initial Concentration					
	Holding Time (Hours)					
	8			24		
Initial concentration (ppm)	.03	.02	.01	.03	.02	.01
Tap water	100	100	100	37	40	0[1]
Sewage water	0	0	0	0	0	0

[1] 0 = less than .003 ppm.

except that the sets of jars contained tap water, sewage water, and sewage water that had been boiled and then cooled to room temperature. After RE11775 was added to the jars at .03, .02, and .01 ppm, the bioassay was begun immediately. The results are shown in Table 5. It is apparent, even without holding the various types of water for given post-treatment periods, that sterilization of the sewage water eliminates the deleterious effect on RE11775; thus, the lack of stability of RE11775 in sewage water is due to microbial action.

TABLE 5.—Stability of RE11775 in tap water, sewage water and in sterilized sewage water

	Percent of Initial Concentration		
Initial concentration	.03	.02	.01
Tap water	100	100	100
Sewage water	100	70	0 [1]
Boiled sewage water	100	100	100

[1] 0 = less than .003 ppm.

STABLITY OF RE11775 IN FIELD WATER AFTER AIRCRAFT APPLICATION OF 0.1 LB/ACRE. Since the largest potential use of RE11775 appears to be for control of irrigated pasture mosquitoes, it was important to determine the stability of this insecticide in field water following aircraft application by typical, operational methods.

TABLE 6.—Concentration of RE11775 (PPM) in field water after aircraft application of 0.1 lb/acre

	Post-Treatment Time (Hours)		
Station	0.5	4	8
1	0.037	0.0 [1]	0.0
2	0.030	0.0	0.0
3	0.031	0.0	0.0
4	0.024	0.0	0.0
5	0.025	0.0	0.0
6	0.026	0.0	0.0
7	0.044	0.0	0.0
8	0.026	0.0	0.0
9	0.058	0.0	0.0
10	0.050	0.0	0.0

[1] 0.0 = less than .003 ppm.

FIRST TEST. A 10-acre alfalfa field having 4 to 6 inches of standing water and 6 to 8 fourth-instar *Aedes nigromaculis* larvae/dip was sprayed by aircraft with 0.1 lb/acre of RE11775. The water had been standing 5 to 6 days, was a dark color, and had a pH of 8.7. Ten sampling stations were established over the field and post-treatment water samples were collected at 30 minutes, 4 and 8 hours. Water samples were analyzed for RE11775 concentration by bioassay methods within 30 minutes of collection. Larval mortality in the field population was 100 percent within 2 hours after treatment. Bioassays of the field water show rapid dissipation of RE11775 (Table 6).

TABLE 7.—Concentration of RE11775 (PPM) in field water following aerial application and in cups of field and tap water treated with 0.1 PPM.

	Post-Treatment Time (Hours)				
Field Station	0.5	2	4	6	8
1	0.0480	0.0066	0.0 [1]	0.0	0.0
2	0.0490	0.0	0.0	0.0	0.0
3	0.0460	0.0170	0.0155	0.0	0.0
4	0.0530	0.0270	0.0165	0.0	0.0
5	0.0380	0.0110	0.0	0.0	0.0
6	0.0220	0.0069	0.0100	0.0130	0.0125
7	0.0270	0.0280	0.0225	0.0175	0.0135
8	0.0410	0.0115	0.0	0.0	0.0
9	0.0490	0.0150	0.0165	0.0	0.0
10	0.0510	0.0062	0.0200	0.0165	0.0060
Field H_2O in jars	0.0220	0.0117	0.0087	0.0108	0.0100
Tap H_2O in jars	0.0395	0.0482	0.0510	0.0520	0.0300

[1] 0.0 = less than 0.003 ppm.

SECOND TEST. A 30-acre pasture containing large numbers of third instar *Aedes nigromaculis* larvae and having 3 to 6 inches of water, which had been standing 4 to 5 days, was treated as above. Ten sampling stations were selected, but in addition samples of field water and of tap water were treated with a standard acetone solution of RE11775 to give an initial concentration of 0.1 ppm; these samples were held in silanized glass jars under field conditions and duplicate samples of each were analyzed at each time that field water samples were taken. At 30 minutes, 2, 4, 6, and 8 hours, field samples were collected from each station and were bioassayed for RE11775 concentration. No live larvae were found in the field 2 hours after spraying. The bioassay results of RE11775 are shown in Table 7.

It is apparent that RE11775 has very limited stability in pasture water; 70 percent of the samples had no biological activity by 8 hours after treatment. The slightly higher stability in the second field test may be due to the fact that the water had not stood as long as that in the first test, and the microbial activity may have been less. It is also apparent that RE11775 is more stable in tap water than in the field water, as was previously demonstrated.

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