EVALUATION OF FENTHION AND BAYGON® MIXTURES FOR CONTROL OF ADULT *AEDES AEGYPTI* (L.) WHEN APPLIED AS THERMAL-FOG

O. E. SHIPP AND W. E. HAZELTINE
Chemagro Corporation, Kansas City, Missouri

Fenthion (BAYTEX®) *O,O*-Dimethyl-*O*-[4-(methylthio)-*m*-tolyl] phosphorothioate,[1] and BAYGON® (*o*-Isopropoxyphenyl methylcarbamate)[1] have been reported to control adult mosquitoes successfully when applied as a thermal fog (Gahan *et al.*, 1965; Lewallen, 1964). Knapp and Pass (1966) stated that both fenthion and malathion could possibly be improved by an additive compound which would cause a more rapid knockdown by these chemicals for adult mosquito control when applied as low-volume concentrates.

This study was initiated after a report of successful control of *Aedes stimulans* (Walker) with fenthion and BAYGON mixtures applied as low-volume aerial sprays in several swampy areas near Gobles, Michigan (Stevens and Stroud, 1966).

The purpose of this study was to evaluate the efficacy of various mixtures of fenthion and BAYGON for adult mosquito control when applied as a thermal fog.

MATERIALS AND METHODS. The chemicals used for this test were BAYGON 10 percent oil-soluble concentrate and fenthion 8 pounds per gallon liquid concentrate. The chemicals were diluted with Diesel oil No. 2 to the desired concentration as percent by weight. The insecticide-Diesel oil solutions were applied with a Dyna-Fog 70® insecticidal fog applicator which employs a resonant pulse-jet engine for fog generation. The oil-solution was dispensed with the machine controls adjusted so that the fog was just at the point of wetness when a flat object was moved rapidly through the fog a few inches from the machine discharge. This machine was modified by the manufacturers to accommodate external pressure and feed lines which by-passed the insecticidal tank on the machine (See figure 1).

The various treatments were made using these insecticides contained in individual pint jars which were fitted with a top modified by soldering in two copper tubes (See figure 2). The first copper tube was a long tube extending to the jar bottom which was joined by Tygon tubing to the chemical container connection of the machine. The second copper tube, which was shorter, was joined to the pressure source connection of the machine.

After each treatment application any remaining insecticide was removed and the machine flushed with Diesel oil No. 2.

The bioassay was made using unsexed, 3- to 5-day old *Aedes aegypti* (L). The mosquitoes were caged in 8-inch long, 18 mesh screen cylinders and were exposed to the oil-insecticide fog using a wedge shaped plywood fogging chamber (See figure 3). The fogging chamber was made 12 feet long with the narrow end, apex, having an opening of 4 inches for the insertion of the fogger nozzle, and the base having an opening of 3½ x 3 feet for the removal of the fog. Ten feet from the narrow end a 6-inch hole was cut into the top of the chamber to allow introduction of the caged mosquitoes into the fog. An 8-inch by 3½ foot baffle board was positioned immediately in front of the 6-inch hole to provide an exposure point for the caged mosquitoes which would be sub-

[1] Fenthion (BAYTEX®) *O,O*-Dimethyl *O*-[4-(methylthio)-*m*-tolyl] phosphorothioate. Reg. U. S. and Canadian Pat. Offs. by Farbenfabriken Bayer A. G., Chemagro Corporation licensee. BAYGON® *o*-Isopropoxphenyl methylcarbamate. Reg. U. S. Pat. Offs. by Farbenfabriken Mayer A. G., Chemagro Corporation licensee. Trademark in Canada.

