COMPARATIVE TOXICITY OF BENZENE HEXACHLORIDE, DDT, AND PYRETHRUM TO MOSQUITO LARVAE

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Benzene hexachloride has been found to be highly toxic to *Anopheles quadrimaculatus* Say mosquitoes. Slade (4) found that the gamma isomer was far more toxic than the other isomers and determined that crude benzene hexachloride contained 10 to 12 percent of this isomer. Kearns *et al.*(3) found that there was no significant difference between DDT and gamma-benzene hexachloride, regardless of the formulations used and the type of application. This paper gives the results of five experiments made to compare the effectiveness of benzene hexachloride DDT, and pyrethrum against anopheline and culicine mosquitoes.

The first three experiments were made with acetone suspensions of the chemicals in water. In the fourth experiment the test materials were dissolved in No. 2 fuel oil. The solutions were applied to the surface of water in small cartons by the method described by Incho and Deonier.(2) In the fifth experiment surface applications of benzene hexachloride dust were made on water contained in 12-inch enameled pans. The benzene hexachloride was diluted with the Loomis talc and applied by sifting through a fine-mesh screen, according to procedure previously described (Deonier *et al.*(1)).

The results of the first experiment, in which the four isomers [3] of benzene hexachloride and DDT were compared, are given in table 1. All but the gamma isomer showed relatively slight toxicity to larvae of *Anopheles quadrimaculatus*.

The gamma isomer was approximately half as toxic as DDT. The remaining isomers were toxic only at such high dosages that further comparisons were made with the gamma isomer only.

Table 2 gives the results of the second experiment, in which crude and gamma-benzene hexachloride and DDT were compared. These results, in general, substantiate Slade's observations on the toxicity of the gamma isomer. Since the alpha and delta isomers have some toxic effect at the lower dosages (table 1), their action in the crude material may add slightly to the toxicity of the crude product.

DDT again showed a higher toxic effect against larvae of *Anopheles quadrimaculatus* at a dosage of 0.005 p.p.m. than did the gamma benzene hexachloride.

The results of the third experiment, in which gamma benzene hexachloride, pyrethrum, and DDT were compared, are given in table 3. The pyrethrins were approximately half as toxic as gamma benzene hexachloride to larvae of *Anopheles quadrimaculatus* and DDT, which was more than twice as toxic as gamma benzene hexachloride at 0.005 p.p.m. caused a somewhat higher mortality of larvae than is usually obtained with this material.

Table 4 gives the results of the fourth experiment, in which gamma benzene hexachloride, DDT, and pyrethrins in No. 2 fuel oil were applied to the surface of the water. In addition to *Anopheles quadrimaculatus* the materials were tested against *Aedes aegypti* (L.) and *Culex quinquefasciatus* Say.

The pyrethrins were more toxic than gamma benzene hexachloride but less toxic

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TABLE 1.—Comparative toxicity of four isomers of benzene hexachloride and DDT in acetone-water suspension to larvae of *Anopheles quadrimaculatus*. (3 replications.)

Isomer	*Dosage*	*Average Mortality After* 24 *Hours*	48 *Hours*
	P.p.m.	*Percent*	*Percent*
Beta	100.0	21.6	36.8
	50.0	8.3	21.0
	20.0	11.6	26.3
Alpha	5.0	100.0	..
	2.5	88.3	91.1
	1.0	5.0	12.1
Delta	5.0	100.0	..
	2.5	40.0	59.6
	1.0	6.6	22.7
Gamma	.005	16.6	36.7
	.0025	5.0	24.5
	.00125	0.0	0.0
DDT	.005	53.3	84.2
	.0025	26.6	52.6
	.00125	8.3	15.8

TABLE 2.—Comparative toxicity of crude and gamma benzene hexachloride and DDT in acetone-water suspensions to larvae of *Anopheles quadrimaculatus*. (3 replications.)

Material	*Dosage*	*Average Mortality After* 24 *Hours*	48 *Hours*
	P.p.m.	*Percent*	*Percent*
Benzene hexachloride:			
Crude	0.1	91.6	92.7
	.05	18.8	22.4
	.025	6.6	6.6
Gamma	.05	100.0	..
	.01	66.6	74.7
	.005	3.3	3.3
DDT	.01	96.6	98.2
	.005	38.3	71.1
	.0025	11.6	24.3

TABLE 3.—Comparative toxicity of gamma benzene hexachloride, pyrethrins, and DDT in acetone-water suspension to larvae of *Anopheles quadrimaculatus*. (3 replications.)

