

## QUICK-BREAKING FUEL-OIL EMULSIONS CONTAINING DDT<sup>1</sup>

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Some difficulty has been encountered in getting proper dispersal of the small quantities of DDT-oil solutions necessary to give control of anopheline larvae when ground equipment has been used. One quart of fuel oil containing 5 per cent of DDT has been found to be ample for treating 1 acre of breeding area containing the average amount of vegetation (Deonier *et al.* 1945), but with the spray equipment in general use it has not always been possible to get satisfactory coverage. One method suggested for obtaining proper distribution of the larvicide was the use of emulsion concentrates diluted with water from the breeding places, thus increasing the quantity of spray material to be applied. Several series of tests to study the last method were conducted in Florida.

**Materials and Methods.**—In the first series of tests various emulsifiers (2 per cent) were added to No. 2 fuel oil in which 5 per cent of DDT had been dissolved. This solution was diluted with various quantities of water, and the resulting emulsions were applied at various dosages and quantities of spray.

Drainage ditches covered with water hyacinths (*Eichhornia crassipes* [Mart.] Solms) provided areas of uniformly high *Anopheles* breeding. These ditches were divided into small plots 100 feet long, with untreated buffer areas 50 feet long between each plot. The rankness of growth of the water hyacinth varied. Larval populations were determined by dipping just before the treatment was applied and again 24 hours later. Checks of larval populations were also made in

several buffer areas to determine the reduction due to natural causes.

Applications were made from a cylindrical hand sprayer equipped with a boom 10 feet long and a spray nozzle with a No. 56 wire gage orifice. The sprays were usually applied directly to the plots, with no fogging or drifting. The water for dilutions was secured either from the ditch or from artesian wells nearby. All the materials were sufficiently emulsified for application by merely shaking the spray cylinder.

In the second series of tests 1 part of an emulsion concentrate containing 25 per cent of DDT and various emulsifiers was diluted with 4 parts of fuel oil and applied at a dosage of 0.1 pound of DDT per acre. A pipette was used to make the application. These tests were made on small chara-filled pools to observe the effects of the emulsifier in spreading the oil.

A series of practical tests was made to determine the effect of a quick-breaking emulsion on larvae of *Culex quinquefasciatus* Say breeding in a 2-acre lake covered with water hyacinth and polluted with sewage. The lake had previously been treated unsuccessfully with DDT in oil. The quick-breaking emulsion was made by mixing 1 gallon of concentrate (25 per cent of DDT, 10 per cent of Triton X-100, and 65 per cent of xylene) with 4 gallons of No. 2 fuel oil and adding 12 gallons of water. The material was applied from the shore of the lake with a portable orchard sprayer at a pressure of 400 pounds per square inch.

With the preparations used in these tests it was possible to obtain thorough distribution of the low dosages of DDT with the available equipment.

**Results.**—The results obtained with emulsifiers added to No. 2 fuel oil con-

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taining 5 per cent of DDT are given in Table 1. At 0.05 and 0.025 pound of DDT per acre good control was obtained, and at the other dosages there was little difference in the control obtained with the various emulsifiers. However, in two tests with formulas containing Triton B-1956, at 0.05 pound of DDT per acre, the control was less than 90 per cent. These sprays were applied without the boom, and an unsuccessful attempt was made to drift the sprays.

All the emulsifiers made equally good emulsions with the exception of Triton B-1956, which was unsatisfactory when it was used with water having a high sulfur

content. There were no appreciable differences in the effectiveness of the emulsions with the various emulsifiers used. Excellent results with GI soap and other wetting agents have also been reported.<sup>2</sup>

Slightly better results were obtained when a greater quantity of spray was used with the very low dosages of DDT. Usually the mortality was lowest where the vegetation was the heaviest, the thick vegetation tending to screen out most of the spray.

<sup>2</sup> Personal communication from Capt. W. C. McDuffie, Sn. C., U. S. Army.

TABLE 1. Effect on *Anopheles* larvae of quick-breaking emulsions made from 5 per cent of DDT in No. 2 fuel oil.

