

Appraisal of Residual Insecticide Activity Following Thermal Aerosol Application

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The area application of insecticides by means of thermal aerosol generators, in an operation generally known as fogging, has attracted considerable public and commercial interest. Such applications are established as effective control for adult mosquitoes and black flies. Less is known about their effect on other insects, but regardless of the insect, the problem has generally been considered one of space control. Frequently, however, the question arises as to possible residual deposits from routine area fog applications. The observations reported here are the outgrowth of an evaluation of fogging as a means of housefly control and are reported here separately. The procedure was designed to appraise possible insecticidal activity of the deposits occurring on surfaces exposed to thermal aerosol application.

Little has been published on this subject although Collins (2) and Yeomans (7) reported convenient methods for measuring droplet size. Collins' technique, however was designed to evaluate results in indoors applications of fogs as reported by Collins and Glasgow (1). The attempt there was to control active clothes moths in a storage warehouse with little regard for active deposits. Osmun (5) exposed wool in closed buildings saturated with fog containing 20% DDT, and obtained significant deposits as indicated by protection tests using webbing clothes moth larvae. These tests have little bearing, however, on conditions occurring in area application.

Procedure

In the present tests, all applications were made with a commercial jet-engine type thermal generator modified to disperse measured amounts of insecticide. Each insecticide was formulated as a solution in an aromatic methylated naphthalene base oil. The exposure panels used were of two types: plywood and stiff glazed cardboard. Both types were cut into panels one square foot in size. Unless otherwise indicated, the panels were arranged as follows: at right angles to the fog stream, at 45°, edgewise vertically, and edgewise horizontally. In each case panels were arranged as indicated both on the ground and on wooden stands two feet above the ground (Figure 1). The usual placement of the exposure panels was 20 feet from the machine although closer applications were tested. The generator passed the panels at two mph.

On the particular generator used, a setting of #5 gave a dense fog which felt moderately moist three feet from the orifice. Droplet sizes at this setting ranged from 2-50 with the average normally

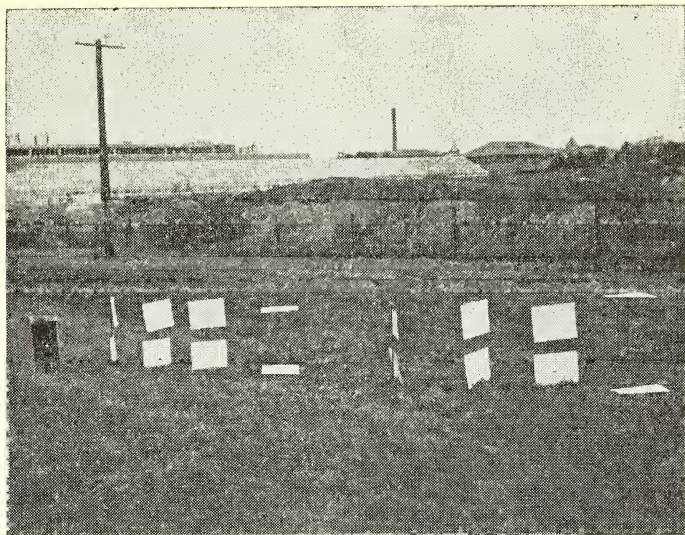


Fig. 1. Arrangement of exposure panels used to determine possible thermal aerosol deposits.

around 18. The insecticides were dispersed only on days when atmospheric conditions permitted the material to "smoke" the grass for 30 feet or more and completely blanket the panels as is shown in Figure 2. Wind velocity never exceeded three mph. It is sometimes a suggested practice in fog application to pass an exposure area twice in the same period of application. This is done to increase the opportunity for contact with insects which may have been sheltered or received only a sublethal dose the first time. In most of these exposures two runs were made, but one of two sets of panels was always removed between runs.

Four insecticides were used: chlordane in 1950, and again in 1951 along with DDT, lindane, and dieldrin. Percentage levels were held constant for each material to simplify the test and were set as follows: dieldrin and lindane 1.5%, chlordane 5% and DDT 10%.