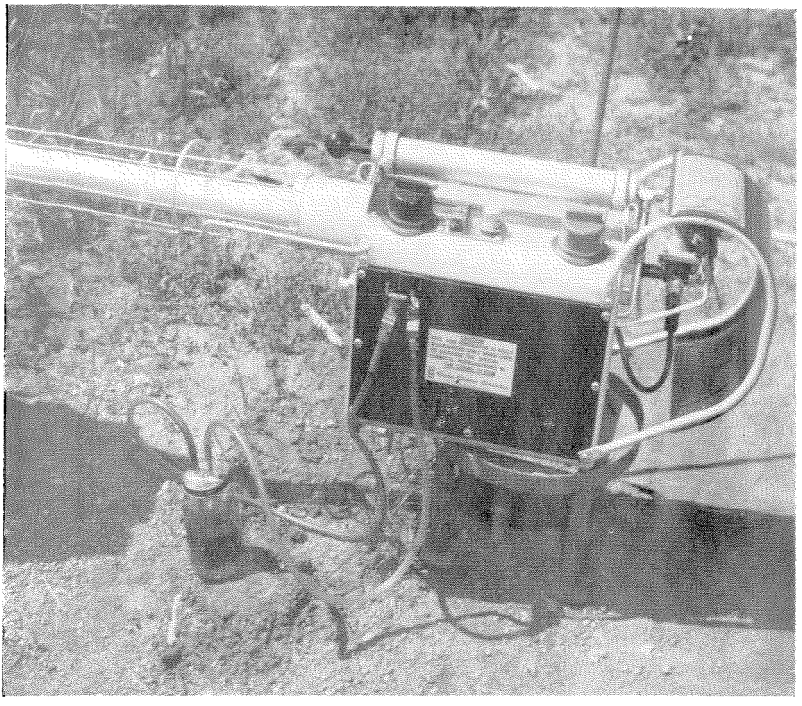

FIG. 1.—Dyna-Fog 70® with side connection modifications for using pint jar to hold insecticide-oil treatments. Modifications made by engineers of Carmen Chemical Corporation, Westfield, Indiana.

ject to oil droplets of uniform size. The fog machine discharge nozzle was placed just within the narrow, 4-inch, opening of the chamber and the fog passed through an area of 9 square feet at the point of mosquito exposure. In use, the fogging chamber was positioned with the long axis at a 90° angle to the wind. This permitted all the fog to flow through the chamber, around the baffle board and through the bioassay cage with minimum loss before passing out the large open end of the chamber.

Three tests were conducted to evaluate several ratio mixtures of fenthion and BAYGON in Diesel oil No. 2. In all tests the mosquitoes were exposed to the oil fog for 10 seconds. In the first and second tests the mosquitoes were held in the treatment cages for mortality observations. In the third test the mosquitoes were removed from the treatment cages within 15 minutes after exposure to the oil-fog and placed in 250 ml. Erlenmeyer flasks for mortality observations. Mortality counts were made at intervals to 18 hours for the first and second test and to 24 hours for the third test. During the period for the mortality counts the mosquitoes were held without feeding in the laboratory at a temperature of 85° F. and 30 to 40 percent R.H. Adjustments for mortality in the controls were made using Abbott's formula (1925).

RESULTS AND DISCUSSION. The results from Test 1 are presented in Table 1. These data are from exposing the caged mosquitoes to the oil-fog for 10 seconds and holding them in the treatment cages during the period of mortality observations. The data of Test 1 indicate that at the dosage of 0.0625 percent active ingredient, the BAYGON treatment apparently effected a quicker mortality than

fenthion. Treatment with a mixture ratio of 1:1; 2:1; or 4:1 (fenthion:BAYGON) did not effect a more complete kill than for fenthion treatments alone. The data from Test 2 are presented in Table 2. These data do not reveal any increased speed of kill of mosquitoes exposed to the combination of fenthion and BAYGON at the ratios of 5:1, 10:1, and 20:1 (fenthion:BAYGON).

The data of Tables 1 and 2 represent mortalities of the adult mosquito after repeated exposure to the treatments which deposited on the screen cage used to expose the mosquito to the chemical and to contain the mosquito during the test period. It was judged necessary to remove the mosquitoes as quickly as possible from the treatment cages and hold them in untreated containers for mortality observations in order to approximate field conditions. The results of Test 3 in which the mosquitoes were removed from the treatment cages within 15 minutes after exposure to the chemicals are presented in Table 3.

