3655/9

ADULT MOSQUITO CONTROL IN PIPELINES WITH A MODIFIED NON-THERMAL AEROSOL GENERATOR[1]

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ABSTRACT. Short duration applications of chlorpyrifos to irrigation pipelines by a modified non-thermal aerosol generator produced 100% mortality in caged *Culex pipiens*. Insecticide flow tests indicated that a calculated treatment time was impractical in a premeasured, open, pipeline system.

Introduction. Mosquito control in underground irrigation pipelines has been successfully conducted through treatment with insecticidal dust (Silveira and Mulhern 1961). The dusts are normally applied to mosquito-producing pipelines by motor driven centrifugal blowers. However, mosquito resistance to chemicals, prohibitive costs and the difficulty in handling the dusts, indicated a search for alternate methodology. A non-thermal aerosol generator (cold fogger) was modified to allow applications to underground pipelines. The machine was tested for its efficiency to produce a lethal aerosol and for the time needed to treat a premeasured length of pipeline.

Materials and Methods. The basic cold fogger used in the tests is similar to the type used by the Colusa Mosquito Abatement District (Whitsell 1973). The fogger was adapted for pipeline blowing by removing the nozzle apparatus from its connection with the blower. The blower and spray apparatus were then reconnected with a piece of 15 ft. 4 in., 70 lb. polyvinyl chloride discharge hose. The spray apparatus was slightly modified by placing the nozzle inside a 6 inch cast iron elbow (Fig. 1). The elbow is normally rested on the edge of a standpipe during normal operations (Fig. 1).

The chemicals used in testing the pipeline blower were chlorpyrifos and GB 1111. The mixture and flow rate that proved successful in normal cold fogging operations were also used in the pipeline tests. Ten fluid oz. of Dursban 6 lb. fogging compound were mixed with 118 oz. of GB 1111 to make a 1.6 lb./gal. solution. A flow rate of 7.5 fluid oz./min. was normally used in all tests. Applications of 60 seconds and 8 seconds duration were used in the trials.

The fogger was evaluated in two ways; 1) by mortality tests, and 2) by timing of the aerosol flow to determine the flow rate in a premeasured pipeline. Mortality tests were conducted during the month of February. Four separate tests were conducted at various locations within the District to evaluate the effects of the fogging machine on caged adult mosquitoes.

For each test a premeasured 30 in. pipeline was selected. Twenty *Culex pipiens quinquefasciatus* (from known susceptible colonies at the Dept. of Health, Sacramento) were deposited into several disposable cages (Townzen and Natvig 1973). The caged mosquitoes were not fed, but a cotton wick in each cage was moistened with water before and after the test and during the period of later observation. The cages were suspended into the pipeline at the approximate mid and endpoints through the surface standpipes. Two cages of mosquitoes were kept in the laboratory as a control.

Following exposure, the caged mosquitoes were transported to a laboratory and were observed for mortality for 10 hrs.

The timing of the aerosol flow through the pipelines was by the use of a stopwatch. The chemical was normally released for 60 seconds and in one case 8 seconds. Af-

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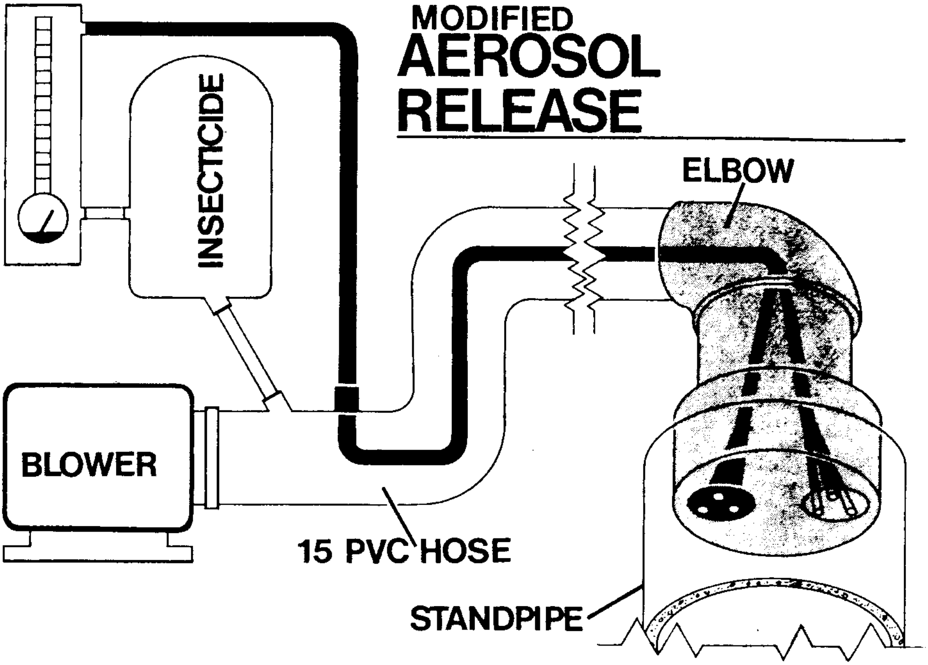

Fig. 1. Modified Non Thermal Aerosol Release.

ter the chemical was released, the blower was allowed to work until the white cloud of insecticide emerged from the last standpipe. The time needed for the chemical to clear the last standpipe was then recorded. Tests were conducted under two different conditions; 1) a completely closed pipeline system and 2) an open pipeline system.

Results. Mortality of adult caged mosquitoes was 100% (Table 1). Mortality of the control mosquitoes was 0%.

