LABORATORY EVALUATION OF ABATE AND MALATHION INSECTICIDAL BRIQUETTES[1]

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Insecticidal briquettes have been used to control mosquito larvae for many years. Raley and Davis (1949) used a mixture of casting plaster, sawdust and a DDT-lindane combination cast in a perforated tin can to control mosquito larvae in ponds and streams in the San Joaquin Valley of California. They obtained better results when formed briquettes were either suspended by wire into the breeding sites or were made to float by attaching them to wooden blocks. Elliot (1955) demonstrated that briquettes made of sand, cement and 50 percent water-wettable dieldrin controlled *Aedes aegypti* Linnaeus in water jars in Africa for periods up to one year. Evans and Fink (1960) showed that dieldrin impregnated cement briquettes killed *Aedes aegypti* in fire barrels and that the latter remained free of reinfestation for 150 days. Laird (1967) found that dieldrin impregnated cement briquettes retained larvicidal properties after almost five years in an extensive field test in the Tokelau Islands. Chromatographic analysis of a sample of these briquettes showed 40–50 percent of the initial available dieldrin remained in the briquettes after five years in the field. Symes, Thompson, and Busvine (1962) mention the use of small plaster of paris bricks containing 0.75 percent (by weight) lindane for control of mosquito breeding in rice fields.

The concept of using insecticidal briquettes as mosquito larvicides to attain long residual action has been closely associated with the use of chlorinated hydrocarbon insecticides which have long residual properties. In view of the extremely low insecticide residues permitted in food and water for human use, the chlorinated hydrocarbon pesticides have become hazardous to use for mosquito control in many areas. Some of the organo-phosphorus (OP) pesticides have demonstrated considerable promise as mosquito adulticides and larvicides. The low toxicity to wildlife due to rapid detoxication of the OP compounds is a major factor in their wide acceptance. An important shortcoming of many of these compounds has been their rapid hydrolysis in water, particularly when exposed to highly alkaline conditions.

The purpose of tests reported in this paper was to extend the residual effect of selected OP compounds used as larvicides against *Culex pipiens pipiens* Linnaeus larvae under laboratory conditions. The object was to incorporate the compound in a substrate which would permit either slow diffusion or release of the toxicant into the water while protecting the remaining material from hydrolysis and other types of decomposition. Such briquettes might be placed into either stagnant pools or running water in adequate numbers or at sufficient concentrations to dose a given volume of water to a desired concentration of toxicant. Malathion (o,o-dimethyl phosphorodithioate of diethyl mercaptosuccinate) was chosen for its low toxicity to wildlife, its short residual life when used in liquid formulations as a larvicide, and its availability on the standard military stock list. Another more persistent OP compound, Abate®[2] (o,o,o′,o′-tetramethyl o,o′-thiodi *p*-phenylene phosphorothioate), was incorporated into bri-

[1] The use of trade names is for identification purposes only and does not imply endorsement by the U. S. Army.

[2] Abate® is a trademark of the American Cyanamid Company.

quettes to evaluate against the malathion standard.

METHODS AND MATERIALS. Three different types of briquettes were used when testing topically applied treatments: commercial charcoal briquettes; casting plaster—tap water (2:1); and a commercial brand of ready-mix concrete, casting plaster, and tap water mixed in the ratio of 205:10:36. The latter two briquette mediums were cast in plastic ice cube trays. Briquettes were treated by pipetting 4 ml. of a 2.5, 5.0, and 10.0 percent (v/v) solution of technical malathion in acetone and a 1.0, 2.0, and 4.0 percent (v/v) solution of technical Abate in acetone upon the desired number of each type of briquette. Control briquettes were treated with 4 ml. of acetone. All briquettes were aged for 72 hours under a hood after treatment.

