

EVALUATION OF FIVE FORMULATIONS OF ABATE AGAINST *Aedes Aegypti*, SAVANNAH, GEORGIA, 1965¹

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Limited field trials with granular formulations of various insecticides against *Aedes aegypti* breeding in water storage drums (Brooks *et al.* 1965) showed Abate³ to possess excellent larvicidal qualities when applied in this type container. Early applications of several formulations for residual effectiveness indicated the granule to be satisfactory for an acceptable period but superior results were obtain-

able with emulsifiable concentrates. Unfortunately, in operational use, the available emulsifiable concentrate formulations clouded the water to an extent unacceptable by the public. An interest in finding an acceptable formulation for general use stimulated a comparative study of the residual effectiveness of several granular and liquid Abate formulations.

MATERIALS AND METHODS. Seventy 55-gallon steel drums, as described by Brooks and Schoof (1965), were assembled as test containers. Treatment levels selected were based on application rates used in earlier field and simulated field studies (Brooks *et al.* 1965). The formulations⁴ em-

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³ Use of trade names is for identification purposes only and does not constitute endorsement by the Public Health Service or the U. S. Department of Health, Education, and Welfare.

⁴ Furnished through the courtesy of American Cyanamid Company, Princeton, New Jersey. (Abate: O,O,O',O'-tetramethyl O,O'-thiodi-*p*-phenylene phosphorothioate.)

ployed in these tests consisted of the following:

Liquid formulations

1. Twenty percent Abate in Panasol.
2. Forty-five percent Abate, 45 percent Atlox 3409, 10 percent xylene.

Granular formulations

1. One percent Abate on 30/60 mesh bentonite granule.
2. Two percent Abate on Celatom granule.
3. One percent Abate on sand granule.

Granular formulations were applied to 50 gallons of water at calculated weights to give treatment levels of 0.1, 1.0, and 2.5 ppm. Liquid treatments were made at 0.1, 0.25, and 1.0 ppm. Both liquid and granular formulations were tested at these dosages with the exception of a special series of bentonite granules set up to test shelf-life which were treated at 1.0 and 2.5 ppm levels only. Three replicate containers were used with the Celatom granule and the bentonite shelf-life series. All other formulations and dosages were replicated in four drums each.

Evaluation of the effectiveness of each treatment was made using 3rd instar DDT-dieldrin resistant *A. aegypti* larvae of the Charlotte Amalie strain. The ability of the treatment to kill within 24 hours or to prevent completion of the life cycle of the test larvae was used as a measure of the persistency of the treatment. The point at which less than 100 percent larval mortality occurred was selected as the point of failure of the treatment. Approximately 50 larvae were planted weekly in each drum and observed at 24-hour intervals for mortality.

RESULTS. As seen in Table 1, the liquid formulation of Abate in Panasol produced effective results for 3, 4, and 19 weeks at the 0.1, 0.25, and 1.0 ppm dosage levels. The emulsion formulation with Atlox and xylene was effective for the full 19-week test period at all dosage levels tested. The 1 percent sand and 2 percent Celatom formulations produced satisfactory mortalities for 19 and 18 weeks when applied at the 2.5 ppm level. Less than 14 weeks of

kills occurred with the 1.0 and 0.1 ppm applications of these same formulations. The newly formulated bentonite granule produced residual effectiveness for 17 and 19 weeks at 1.0 and 2.5 ppm, respectively, while at the same dosages the 7-month-old formulation killed for less than 14 weeks.

DISCUSSION. All formulations tested gave 100 percent kills at 1.0 ppm applications for 13 weeks or longer, thus confirming earlier reports of the excellence of Abate as a residual larvicide. Although the residual life is important, the formulation must also be acceptable in appearance upon introduction into the water (Brooks *et al.* 1965). Since one of the basic problems is public reaction to any foreign matter placed in water drums, evaluation of the appearance factor was necessary. The emulsifiable concentrate formulations used in earlier tests clouded the water considerably and were highly objectionable to the householders. The Panasol and Atlox emulsions did not cause the same degree of milkiness; however, they did, upon close observation, produce a slight bluish tinge discernible when the solution was poured into the drums. Upon standing for approximately a week, the cloudy appearance disappeared and was indistinguishable from the untreated drum.

Concurrent studies have indicated the rate of release of the toxicant from the granular formulation to be approximately 50 percent in 48 hours. Further, the

TABLE 1.—Average weeks of 100 percent kills with five Abate formulations against *A. aegypti* (Charlotte Amalie strain).

Formulation	Dosage in ppm			
	0.1	0.25	1.0	2.5
20% in Panasol	3	4	19	..
45% Abate, 45% Atlox + 10% xylene	19	19	19	..
1% on sand	3	..	14	19
2% on Celatom	7	..	13	18
1% on bentonite 30/60 mesh (newly formulated)	2	..	17	19
1% on bentonite 30/60 mesh (aged 7 months)	14	10

average concentration in ppm never increased much above this level regardless of the period of time the treatment remained in the water. At the 1.0 ppm dosage then, the liquid formulation produces a higher ppm concentration than does the granular preparation. Even so, these data again indicate that biologically the liquid preparations are superior to the granular formulations.

Although the addition of granular material is objectionable in principle, it creates less objection by the householder because the granules settle to the bottom of the drum and do not cloud the water or make it appear dirty. A second factor in favor of the granular formulation is that operational personnel can visually differentiate between a treated and an untreated water container. The disappearance of the emulsifiable treatment prohibits visual spotting of untreated vessels. The granular formulation is still the formulation of choice because of its innocuous appearance and ease of handling. The major drawbacks associated with it are the low concentration of toxicant and the weight of the material involved in shipment or in treatments of large water volumes. Although ideal for 50-gallon water drums (18.9 g. of 1 percent Abate on sand), a cistern containing 5,000 gallons of water would require 1.89 kg of the same sand granule for a 1 ppm dosage.

Comparison of the shelf life of a 7-month-old bentonite granular formulation with a freshly formulated batch of the same composition verified reports received of the limited shelf life of this formulation. A 3- to 9-week greater kill was observed with the new formulation against the old. While the effects of age are not too important in a rapidly moving control program, the fact that sand granules show little or no change during storage makes this the most efficient formulation. No tests were carried out for comparison of the shelf life of the Celatom granule.

SUMMARY. Five formulations of Abate were biologically assessed for residual effectiveness against *A. aegypti* at Savannah, Georgia, in 1965.

The two liquid preparations indicated, as a whole, superior performance over granular formulations. The emulsifiable liquid combining 45 percent Abate with 45 percent Atlox-xylene produced complete kills for 19 weeks at 0.1, 0.25, and 1.0 ppm dosages against 3, 4, and 19 weeks at these respective levels with 20 percent formulations in Panazol.

Sand granules were superior under simulated conditions to both Celatom and bentonite formulations. At treatment levels of 0.1, 1.0, and 2.5 ppm, 1 percent Abate on sand gave 3, 14, and 19 weeks of kill for the respective dosages. On the other hand, 2 percent on Celatom and 1 percent on bentonite gave satisfactory mortalities for 7, 13, 18 and 2, 17, and 19 weeks, respectively.

Tests on aged and fresh formulations of bentonite granules containing 1 percent Abate showed a reduction of from 3 to 9 weeks in residual life after 7 months of storage.

Undesirable discoloration of the water in the drum and difficulty in visual observation of treatment by the liquid formulation again would make the granular formulation the compound of choice for field application.

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