THE TOXICITY OF SEVERAL INSECTICIDE RESIDUES TO MOSQUITOES COMMON IN THE PACIFIC NORTHWEST

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In 1949 laboratory tests were made at the Corvallis, Oreg., laboratory of the Bureau of Entomology and Plant Quarantine to determine the effect of the residues from several insecticides on three genera of mosquitoes common in the Pacific Northwest—*Aedes, Culex,* and *Culiseta.* The results of these tests are discussed in this paper.

Materials and Methods.—The floodwater *Aedes* included *A. vexans* (Meig.) and *A. sticticus* (Meig.) in about equal numbers. These species occur in large numbers in the overflow lands along the Columbia River and its tributaries, and they are easily collected and reared from eggs under controlled conditions. *Culex pipiens* (L.), *C. tarsalis* (Coq.), and *Culiseta incidens* (Thom.) were collected locally from ponds as fourth-instar larvae and as pupae, and were then placed in the insectary, where they emerged. This room was kept at a constant temperature of 80° F. and a humidity of 60 to 70 percent. All tests were made under these conditions. The collection of *Culex tarsalis* included a small number of the closely allied species *C. stigmatosoma* (Dyar), as these two species are difficult to separate.

Two types of tests were conducted—the first to determine the time required to knock down all mosquitoes exposed continuously to a residue, and the second to determine the mortality of mosquitoes exposed to a residue for only 2 minutes. In the knock-down tests the mosquitoes were transferred to holding cages when all of them were prostrate and unable to fly or crawl. This was done to determine whether any of the mosquitoes would recover. In the mortality tests the mosqui-

toes were removed to holding cages after the 2-minute exposure and the numbers down after 1, 2, 4, 6, and 24 hours were recorded; however, only the 24-hour records are given in table 1. In many cases the mosquitoes were down and apparently dead within 1 to 6 hours after exposure.

TABLE 1.—Speed of knock-down and mortality of mosquitoes exposed to residues of several insecticides. All except pyrethrum used at the rate of 10 mg. per square foot.

Insecticide	Floodwater *Aedes*		*Culex tarsalis*		*Culex pipiens*		*Culiseta incidens*	
	Time for complete knock-down	24-hour mortality after 2 minutes' exposure	Time for complete knock-down	24-hour mortality after 2 minutes' exposure	Time for complete knock-down	24-hour mortality after 2 minutes' exposure	Time for complete knock-down	24-hour mortality after 2 minutes' exposure
	Minutes	*Per cent*	*Minutes*	*Per cent*	*Minutes*	*Per cent*	*Minutes*	*Per cent*
DDT	36	100	55	89	61	77	44	100
Methoxychlor	47 (2) [1]	83	68	44	101	31	80	100
TDE	56 (8)	68	52	49	58	79	71	100
Fluoro analog of DDT [2]	11	94	12	100	12	100	14	100
Ethoxy analog of DDT	159 (12)	54	351 (4)	...	268 (9)	...	180	...
Benzene hexachloride (12.8 per cent gamma)	27	100	26	97	29	100	23	100
Lindane	21	100	23	100	24	100	15	100
Toxaphene	192	77	202	56	203	69	168	62
Chlordane	67	97	65	89	59	88	64	100
Parathion	22	100	29	100	28	100	24	100
Dieldrin	104	98	92	83	104	100	68	100
Aldrin	68	100	70	100	53	100	56	100
Heptachlor	61	94	61	100	58	100	72	100
Pyrethrins:								
0.1 mg. per square foot	10 (5)	65	11	49	14	84	9 (7)	97
0.05 mg. plus piperonyl butoxide 0.5 mg. per square foot	9	100	17	79	14	91	13	100

[1] Figures in parentheses indicate per cent recovery in 24 hours.
[2] 1,1,1-trichloro-2,2-bis(*p*-fluorophenyl)ethane.

Wide-mouth quart mason jars fitted with screen-wire lids were used as the test chambers. The inside surfaces were uniformly coated with acetone solutions of the test chemicals by rolling the jars containing them between the hands until the solvent evaporated. All the chemicals except pyrethrum were applied at the rate of 10 mg. per square foot. Pyrethrum was tested alone at 0.1 mg. and also at 0.05 mg. plus 0.5 mg. of piperonyl butoxide. From 10 to 20 female mosquitoes 2 to 11 days old were used per test, and each test was replicated from 2 to 5 times with different lots of mosquitoes. Only the females were used, as males are unreliable test insects. A few days' difference in the age of the males makes a great difference in their susceptibility, and they are much easier to kill than females.

Results.—The results given in table 1 show that *Culiseta incidens* was easy to kill, all except two of the chemicals causing 100 per cent mortality after a 2-minute exposure. However, the knock-down time was not always so short with this species as with the others. The *Aedes* mosquitoes were knocked down faster and killed

easier than the *Culex* with several of the compounds, especially DDT, methoxychlor, parathion, and pyrethrum plus piperonyl butoxide. There was little difference in the susceptibility of the two *Culex* species.

Pyrethrum, the fluoro analog of DDT, parathion, and lindane caused the most rapid knock-down of all the species. The fluoro analog, for example, gave complete knock-down in 11 to 14 minutes whereas parathion required 22 to 29 minutes. However, an exposure to parathion of only 2 minutes in all cases gave 100 percent mortality within 2 hours. Dieldrin, aldrin, and heptachlor were slow to cause knock-down but within 24 hours gave nearly complete mortality. Lindane was one of the most efficient residual poisons on adult mosquitoes. (This is especially interesting since lindane is inferior to many of the other chemicals when used as a larvicide on the immature stages.) The ethoxy analog of DDT was inferior to DDT, the fluoro analog of DDT, TDE, and methoxychlor. Because several of the materials gave 100 percent kill, it is impossible to compare them closely.