Twenty late third instar *Culex pipiens pipiens* L. larvae from a DDT and malathion susceptible laboratory colony were added to a labelled 13-inch-diameter enamel wash pan containing 2000 ml. of tap water. Larvae were fed and permitted to stabilize 24 hours prior to addition of the briquettes. All concentrations of malathion, Abate and controls were replicated three times. Mortality counts were made daily. Briquettes were removed from the pans at scheduled intervals, the pans cleaned, heat sterilized, refilled, and food and new larvae added. The larvae were stabilized again before briquettes were replaced for the subsequent test. Maximum and minimum laboratory temperatures were recorded daily.

RESULTS. The data in Table 1 are a summary of results obtained with three types of insecticide-impregnated briquettes. Mortality during the 24-hour stability periods was negligible, averaging less than 0.3 percent for all pans. Excellent control was obtained using all three types of briquettes impregnated with either malathion or Abate, except the malathion-concrete formulation which gave poor control after the second water change. Table 2 lists the

TABLE 2.—Initial insecticide concentrations in briquettes.

Insecticide	% Concentration	mg. in Briquette
Malathion [a]	2.5	116.85
	5.0	233.70
	10.0	467.40
Abate [b]	1.0	45.51
	2.0	91.02
	4.0	182.04

[a] sp. gravity 1.23; 95% technical grade.
[b] sp. gravity 1.32; 86.2% technical grade.

TABLE 1.—Control longevity and average percent mortality of *Culex pipiens pipiens* L. larvae using topically treated briquettes.

Compound (in medium)	% concentration	Av. 24-hr. mortality/ water change (%)	24-hr. mortality final water change (%)	No. water changes	Days briquette immersed
Malathion	2.5	96	80	..	..
(charcoal)	5.0	100	100	7	35
	10.0	100	100	..	..
Malathion	2.5	34	...	..	..
(concrete)	5.0	26	0	5	17
	10.0	31	...	..	..
Malathion	2.0	...	...	..	..
(casting plaster)	5.0	100	100	7	35
	10.0	...	...	..	..
Abate	1.0	...	...	..	..
(all mediums)	2.0	100	100	7	36
	4.0	...	...	..	..
Acetone control	0	8	6	7	36
(all mediums)	...	...	...	..	..

initial concentrations of insecticide applied to each briquette in milligrams of actual insecticide per briquette.

DISCUSSION. Data obtained during these laboratory tests indicate the briquette formulations tested, with the exception of malathion-concrete, may be particularly useful to control mosquito larvae in intermittent pools, e.g., roadside ditches, irrigated pastures, woodland pools, and artificial containers. However, higher insecticidal concentrations within such briquettes may be required for field application. Laboratory tests to determine maximum longevity of insecticidal briquettes are continuing and field evaluations using briquette formulations are underway.

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NEMATODE PARASITES OF CULICIDAE AND CHAOBORIDAE IN LOUISIANA[1]

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The following 16 species of mosquitoes in North America were reported as hosts of nematodes: *Aedes canadensis, A. cinereus, A. communis, A. decticus, A. excrucians, A. flavescens, A. impiger, A. nigripes, A. pionips, A. pullatus, A. punctor, A. sollicitans, A. sticticus, A. vexans, Culex pipiens, and C. salinarius* (Jenkins, 1964). Additionally, two species of Chaoboridae, *Mochlonyx* sp. and *Chaoborus* sp., were reported as hosts in Canada (Welch, 1960).

However, most host records of mosquitoes are from Canada northward, and only 4 of the 14 species of *Aedes* (*A. cinereus, A. sollicitans, A. sticticus,* and *A. vexans*) are multivoltine. Also, in many localities, *A. cinereus* and *A. sticticus* behave as univoltine species because of climatological or ecological factors.

Our laboratory has surveyed many larval and adult mosquito populations in southwestern Louisiana for pathogens and parasites. Larval populations of chaoborids were also collected periodically and examined for parasites and pathogens since most chaoborid larvae, even those of *Corethrella,* are very efficient predators of mosquito larvae. As shown in Table 1, nematodes were present in eight species of mosquitoes and one species of a chaoborid collected from 1964–1967. All were multivoltine species.

Aedes sollicitans. The life cycle of *Agamomermis culicis* in *Aedes sollicitans*

[1] In cooperation with McNeese State College, Lake Charles, Louisiana.