Panel activity was bio-assayed 24 hours after exposure using standard 4-day old CSMA¹ house flies. Standards for comparison were set at 200 mg./sq. ft. for DDT, 100 mg./sq. ft. for chlordane, 30 mg./sq. ft. for lindane and dieldrin. Ten flies exposed for 30 minutes in eight ounce cardboard cages with screened tops and replicated four times on each panel. This exposure period was extended to 24 hours in certain instances, but all final readings were made at 24 or 48 hours.

Results and Discussion

In 1950 four separate exposures using chlordane were made with plywood panels placed 12 feet from the machine. The latter was not

¹ Chemical Specialties Manufacturers Association.

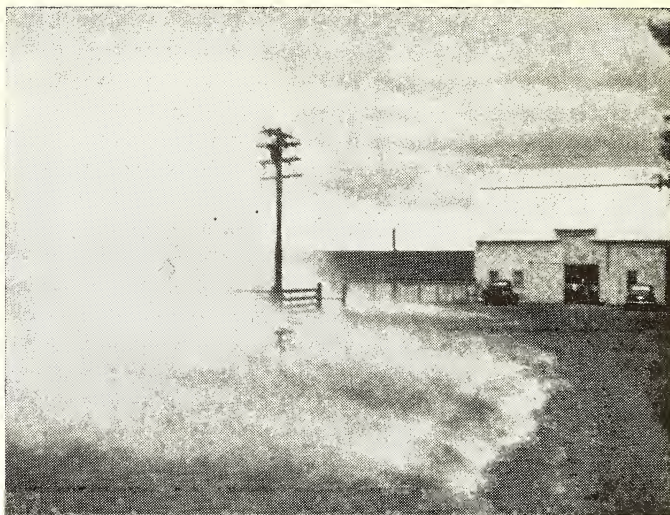


Fig. 2. Application of fog showing blanketing of exposure panels at left center.

moving but was allowed to disperse an insecticide for five seconds. No mortality was recorded on any panels in two exposures, 10% on one horizontal panel on the ground in the third exposure, and 20% and 10% on horizontal panels on the ground and on the stand respectively in the fourth run. Although the untreated checks showed no mortality, it is doubtful that much significance can be placed on these low percentages in view of the stationary position of the generator.

In 1951 tests were numerous and varied in design to evaluate various aspects of the problem.

The results of one application using lindane at 20 feet are tabulated in Table I. No deposits of insecticide were detected by fly exposure even with 24-hour continuous exposure. All other 1.5% lindane tests gave like results. Similar exposures for chlordane, DDT, and dieldrin were conducted, and with the exception of the number moribund at the end of 30 minutes in the prepared standards, the results were the same, i.e., negative. In the case of the dieldrin panels, a total of 48 hours continuous exposure was made due to the generally slow action of this chemical. These results were also negative. No deposits were detected on the reverse side of several panels exposed facing the fog drift.

Since lindane in small quantities could conceivably lose its toxicity in 24 hours, one fly assay was made two hours after fog application. No mortality resulted.

The negative results obtained in these tests made it desirable to ascertain whether there had been a significant destruction of active principle in the thermal production of the aerosol, or whether it was

TABLE I. Adult Housefly Mortality on Panels exposed at 20 Feet to a Fog containing 1.5% Lindane

Panel position	30 min. ¹	24 hrs.	24 hr. total exposure ²
One exposure:			
Ground perpendicular	0	0	0
Ground 45°	0	0	0
Ground 0° vertical	0	0	0
Ground 0° horizontal	0	0	0
2 feet up perpendicular	0	0	0
2 feet up 45°	0	0	0
2 feet up 0° vertical	0	0	0
2 feet up 0° horizontal	0	0	0
Two exposures:			
Ground perpendicular	0	0	0
Ground 45°	0	0	0
Ground 0° vertical	0	0	0
Ground 0° horizontal	0	0	0
2 feet up perpendicular	0	0	0
2 feet up 45°	0	0	0
2 feet up 0° vertical	0	0	0
2 feet up 0° horizontal	0	0	0
30 mg./sq. ft.	100% moribund	100% dead	0
Standard	100% moribund	100% dead	0
Check	0	0	0
	0	0	0

¹ Two replicates removed at end of this period.² Two replicates exposed continuously for 24 hrs.