Emulsifier and concentration	Dosage per acre		Area of Plot <i>Square Feet</i>	Larvae obtained	
	Total Spray	DDT		before treatment (20 dips)	Reduction due to treatment
	<i>Quarts</i>	<i>Pounds</i>		<i>Number</i>	<i>Per Cent</i>
Triton B-1956 (polyglyceride of a glyptal resin) 2%	5	0.05	6800	570	99.0
	5	.05	2000	170	88.9
	10	.05	2200	404	97.1
	25	.05	3500	304	85.6
	5	.025	2000	154	94.2
	5	.025	1500	271	99.2
	12.5	.025	1500	271	99.6
	5	.0125	1500	174	95.4
12.5	.0125	1500	194	96.9	
Triton X-100 (an aralkyl polyether alcohol) 2%	5	.025	1500	225	98.6
	12.5	.025	1000	209	99.6
	5	.0125	1500	236	83.9
	12.5	.0125	1500	187	97.4
Triton X-100 0.5% + Triton B-1956 1.5%	5	.025	1500	281	98.2
	12.5	.025	1000	185	100.0
	5	.0125	1500	195	82.6
	12.5	.0125	1500	230	97.4
Triton X-100 0.5% + Emulphor ELA (polyglycol ether ester) 1.5%	5	.025	1000	310	96.5
	12.5	.025	1000	120	98.7
	5	.0125	1500	160	87.4
	12.5	.0125	1500	221	91.4
Span 20 (sorbitan monooleate) 1% + Tween 20 (polyoxyalkylene derivative of sorbitan monolaurate) 1%	5	.025	1000	293	99.4
	12.5	.025	1000	202	100.0
	5	.0125	1500	255	90.2
	12.5	.0125	1500	196	91.4
No emulsifier	5	.05	1000	99	97.0
No. 2 fuel oil	1	None	225	48	31.25

TABLE 2. Effect of treatment with fuel-oil solutions of various emulsion concentrates containing 25 per cent of DDT on *Anopheles* larvae breeding in small chara-filled pools. Dosage 0.1 pound of DDT per acre.

Emulsifier and concentration	Solvent (68%)	Area of pond	Larvae	Reduction
			per dip before treatment	
		Square Feet	Number	Per Cent
Triton X-100 7%	PD-544-C (all aromatic petroleum fraction Hi-flash solvent (a coal-tar fraction) Xylene	400	7.35	86.4
		135	7.9	96.2
		240	10.4	62.5
Span 20 5% + Tween 20 5%	do. <sup>1</sup>	406	13.2	99.3
Span 20 3.5% + Tween 20 3.5%	do.	350	8.7	92.0

<sup>1</sup> Only 65 per cent of solvent used.

Table 2 gives the results of unreplicated tests made in chara-filled pools treated with various concentrations diluted with No. 2 fuel oil. The emulsifiers used in these tests were also good spreading agents for the oil carrier. The concentrate containing 25 per cent of DDT, 7 per cent of Triton X-100, and 68 per cent of xylene gave the least satisfactory results.

In the practical test the quick-breaking emulsion gave better control of *Culex quinquefasciatus* than did the oil spray. The wind drifted the material the width of the lake, and good control was obtained even though most of the spray fell within 150 feet of the point of application. Although the larval population was not immediately checked (the late fourth instars being more resistant and continuing to pupate), the residue from the treatment prevented larval development for 2 weeks.

Breeding was heavy on the pond as indicated by the observed egg rafts.

Summary.—The use of 2 per cent of an emulsifier in a solution containing 5 per cent of DDT in No. 2 fuel oil permits the addition of water from the breeding places of mosquitoes, and this makes it possible to obtain the quantity of spray necessary for thorough distribution of the low dosages of DDT with the available equipment. Any emulsifier may be used which will form good emulsions with fuel oil. The emulsion concentrates may be used to form quick-breaking emulsions by diluting 1 part of concentrate in 4 parts of fuel oil.

#### Literature Cited

- Deonier, C. C., Burrell, R. W., Maple, J. D., and Cochran, J. H. 1945. DDT as an anopheline larvicide: preliminary field studies. Jour. Econ. Ent. 38:244-249.