These data indicate that although BAYGON treatments effected a quicker mortality of adult *Aedes aegypti,* fenthion treatments at the same concentrations were equally efficacious, but required a longer period of time to effect equal mortality. This can be shown by comparing the results of the chemicals applied alone at dosages of 0.3125 percent and 0.15625 percent concentration. The 30-minute readings for the BAYGON treatments were 25 percent and 10 percent mortality for these respective concentrations whereas the fenthion treatments at the 30-minute intervals caused no mortality. At these same concentrations in 24 hours, the fenthion

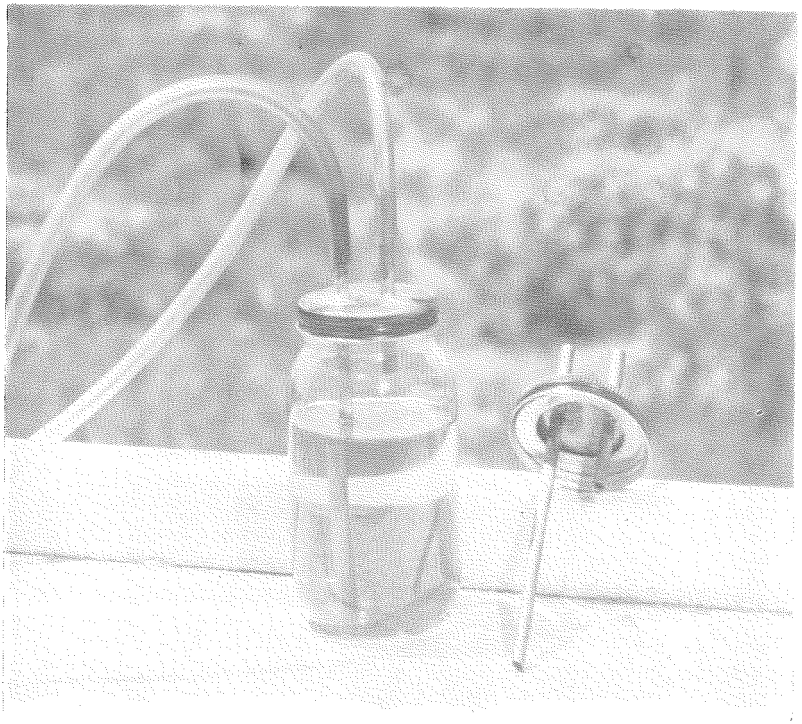

FIG. 2.—Pint jar with top modified by soldering in two copper tubes to dispense the insecticide-oil solutions.