TABLE II. Adult Housefly Mortality on Cloth exposed to 1.5% Lindane at 1 Foot for 2 Seconds

	Alive	30 min. ¹ % Moribund	Dead	Alive	2 hrs. % Moribund	Dead	Alive	24 hrs. % Moribund	Dead
Cage A.	10	90	0		22.5	77.5	0	0	100
Cage B.	0	100	0		30	70	0	0	100
Standard	0	100			17.5	82.5	0	0	100
30 mg./sq. ft.									
Check	100	0	0	100	0	0	100	0	0

¹ Removal after this exposure interval.

TABLE III. Adult Housefly Mortality on Panels exposed at 4 Feet to Fog containing 1.5% Lindane

	Alive	30 minutes % Moribund	Dead	Alive	2 hours % Moribund	Dead	Alive	24 hours % Moribund	Dead
Test at 2 hrs.; 30 min. exposure									
Panel A.	90	10	0	52.5	47.5	0	10	0	90
Panel B.	82.5	17.5	0	50	50	0	30	10	60
Test at 24 hrs.; 30 min. exposure									
Panel A.	100	0	0	100	0	0	22.5	0	77.5
Panel B.	100	0	0	100	0	0	30	0	70
Test at 24 hrs.; 24 hr. exposure									
Panel A.	100	0	0	100	0	0	0	0	100
Panel B.	100	0	0	100	0	0	0	0	100
Check, unexposed.....	100	0	0	100	0	0	100	0	0
Standard, 30 mg./sq. ft.....	0	100	0	0	30	70	0	0	100

simply a matter of distance with its related factors. A one square foot piece of cheese cloth was held 1 foot from the generator orifice dispensing 1.5% lindane for a period of two seconds. After drying 24 hours, the cloth was tested as indicated in Table II. Activity comparable with the standard was recorded. It should be noted however that cloth is a much better medium for deposit than the panels, and that the impinging pressure at that distance is considerable.

In another exposure to lindane, two panels were placed flat on the ground in direct line of fire at a distance of four feet. These panels received heavy, dark speckling from this exposure. The results, which are shown in Table III, indicate that significant deposits were made at this short distance, although they were less rapid in action after 24 hours.

One additional exposure was made in the routine fogging of a housing area with 5% chlordane. A porch 20 feet from the path of the generator was tested with flies in a manner similar to that used for the panels. The results were entirely negative.

There seems to be nothing unreasonable about the results when it is considered that the thermal aerosol is scattered in fine particles over a relatively large area. Even at 20 feet a given volume of fog has extended itself tremendously as compared with its compactness when leaving the four inch orifice. As Glasgow (3) pointed out, even to anticipate a DDT deposit of 200 mg./square foot would require the use of 17.5 pounds per acre. Yeomans (6) indicated that with the most ideal conditions, only about 50% of the insecticide can be accounted for and the loss becomes greater with abnormal climatic conditions. The work of Horsfall (4) shows that slight environmental changes are sufficient to cause irregular fog behavior, all of which decreases the opportunity for significant deposit. Actually the little insecticide that is normally discharged by a fog machine is moving in the air in such small particles that most of them tend to pass around objects as part of the normal wind slip, and settle only gradually according to particle size. The positive results recorded on panels close to the generator are understandable in view of the compactness of the fog at such distances and velocity driving the aerosol against the surfaces.

The results of these observations should not be construed as indicating a lack of usefulness in thermal aerosol applications. Actually fogging is designed for immediate area space control of flying insects, and to that end no residual deposits are indicated. The test results do preclude the possibility of any lasting insecticide deposits over extensive areas following fogging applications.

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