Material	*Dosage*	*Average Mortality After* 24 *Hours*	48 *Hours*
	P.p.m.	*Percent*	*Percent*
gamma Benzene hexachloride	0.05	100.0	..
	.01	80.0	100.0
	.005	35.0	45.9
	.0025	0.0	24.3
Pyrethrins	.025	86.6	96.5
	.01	18.3	62.3
	.005	0.0	0.0
DDT	.005	95.0	100.0
	.0025	85.0	100.0
	.00125	0.0	18.9

TABLE 4.—Comparative toxicity to culicine and anopheline mosquito larvae of pyrethrins, gamma benzene hexachloride, and DDT at 0.5 percent in No. 2 fuel oil when applied to the surface of water containing the larvae. (3 replications.)

Materials	Dosage	Average Mortality After Indicated Period					
		Anopheles quadrimaculatus		*Aedes aegypti*		*Culex quinquefasciatus*	
	Pounds per Acre	24 Hours Percent	48 Hours Percent	24 Hours Percent	48 Hours Percent	24 Hours Percent	48 Hours Percent
Pyrethrins	0.01	..	..	..	..	56.6	56.6
	.005	98.6	98.6	18.3	38.3	..	..
	.0025	83.3	83.3	..	..	..	..
gamma Benzene hexachloride	.01	..	..	..	..	51.6	53.3
	.005	31.6	36.6	5.0	36.6	..	..
	.0025	10.0	10.0	..	..	..	..
DDT	.01	..	..	..	..	10.0	11.6
	.005	100	100	71.6	91.6	..	..
	.0025	95.0	95.0	..	..	..	..

than DDT to *Anopheles quadrimaculatus*. Gamma-benzene hexachloride and the pyrethrins were more toxic than DDT to *Culex quinquefasciatus* but less toxic to *Aedes aegypti*.

In the fifth experiment a dust made of crude benzene hexachloride containing about 12 percent of the gamma isomer killed 70 percent of *Anopheles quadrimaculatus* larvae when it was applied at a dosage of 1/40 pound per acre. This kill was higher with the crude material than would be expected for a material containing this amount of the gamma isomer. However, as shown in table 1, the other components of the crude material have some toxic effect, which may add to the toxicity.

SUMMARY

Tests were made of the comparative toxicity of the isomers of benzene hexachloride, pyrethrum, and DDT in acetone-water suspensions, in oil solutions, and as a dust against mosquito larvae. Four isomers of benzene hexachloride were tested against larvae of *Anopheles quadrimaculatus* Say, and only the gamma isomer, which is present at concentrations of about 12 percent in the crude product, was toxic in a dosage range comparable to DDT. Pyrethrum was less effective than DDT or the gamma isomer in acetone-water suspensions. In oil solutions applied to the surface of water containing the larvae it was more toxic than benzene hexachloride, but less toxic than DDT to *A. quadrimaculatus*. Gamma benzene hexachloride and pyrethrum were more toxic than DDT to *Culex quinquefasciatus* Say but less toxic to *Aedes aegypti* (L.).

Literature Cited

(1) DEONIER, C. C., J. D. MAPLE, H. A. JONES, E. HINCHEY, and P. M. EIDE. 1945. DDT as an anopheline larvicide—Laboratory tests. *Jour. Econ. Ent.* 38(2):241–43.

(2) INCHO, H. H., and C. C. DEONIER. 1947. Comparative toxicity of DDT to three representative species of mosquito larvae. *Mosquito News* 7(2):67–70.

(3) KEARNS, C. W., L. INGLE, and R. L. METCALF. 1945. A new chlorinated hydrocarbon insecticide. *Jour. Econ. Ent.* 38(6):661–68.

(4) SLADE, R. 1945. The gamma isomer of hexachlorocycleohexane (Gammexane) an insecticide with outstanding properties. *Chem. and Indus.* 40:314–19.