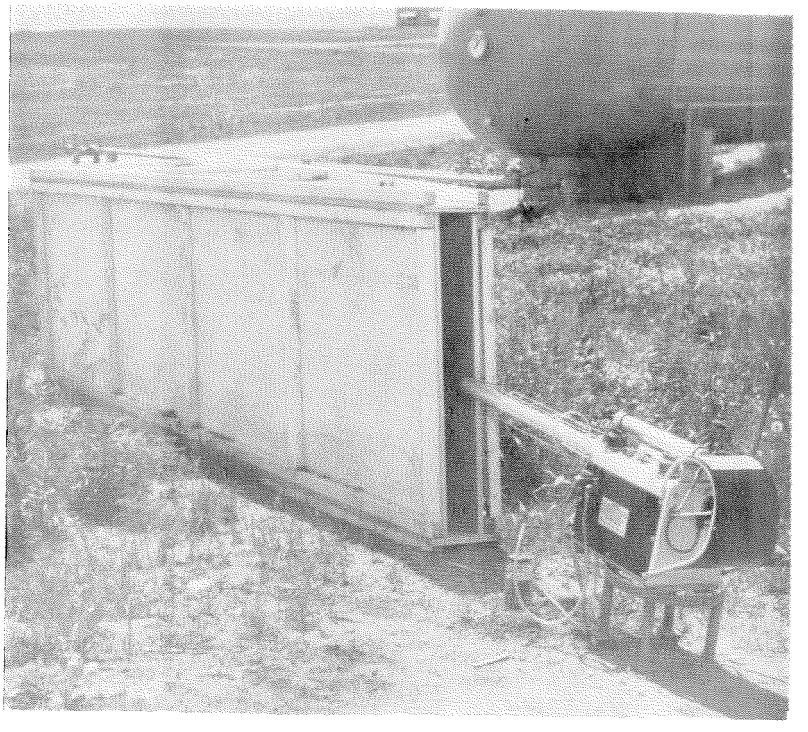

FIG. 3.—Oil-fogging chamber with oil-fog machine in position for use. Note the muzzle of machine positioned just within the open small end of chamber.

TABLE 1.—Percent mortality of adult mosquitoes from BAYGON or fenthion applied by thermal-fog in Diesel oil No. 2. Time of exposure, 10 seconds. Test number 1.

Treatment	Percent AI in Diesel No. 2	Percent Mortality[a] at			
		30 Min.	1 Hr.	2 Hrs.	18 Hrs.
fenthion	0.50	100	100	100	100
	0.25	60	70	100	100
	0.125	0	60	80	100
	0.0625	0	0	0	100
	LSD 5%	16	16	16	..
BAYGON	0.25	30	70	90	100
	0.125	20	50	100	100
	0.0625	0	40	40	100
	0.03125	0	30	40	100
	LSD 5%	5	16	23	..
fenthion+BAYGON 1:1	0.125+0.125	30	100	100	100
2:1	0.125+0.0625	30	90	100	100
4:1	0.125+0.03125	5	21	100	100
	LSD 5%	5	21	10	10
Control		0	0	0	0

[a] Average of three replicates of ten mosquitoes each.

TABLE 2.—Percent mortality of adult mosquitoes from BAYGON or fenthion applied as thermal-fog in Diesel oil No. 2. Time of exposure, 10 seconds. Test Number 2.

Treatment	Percent AI in Diesel No. 2	Percent Mortality[b] at 30 Min.	1 Hr.	2 Hrs.	18 Hrs.
fenthion	1.250	100	100	100	100
	0.625	80	100	100	100
	0.3125	60	75	100	100
	0.15625	20	50	100	100
	LSD 5%	20	27	..	..
BAYGON	0.24	100	100	100	100
	0.125	45	64	73	100
	0.0625	20	33	33	100
	0.03125	20	20	20	100
	LSD 5%	20	20	20	..
fenthion+BAYGON 5:1	0.3125+0.0625	40	67	100	100
10:1	0.3125+0.03125	30	50	100	100
20:1	0.3125+0.015625	20	33	100	100
	LSD 5%	10	10	..	..
Control		0	0	0	0

[b] Average of three replicates of 8 to 10 mosquitoes each.

treatments effected 81 percent and 40 percent mortality whereas BAYGON treatments caused a 62 percent and 51 percent mortality.

The mortalities resulting from exposing adult *Aedes aegypti* to mixtures of fenthion and BAYGON indicate that mixture ratios of 1:1 and 2:1 (fenthion:BAYGON) gave a greater mortality in a shorter period of time than the 3:1 or 4:1 mixture ratios.

SUMMARY AND CONCLUSIONS. A comparison of the combinations of fenthion and BAYGON with the appropriate concentrations of either chemical applied singly indicated that the speed of kill of

TABLE 3.—Percent mortality of adult mosquitoes exposed to BAYGON or fenthion in Diesel oil No. 2 and removed from treatment cages within 15 minutes of exposure. Time of exposure, 10 seconds.

