work of a hand labor crew of about 25 men working under 1946 conditions.

(Note—A new design for a machine based on the same principles but employing sealed roller and ball bearings, hydraulic lift, enclosed chain drives and other improved features has been prepared, and the design has been approved by the special Machine Committee of the Associated Executives of Mosquito Control Work in New Jersey. A machine based on the new plans is now under construction for the Ocean County Mosquito Extermination Commission for trial and use beginning in the spring of 1947.)

Reference

(1) A Further Development in Machinery for Digging and Cleaning Salt Marsh Ditches. (Proceedings of the 29th Annual Meeting of the New Jersey Mosquito Extermination Association, held at Atlantic City, New Jersey, on March 11, 12 and 13, 1942.)

PRE-HATCHING APPLICATIONS OF DDT LARVICIDES ON FLOODWATER *AEDES* MOSQUITOES

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The Columbia River is bordered by extensive areas that are flooded by the annual rise of this river. These areas produce large numbers of *Aedes vexans* (Meig.) and *A. lateralis* (Meig.) mosquito larvae. The amount of low land covered and the time the flood crest is reached varies from year to year. In some years the rise is gradual, whereas in others it is rapid, or there may be several rises and recessions before the crest is reached. The highest stage usually comes in May or June, but often the several rises cause large numbers of larvae to hatch earlier than this. These variations cannot always be forecast with certainty, and an effective pre-hatching treatment must be of such a nature that it can be applied several days or weeks before the land is flooded. It must withstand considerable rainfall and weathering and still be lethal to the emerging larvae.

The application of various materials to the ground seeded with eggs prior to hatching has been tried on floodwater *Aedes* mosquitoes in the Columbia River area in previous years without success. This paper gives the results of field tests made with DDT in an oil solution and in an emulsion.

A few preliminary tests were made in 1944 and 1945 with 5 per cent of DDT in Diesel oil. In 1946 more extensive tests were made, using both types of preparations. The emulsion was prepared by diluting a stock containing 25 per cent of DDT, 68 per cent of xylene, and 7 per cent of Triton X-100 (an aralkyl polyether alcohol) with seven parts of water. Two plots were treated with this emulsion. The sprays were applied with either a hand compressed-air sprayer or a knapsack sprayer. Most of the areas were covered with low brush or grass, or dead rank vegetation of the previous year's growth; in some places there was considerable ground litter of stumps, logs, and dead branches.

TABLE 1. Results of Field Tests With Pre-Hatching Applications of DDT Larvicides on Floodwater *Aedes* Mosquitoes.

Plot No.	Material Applied per Acre: Pounds of DDT	Material Applied per Acre: Pints of Liquid	Acres Treated	Date Treated	Number of Larvae [1] from Soil Samples	Days Between Treatment and Flooding	Results
				1944			
1	0.1	1	0.5	May 26	8	18	No apparent reduction in numbers
2	.1	.5	.25	26	185	18	
3	.2	.3	.07	26	220	18	A few appeared affected but mortality low
				1945			Second and third instar larvae numerous, but untreated areas had been flooded
4	.5	5	.5	May 9	22[2]	5	
5	1	4.5	.25	9	90	5	
6	2	13.3	.33	15	Numerous	6	
7	2	10	.25	15	do	6	
				1946			
8	2	10	.25	April 22	114	2	
9[3]	2	8.5	.1	22	132	2	All killed
10	3	6.5	.125	22	109	14	
11	1	2.8	.15	22	205	21	
12	1	3.8	.2	23	905	22	
13	2	6	.16	23	62	31	
14	3	5.7	.1	23	52	33	Inconclusive; only a 24-hour check obtained
15[3]	3	10	.11	March 1	415	40	
16	3	25.5	.45	21	4600±	49	All killed
17	1	3.75	.2	21	6300±	51	
18	2	18.5	.5	21	3600±	54	Inconclusive owing to rapid rise of water. One side showed reduction of larvae

[1] Average count of larvae from either 2 or 3 samples of 3 quarts of soil.
[2] Larvae check from small area already flooded.
[3] These plots treated with 25% emulsion diluted 1 to 7.

Table 1 gives the results of these tests. The small amount of DDT applied in 1944 was not effective when the treated areas were flooded 18 days after application. In 1945 more DDT was applied, and the treatments were more effective. On plots 1 and 2 results were not conclusive, because the rapid rise of the river flooded adjacent areas before a check could be made, and larvae drifting into the area were not killed. Applications of 2 pounds of DDT per acre killed all the first instar larvae, but the time that elapsed between application and flooding was short.

In 1946 eleven plots were treated 2 to 54 days before the areas were flooded. It was impossible to obtain satisfactory checks on two plots because of the rapid rise of the river. Good kills were obtained in the other nine plots with 1, 2, or 3 pounds of DDT per acre. The oil solution and the emulsion gave equally good results. Newly hatched larvae could be found in the plots from a few hours to 24 hours after they were flooded, but 48-to-72-hour checks showed that all were dead. In plots 8 and 9 all first and second instar larvae that drifted into the area from adjacent untreated ground were killed. In plots 10 and 11 about half the fourth instar larvae brought in by the rising water were killed. In the latter plot the water advancing up the swale above treated ground killed many emerging larvae. On plot 17, on which 1 pound per acre was applied 51 days before the plot was flooded, larvae hatching in the area were killed, but third instar larvae entering from untreated areas were not affected. Fourth instar larvae that came into plot 12, where the same quantity of DDT had been exposed for 22 days, were also unaffected. A few dead or affected pupae that had drifted into several treated plots were seen, but most of the pupae were not seriously injured.

Observations were also made on the effect of these DDT applications on other aqueous organisms. In plots 1 and 2, which were flooded soon after treatment, dead beetles and other aqueous forms were found the first day after flooding, but after the water had spread out and covered more area live organisms were present. Where the time between application and flooding was longer, live beetles, cyclops, water fleas, small carp ¼ to ¾ inch long, and other water life were abundant.

In November 1946 soil was again taken from plot 16, which had received 3 pounds of DDT as an oil spray in April 1946. Two quart samples of this soil hatched several hundred larvae when flooded, but most of these died within 48 hours. Repeated trials within additional soil from this area failed to produce larvae that would live beyond the third instar.

All of the low lands along the Columbia River in which the DDT test plots were situated, were flooded in December by unseasonable high waters of the river. No larvae hatched in these winter floods. In January 1947 soil was collected from plot 16, and also from plot 15, which had the same amount of DDT in the form of an emulsion. These samples were compared with soil taken from an area that had not been treated with DDT. Many larvae hatched in all of these samples. The larvae in the check samples were vigorous, and within 5 days they had reached the fourth instar. Larvae from the two treated areas appeared normal for about 24 hours and then started to die. Within 48 hours most of them were dead, and none lived beyond third instar.

From these tests it appears that under conditions found along the Columbia River, an application of 3 pounds of DDT per acre will leave a residue in the soil nine months later that is toxic to newly-hatched larvae, even after the ground has been covered with water two times.