During our attempt to calculate the speed at which the pesticide moved down a 30 in. pipeline, it became apparent that the chemical was traveling through the open pipeline system at a greater speed than was initially calculated. Table 2 illustrates this phenomenon.

When all standpipes were covered and a hood was connected between the fogger and the pipeline system, it was apparent that calculated speeds closely equaled operational speeds (Table 2). When no hood

Table 1. Data on nonthermal aerosol applications of chlorpyrifos in pipelines.

	Pipeline		Chem. Output	Treatment	Distance to Cages		% Mortality in Minutes	
Site	Diam. in ins.	Length in ft.	Sec./fl. oz.	Time Sec.	Cage 1	Cage 2	Cage 1	Cage 2
Claus Rd.	30	1240	60/7.5	360	620	1240	100/60	100/60
McClure Rd.	30	1109	60/7.5	280	550	1109	100/60	100/60
River Rd.	30	1155	60/7.5	340	570	1155	100/180	100/180
Garner Rd.	30	1690	8/1	650	845	1690	100/180	100/180

Table 2. Data on nonthermal aerosol applications of chlorpyrifos (Dursban) in pipelines

Trial	Site	Pipeline Diam. in ins.	Pipeline Length in ft.	Operational Time Minutes	Calculated Time Minutes
	HOOD USED	ALL STANDPIPES COVERED			
1	Claus Rd.	30	1240	28.8	28.9
2	Claus Rd.	30	1240	28.4	28.9
1	McClure Rd.	30	1109	25.2	25.9
2	McClure Rd.	30	1109	24.3	25.9
1	River Rd.	30	1155	23.2	26.9
2	River Rd.	30	1155	22.2	26.9
	NO HOOD USED	ALL STANDPIPES UNCOVERED			
1	Claus Rd.	30	1240	7.2	28.9
2	Claus Rd.	30	1240	7.3	28.9
3	Claus Rd.	30	1240	6.8	28.9
1	McCure Rd.	30	1109	6.2	25.9
2	McCure Rd.	30	1109	6.1	25.9
3	McCure Rd.	30	1109	6.7	25.9
1	River Rd.	30	1155	4.7	26.9
2	River Rd.	30	1155	4.6	26.9
3	River Rd.	30	1155	4.6	26.9

was used and the standpipes were open it became apparent that a vacuum was being created and external air was being drawn into the pipes causing an erratic and faster treatment time (Table 3). A second factor causing the erratic and faster treatment time in an open system is the presence of an existing draft in the pipes (Silveira and Mulhern 1961).

DISCUSSION. The aerosol created by the modified cold fogger will move through a pipeline with adulticidal effects. Unpublished data also indicate that the machine may demonstrate good larvicidal action.

Calculations were made to determine the time needed to treat 1 ft. of 30 in. pipe. Unfortunately the calculations were only good for a completely enclosed system. Due to the fact that a vacuum was being created when an open system was used and that previous air currents existed, it became impractical to state that a particular diameter and length of pipe could be treated in a specific period of time.

The best method of determining when the insecticide has cleared a pipeline is by

Table 3. Data on nonthermal aerosol applications of chlorpyrifos (Dursban) in premeasured pipelines

Trial	Site	Pipeline diam/ins	Pipeline l/ft	Speed of Dispersal (Average) Ft/Min
	HOOD USED	ALL STANDPIPES COVERED		
1	Claus Rd.	30	1240	46.6
2	McClure Rd.	30	1109	44.7
3	River Rd.	30	1155	50.8
	NO HOOD USED	ALL STANDPIPES UNCOVERED		
1	Claus Rd.	30	1240	174.6
2	McClure Rd.	30	1109	176.3
3	River Rd.	30	1155	251.9

visual observation. Physical observation of the insecticide cloud as it emerges from the end standpipe is a positive indication that the pipeline has been satisfactorily treated.

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AN *IN VITRO* BLOOD-FEEDING SYSTEM FOR QUANTITATIVE TESTING OF MOSQUITO REPELLENTS[1]

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ABSTRACT. A new test system was developed to assess the intrinsic repellency of chemical compounds and formulations to mosquitoes. The system incorporates an *in vitro* blood-feeding device which allows unrestricted "free choice" feeding on various repellent-treated membrane surfaces, thereby providing comparative feeding data on a quantitative basis. Three configurations of the blood-feeding device permit the use of a variety of experimental designs. Examples of experiments employing factorial and dose-response designs are presented. The *in vitro* repellent test system was proved in more than 250 repellent tests utilizing a variety of chemicals and mosquito species and strains.

Investigators concerned with the development of new and improved mosquito repellents have employed various methods of evaluating the intrinsic repellency of chemical compounds and formulations to mosquitoes. In one approach to the problem, an olfactometer such as that of Schreck et al. (1967) is employed to measure the repellency of candidate materials relative to that of a control or of a repellent standard such as N,N-diethyl-m-toluamide (deet). Although the olfactometer method is convenient and productive, it does not closely simulate the natural conditions of host-seeking and blood-feeding and it does not measure tactochemical repellent effects.

A more natural test is provided by those methods in which a repellent-treated area of the skin of a human test subject is directly exposed to bites of the test mosquitoes (Smith et al. 1963). For reasons of comfort and safety the untreated control is customarily neglected and the test is terminated when one or a few bites have been received on the treated area. The parameter estimated is the minimum effective dosage, or the minimum amount of repellent per unit of surface area required to protect the skin from bites of the

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