Chlorpyrifos Residues in Air After Application to Crevices in Rooms[1]

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Few data are available in the literature on movement of insecticides after application in structures to nontarget sites. WINNETT and SIEWIERSKI (1975) showed that pesticides moved from a storage building to nearby buildings. ROGERS et al. (1974) indicated that pest control technicians were contaminated with small quantities of the insecticide they were applying while TESSARI and SPENCER (1971) detected pesticides in the homes of occupationally exposed men. Contamination of plates in sprayed cabinets and in several locations in fogged or sprayed apartments was reported by WRIGHT and JACKSON (1971) and (1974), respectively. Extremely low quantities of insecticides moved to nontarget sites in rooms after routine crack and crevice applications (WRIGHT 1976, WRIGHT and JACKSON 1975 and 1976, and JACKSON and WRIGHT 1975). WRIGHT (1976) showed that caged German cockroaches, Blattella germanica L., present in rooms during and after crack and crevice insecticide application with the Whitmire Prescription Method® had no significant mortality. House flies, Musca domestica L., exposed alongside the German cockroaches exhibited significant mortality. The amount of insecticide present in the air of the structures following crack and crevice application of the insecticide in structures has not been reported, therefore, the study discussed herein was made to determine the insecticide present in the air of rooms following its application to cracks and crevices in the rooms.

METHODS

Rooms used in the experiment were of the same size and arrangement as used in earlier research (WRIGHT and JACKSON 1976).

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Personnel type air samplers with Midget Impingers were placed in test rooms the day prior to chlorpyrifos application and operated for four hours to determine background values.[2] The chemical 2-methyl-2,4-pentanediol was used in the samplers to trap chlorpyrifos present in the air and the samplers were calibrated to give a constant air flow rate of 2.8 liters per minute.

Chlorpyrifos was applied as emulsion or aerosol-type sprays at 0.5 and 1.0% concentrations. Water was used to dilute the chlorpyrifos (E 910g/liter). A 3.785 liter compressed air sprayer was used to apply the emulsion as a pinpoint spray stream into crevices in the rooms. The fine pin stream nozzle orifice of a multeejet nozzle was held over the crevice, with the spray stream directed into the crevice, while moving the nozzle along the crevice.[3] Pressure in the sprayer was maintained between 0.7 and 1.0 kg/cm^2 during spraying. Aerosol-type sprays containing 0.5 or 1.0% chlorpyrifos, with a pressure of 2 to 2.2 kg/cm^2 at the orifice, were injected into cracks and crevices with an injection tube supplied.[4] These sprays were applied at an application rate of 1 sec of spray for each 30.5 cm of crevice. The four treatments were applied to one room in each of the four suites on a floor during one morning. The amount of dilute insecticide applied per room and the time required to treat each room by both techniques were recorded. Immediately after chlorpyrifos application and at 1-, 2-, and 3-day intervals air was drawn through a sampler present in the room for four hours. Temperature and relative humidity were recorded throughout the experiment. There were six replications per treatment.

Samples were taken to the laboratory and analyzed. Aliquots were taken directly from the impinger tube and injected into a gas chromatograph. If the resulting chlorpyrifos peak were less than 40% fsd, the samples were extracted as follows: 10 ml 2% NaCl was added to the impinger tube and shaken vigorously for 30 seconds. The solution was transferred to a 125 ml separatory funnel and extracted three times with 10 ml portions of n-heptane. The n-heptane fraction was evaporated under vacuum at 40° C, and the chlorpyrifos residue was transferred quantita-

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[2]Monnitaire Sampler, Model S, and Midget-Impinger manufactured by Mine Safety Appliances Company, Pittsburgh, Pennsylvania 15208.

[3]Multeejet nozzle, no. 1/8" T-5700, manufactured by Spraying Systems Company, Bellwood, Illinois 60104.

[4]Aerosol-type pressurized spray with a liquified-gas propellant system formulated specifically for crack and crevice applications, supplied by the Whitmire Research Laboratories, Inc., Saint Louis, Missouri 63122.

tively into conical tubes with 1-4 ml and 3-2 ml fractions of ethyl acetate. The efficiency of the extraction was determined by adding known amounts of chlorpyrifos to 24,10 ml samples of 2-methyl-2,4-pentanediol, and comparing the extracts to equivalent amounts which had not been extracted.

The gas chromatograph was a Tracor Model 222 equipped with a flame photometric detector operated in the phosphorous mode. Columns were U-shaped glass (91x0.64 cm) packed with 4% SE-30 + 6% QF1 on Gas Chrom Q (60/80 mesh). Nitrogen was the carrier gas with a flow rate of 80 ml/min. Gases to the detector were hydrogen and air at flow rates of 35 and 78 ml/min., respectively. Temperature conditions were as follows: oven 190° C, detector 175° C, and inlet 200° C. Residues were quantitated using the peak height method. The sensitivity of detection was 0.001 g of chlorpyrifos.

A completely randomized analysis of variance was performed to determine significant differences in chlorpyrifos collections.[5]

RESULTS AND DISCUSSION

The temperature and relative humidity in the test rooms ranged from 17 to 30° C and 30 to 94%, respectively, during the experiment. There was a gradual increase in the temperature and relative humidity during successive replications with no correlation between temperature or relative humidity and the directional orientation of the rooms. Total insecticide application times per room with the aerosol-type and compressed air sprayers were 10.8 min. (range, 9.1 to 11.7 min.) and 7.8 min. (range, 6.4 to 9.6 min.), respectively.

Recoveries of known amounts of chlorpyrifos extracted from the 10 ml samples of 2-methyl-2,4-pentanediol ranged from 68 to 91%, mean of 81%.

Less chlorpyrifos was applied to a room with the aerosol-type sprayer (Table 1). Air in rooms treated with the 1.0% concentrations contained more chlorpyrifos than did the 0.5% treated rooms. There was less chlorpyrifos collected on the day of application from rooms treated with the compressed air sprayer than from rooms treated with the aerosol-type sprayer. However, 1, 2, and 3 days past application there was less chlorpyrifos collected in the rooms treated with the aerosol-type sprayer. Chlorpyrifos collections decreased 10-fold and 2-fold between days 0 and 1 in the aerosol-type and compressed air treated rooms, respectively. The larger amount of chlorpyrifos

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in the aerosol-type treated rooms immediately after application may be related to the smaller size particles present in the formulation which may have a tendency to move more quickly throughout the air than do the larger-sized particles produced by the compressed air sprayer. At 1-, 2-, and 3-days the smaller particles probably were not as prevalent, while the larger particles in the compressed air sprayer treated rooms were still present in the rooms' air. A significant decrease in collected chlorpyrifos occurred between days 0 and 1, while there were no differences between days 1, 2, and 3.

TABLE 1

Chlorpyrifos (ng) recovered from the air of rooms following aerosol-type or compressed air sprayer applications to room crevices.

Kind of Application	Conc. of Sprays (%)	Chlorpyrifos Applied per Room (g)	Time After Application (Days)	Chlorpyrifos Recovered per Air Sampler[a]
Aerosol	0.5	0.9±0.07[b]	0	986±375[b]
			1	77±39
			2	66±36
			3	46±31
	1.0	1.4±0.20	0	1796±638
			1	129±61
			2	117±89
			3	69±44
Sprayer	0.5	2.0±0.14	0	249±157
			1	151±107
			2	133±71
			3	103±57
	1.0	3.7±0.67	0	403±167
			1	285±178
			2	235±99
			3	158±75

[a]The ng of chlorpyrifos collected from 672 l of air which passed through the sampler in 4 hr.

[b]Mean and standard deviation for six replications per treatment.

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