Treatment	Percent AI in Diesel No. 2	Percent Mortality[a] at 30 Min.	1 Hr.	2 Hrs.	6 Hrs.	24 Hrs.
fenthion	1.25	0	14	72	94	100
	0.625	0	5	59	87	100
	0.3125	0	0	18	58	81
	0.15625	0	0	0	23	40
	LSD 5%	..	4	24	23	20
BAYGON	0.3125	25	31	33	45	62
	0.15625	10	10	20	29	51
	0.0390625	6	6	6	36	47
	0.078125	0	0	3	14	32
	LSD 5%	8	10	10	10	10
fenthion+BAYGON						
1:1 ratio	0.3125+0.3125	18	23	44	82	84
2:1 ratio	0.3124+0.15625	19	34	38	74	80
3:1 ratio	0.3125+0.1041	3	6	13	48	90
4:1 ratio	0.3125+0.078125	6	6	11	59	92
	LSD 5%	5	10	11	11	4
Control		0	0	0	13	19

[a] Average of four replicates of ten mosquitoes each.

fenthion was enhanced by the addition of BAYGON.

The ratio mixtures of 1:1 and 2:1 fenthion:BAYGON appeared to be the most effective for obtaining a quick mortality of adult *Aedes aegypti*.

The mixture ratios of 3:1 and 4:1 fenthion:BAYGON were more efficacious than either chemical applied singly at a comparable dosage; however, these ratios did not appear to make the fullest use of the action of BAYGON in increasing the speed of action of fenthion. The mortalities effected from exposing mosquitoes to the higher ratios of fenthion:BAYGON, i.e. 5:1, 10:1, and 20:1 did not indicate any increase in speed of action of fenthion.

References

ABBOTT, W. S. 1925. A method of computing the effectiveness of an insecticide. Jour. Econ. Ent. 18:265–267.

GAHAN, J. B., YOUNG, W. W., PENNINGTON, N. E., and LABRECQUE, G. C. 1965. Thermal aerosol and larvicide tests with new insecticides to control two species of *Culex* mosquitoes on Okinawa. Mosquito News 25(2):165–169.

LEWALLEN, L. L. 1964. Preliminary observations on thermal aerosol applications of insecticides to control adult mountain *Aedes* in California. California Vector Views Vol. II(8):48–49.

KNAPP, F. W., and PASS, B. C. 1966. Low volume aerial sprays for mosquito control. Mosquito News 26(1):22–25.

STEVENS, L., and STROUD, R. 1966. Control of mosquito adults and larvae with ultra-low-volume aerial applications of BAYTEX® and BAYTEX-BAYGON® Mixture. Mosquito News 26(2):124–128.

EVALUATION OF TWO ORGANOPHOSPHORUS COMPOUNDS AS BLACKFLY LARVICIDES

YVONNE H. SWABEY AND C. F. SCHENK

Ontario Water Resources Commission, Toronto, Ontario

AND

G. L. PARKER

Ontario Hydro Electric Power Commission, Toronto, Ontario

The insecticide DDT has been used almost exclusively for mosquito and blackfly control in Ontario. Annual control measures are undertaken by municipalities, provincial and federal governmental agencies, northern construction camps and resort and cottage owners. Evidence of the accumulation of DDT in fish and other aquatic life (Anon., 1966; Burdick *et al.*, 1964; Anderson and Everhart, 1966) and the effects of the accumulated insecticide on fish reproduction (Burdick *et al.*, 1964) demonstrate that the continued use of DDT for mosquito and blackfly control is hazardous. This applies particularly to forested regions where sport fishing contributes substantially in maintaining the position of the tourist industry as a main-stay of the economy. Applications of pesticides to water are subject to governmental scrutiny and control and the use of less residual organophosphates for mosquito larviciding is being promoted.

Since an organophosphate blackfly larvicide has not been available, tests were undertaken in May and early June of 1966 to determine the effectiveness of two products and their toxicity to resident stream biota. Field evaluations were made of Baytex® or fenthion (O,O Dimethyl o-[4-(methylthio)-*m*-tolyl] phosphorothioate) and Abate® or American Cyanamid 52,160 (o,o,o',o'-tetramethyl o,o'-thiodi-p-phenylene phosphorothioate). Fenthion is reported to have a residual life at least four days (Mulla, 1963), while recent studies by Bowman and Orloski (1966) testify to the low residual nature of Abate.