CONTROL OF HOUSE FLIES IN POULTRY HOUSES WITH LARVICIDES

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ABSTRACT

Field tests were conducted with 19 insecticides against the larvae of the house fly, *Musca domestica* L. Seven were effective for 1 day, 4 for 5 days, and 3 for 7 days. All the compounds were ineffective the 9th day. Laboratory tests with diazinon made to determine the resistance of larvae from the field strain compared with a susceptible laboratory strain showed that at the LC_{50} level the field strain was 75.6 times harder to kill than the susceptible strain and 120.5 times harder at the LC_{90} level.

The house fly, *Musca domestica* L., has been and continues to be a major problem in establishments handling caged poultry since the accumulation of manure under laying hens is an ideal rearing medium for the larvae. Even with the most effective insecticides, control of larvae in such circumstances has been difficult. The large quantity of breeding medium cannot be thoroughly treated because application to the surface of the manure and constant movement of the larvae through the surface layer mixes the chemical with the medium and quickly makes the concentration too low to be effective. Second, the daily deposit of fresh manure by the chickens provides the flies with a constant supply of new, untreated medium. Finally, and a factor that needs more study, the chemical properties of the medium cause detoxification of the insecticides.

After the house fly developed resistance to chlorinated hydrocarbons, organophosphate insecticides were used for larval control. Most of these organophosphorous materials are more effective than the chlorinated hydrocarbons in controlling larvae at the time of application, but they lose their effectiveness much more rapidly. Also, house flies are developing resistance to these new insecticides as they become available (LaBrecque and Wilson 1957). Consequently, the Gainesville, Florida laboratory of the Entomology Research Division is making a continuous search for new and more effective chemicals, and over the past 12 years, more than 50 chemicals have been evaluated as house fly larvicides (Wilson and Gahan 1957, Wilson and LaBrecque 1958, 1960, Morgan et al. 1966, and Brady and LaBrecque 1966). Because diazinon produced complete larval control for 1-2 weeks in 1957, it has since been frequently selected as the standard (Wilson and Gahan 1957). However, its extensive use by poultrymen to control house fly larvae has apparently caused the house fly to develop resistance; Morgan et al. in 1966 could obtain only 1 day control. In this paper, we present the results of evaluations of additional insecticides as larvicides and describe tests of resistance of house fly larvae to diazinon.

METHODS AND MATERIALS

Nineteen compounds applied as emulsions or as suspensions of wettable powders were evaluated against natural infestations of house fly larvae in manure under caged poultry in Hillsborough County, Florida, in September 1967. The company designations or common names for the compounds tested, their chemical names, and their acute oral toxicities, as compiled by the Pesticide Chemicals Research Branch, Entomology Research Division, ARS, or as received from the manufacturers, are listed below. All LD_{50}'s are based on tests with white rats except those followed by "M" which are based on tests with white mice.

		Minimum LD_{50} (mg/kg)
Abate®	*0,0*-dimethyl phosphorothioate *0,0*-diester with 4,4′-thiodiphenol	2000
Anthio®	*0,0*-dimethyl phosphorodithioate *S*-ester with *N*-formyl-2-mercapto-*N*-methylacetamide	375
Banol®	6-chloro-3,4-xylyl methylcarbamate	300M
Bay 33051	ethyl mercaptophenylacetate *S*-ester with *0,0*-dimethyl phosphorodithioate	200
Bay 37344	4-(methylthio)-3,5-xylyl methylcarbamate	130
Bay 39007	*0*-isopropoxyphenyl methylcarbamate	95
Bay 41831	*0,0*-dimethyl *0*-4-nitro-*m*-tolyl phosphorothioate	250
Bay 62863	2,3-dihydro-2-methyl-7-benzofuranyl methylcarbamate	100
Bay 77488	*0,0*-diethyl phosphorothioate *0*-ester with phenylglyoxylonitrile oxime	>1000
Bay 78182	*0,0*-diethyl phosphorothioate *0*-ester with (*o*-chlorophenyl)glyoxylonitrile oxime	>1000
Calcium arsenate		35
Coumaphos		860
Diazinon		100
Dimethoate		200
Dursban®	*0,0*-diethyl *0*-3,5,6-trichloro-2-pyridyl phosphorothioate	135
Hooker HRS-1422	3,5-diisopropylphenyl methylcarbamate	526
Montecatini L-561	ethyl mercaptophenylacetate *S*-ester with *0,0*-dimethyl phosphorodithioate	250
Neopynamin®	2,2-dimethyl-3-(2-methylpropenyl)= cyclopropanecarboxylic acid ester with *N*-(hydroxymethyl)-1-cyclohexene-1,2-dicarboximide	15000
Shell SD-8447	2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate	4000

Each compound was applied to the surface of 10 m^2 plots of droppings at the rate of 2 g active ingredient/m^2. One liter of water was used as the diluent for the insecticide for each plot treated. A small carbon dioxide cylinder charged to a pressure of 70,000 g/cm^2 (about 1,000 psi) was adapted to a two-liter compressed air sprayer. This cylinder was equipped with a pressure regulator that maintained a constant pressure of 3,000 g/cm^2 (about 40 psi) in the spray tank. All hoses had quick-disconnect couplings to make loading the tank easier. The sprayer was equipped with a TeeJet® 80-02 nozzle that delivered 1 liter of spray per minute. This type sprayer had not previously been used to apply larvicides, but it proved superior to hand pump sprayers and enabled us to treat a large number of plots in a relatively short period by eliminating the time required for pumping.

Larval density in each plot was determined by collecting a large spoonful of manure from each of 10 locations where the heaviest infestations were apparent, spreading the samples on a plywood panel, and counting the larvae present. The effectiveness of the treatments was determined by comparing the difference in counts made immediately before and 1, 5, 7, and 9 days after treatment. The compounds were considered ineffective after control dropped below 75%.

Also, a sample of adult flies was collected at the poultry farm, brought into the laboratory, and reared to the F_1 generation. The resistance of the F_1 larvae to diazinon was then determined by comparing their susceptibility to diazinon with that of the Orlando regular (susceptible) strain as follows: technical diazinon in 50 ml water was thoroughly mixed (in 225 g cups) with 25 g dry CSMA larval medium at concentrations of 3.0, 1.0, 0.3, 0.1, 0.03, 0.01, 0.003, or 0.001 mg toxicant/g medium. Then 50 third-instar larvae were placed on the medium in each cup, and a piece of organdy cloth was laid over the top and secured by a rubber band. Each concentration and an untreated check was replicated once for each strain of flies. The cups were held at 27° C and 50% relative humidity until the larvae pupated and emerged as adults. Percentage mortality was computed from the number of larvae that failed to develop into adult flies, and the data were used to compute the LC_{50}'s and LC_{90}'s.

Results

The results of the field test are presented in Table 1. Of the 19 compounds tested, 7 were effective for 1 day and 4 were effective for 5 days. At the 7th day, reduction from the wettable powder suspensions of Bay 62863 and Shell SD-8447 and an emulsion of dimethoate was still above 75% All compounds were ineffective the 9th day. Calcium arsenate, which was being used by personnel at the poultry farm for larval control before the test, showed only 27.2% reduction the 1st day after treatment. This percentage was not much higher than natural reduction in the untreated checks (20.3%) the 1st day, but the checks then showed no reduction during the remainder of the test.

Diazinon, which has been used for several years to control house fly larvae and which was effective during the early years of its use, gave 57.4% reduction after 1 day. The laboratory comparison of the resistance of larvae from the field strain with the susceptible laboratory strain is shown in Table 2. At the LC_{50} level, the field strain was 75.6 times harder to kill than the susceptible strain, and at the LC_{90} level, it was 120.5 times harder to kill. Thus investigators in various parts of the country would be well advised to evaluate the resistance in house flies to chemicals presently recommended for their control.

TABLE 1.—EFFECTIVENESS OF VARIOUS INSECTICIDES (AT 2 G/M²) AS LARVICIDES IN POULTRY HOUSES (AVERAGE OF 2 REPLICATIONS OF 10 M²).

Insecticide	Formulation	Pretreatment counts of larvae	Percentage reduction after indicated days—			
			1	5	7	9
Abate	E.C.	1538	48.9			
Anthio	E.C.	1664	100.0	95.4	71.0	
Banol	W.P.	1620	71.6			
Bay 33051	E.C.	1053	34.0			
Bay 37344	W.P.	996	89.2	19.9		
Bay 39007	W.P.	798	93.3	8.2		
Bay 41831	W.P.	1664	0.0			
Bay 62863	W.P.	1371	97.7	98.9	79.6	38.6
Bay 77488	E.C.	973	46.0			
Bay 78182	E.C.	1104	34.6			
Calcium arsenate	W.P.	1307	27.2			
Coumaphos	E.C.	1040	60.7			
Diazinon	E.C.	1413	57.4			
Dimethoate	E.C.	1155	100.0	88.3	80.5	0.0
	W.P.	1116	99.8	67.7		
Dursban	W.P.	1100	49.1			
Hooker HRS-1422	W.P.	2021	33.8			
Montecatini L-561	E.C.	1184	41.5			
	W.P.	1121	47.8			
Neopynamin	E.C.	1599	53.3			
Shell SD-8447	W.P.	1791	99.6	92.0	84.2	47.9
None (check)		908	20.3	0.0	0.0	0.0

TABLE 2.—RESISTANCE OF A FIELD STRAIN OF HOUSE FLIES TO DIAZINON COMPARED WITH THAT OF THE ORLANDO REGULAR (SUSCEPTIBLE) STRAIN (AVERAGE OF 2 REPLICATIONS OF 50 LARVAE EACH PER CONCENTRATION).

Colony	LC_{50}		LC_{90}	
	Mg/g medium	Ratio to Regular	Mg/g medium	Ratio to Regular
Field strain	0.378	75.6	2.650	120.5
Orlando regular (susceptible) strain	.005		.022	

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