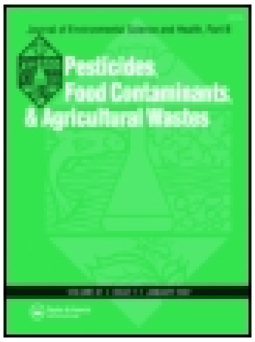

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CONCENTRATION AND MOVEMENT OF DIAZINON IN AIR

Key Words: Diazinon, Airborne Concentration, Crack and Crevice Application, Movement

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ABSTRACT

Airborne concentrations of diazinon were measured in rooms for 21 days after crack and crevice application. Residue levels were largest in treated rooms (38 $\mu g/m^3$) after application, followed by adjacent (1 $\mu g/m^3$) and upper and lower rooms (ca. 0.4 $\mu g/m^3$). Low levels of diazinon were detected in all rooms 21 days after application. Small amounts of diazinon (corrected to an 8 min application period) were detected on respirator pads (2.6 μg) and waist pads (2.3 μg) worn by the applicator.

INTRODUCTION

Studies with insecticides used in the commercial pest control industry have shown that movement of the chemicals occurs after application. Winnert and Seivierski[1] detected pesticide residues that moved from a chemical storage building to a nearby laboratory. Insecticides applied as crack and crevice treatments moved into the ambient air and onto surfaces in rooms[2,3,4]. In other tests extensive movement of insecticides occurred after application as crack and crevice treatments[5].

Therefore, a study was initiated to determine if residues of diazinon, applied in a prescribed crack and crevice type treatment, moved between rooms and floors. In addition, the applicator was fitted with a respirator containing a cheesecloth pad, and another cheesecloth pad was attached to the waist area to determine exposure during application.

MATERIALS AND METHODS

A four-story vacant dormitory at North Carolina State University was used in the study. Four similar rooms were monitored for diazinon: The treated room, a room separated from the treated room by a wall (no entrance between the two rooms), and the rooms directly above and below the treated room. Each room contained two single beds, two desks, a dresser, and a closet area. Beds were hinged to provide a storage area underneath; these were raised and all drawers were removed during treatment and replaced afterwards. Each room contained two adjacent windows which remained closed during diazinon application.

The amount of active ingredient applied per room ranged from 1.8 to 1.9 g with a mean of 1.9 g. The mean room size was 45.1 m^3, and the total application time per room with the compressed air sprayer was 9 min with a range of 8 to 11 min. During the experimental period, temperature and relative humidity ranged from 25.8 to 32.2 C and 45.5 to 62.5%, respectively, with means of 27.2 C and 53.6%.

One personnel-type air sampler[6] was placed in the center of each room with the inlet to the trapping agent (a polyurethane foam plug) ca. 46 cm above the floor surface. The pump was connected to a glass tube [2 by 7 cm portion (containing the foam plug) tapering to 0.6 by 5 cm to which the tubing was connected]. Pumps were calibrated to give a constant flow rate of 2.8 L/min.

Prior to diazinon application, background levels were determined in samples collected over a 4-h period from each room. Only rooms with background levels below the low detectable limit (0.005 μg) for a 7-day period were used in the test.

A commercial formulation of diazinon was applied as a 1.0% emulsion. Application conditions have been described previously[3]. Air samples were collected on days 0, 1, 3, 7, 14 and 21 and extracted by placing the foam plug in a 250 mL beaker and pouring 100 mL ethyl acetate through the glass container. An additional 150 mL of ethyl acetate were added to the flask, and the foam plug was squeezed, at 10 min intervals with a glass rod, for 30 min. The ethyl acetate was poured into a 500 mL boiling flask. An additional 50 mL rinse of ethyl acetate was added to the flask, and this fraction was combined with the first. The solvent was evaporated to 1 to 2 mL under reduced pressure at 40 C. A cheesecloth pad (10 by 10 cm) was placed in a respirator and nother was attached to the waist area on the side of the body where the spray nozzle was held, and these were worn during application. The experiment was replicated three times.

The cloth pads were extracted as follows: the entire pad was cut into 1-cm squares. All squares were placed in a 250-mL beaker, and 100 mL ethyl acetate were added. The mixture was agitated at 10-min intervals for 60 min, and the ethyl acetate was poured into a stainless steel funnel containing glass wool and allowed to filter into a 500-mL boiling flask. The cloth squares were transferred to the funnel and rinsed with two 100-mL portions of ethyl acetate. The combined extract was evaporated to 1 to 2 mL under reduced pressure at 40 C. As there were no interfering peaks, no further cleanup was done. Gas-Liquid chromatography (GLC) conditions were the same as described previously.[5]

The efficiency of the extraction was determined by adding known amounts of diazinon to untreated foam plugs and cheesecloth and analyzing the fortified samples by the same method. Two fortified samples were analyzed during each sampling period. To determine the trapping efficiency of the foam plugs, a 5 cm^2 piece of cheesecloth was impregnated with 1.0 mL ethyl acetate containing 500 μg analytical-grade diazinon. This was placed in an 18.9 L glass carboy, stoppered, and allowed to equilibrate for 2 h. Two foam sampling containers were connected in series with a rubber stopper, and this was placed in the carboy, through a vented-rubber stopper, at a distance of ca. 30 cm above the cloth. The samplers were connected to a personnel monitoring pump, and air was drawn through the samplers at 2.8 L/min for 4 h. The plugs were removed, cut into thirds, and each foam fraction was extracted as described previously. Residues of diazinon were calculated by the peak height method against standards of known concentration. The data were not corrected to reflect extraction efficiencies.

RESULTS AND DISCUSSION

The average recoveries of diazinon were 91% from polyurethane foam, and 95% from cheesecloth pads at spiking levels of 0.1 to 25.0 μg (Table 1). These data are similar to those reported from an earlier study using aluminum pans.[2] When the 6 foam-plug fractions were analyzed for residues of diazinon, 99.3% was found in the first third of foam from the sampler closest to the cheesecloth (Table 2). Traces (<1.0%) were found in the second third, and none was found in any other fraction. These data are similar to those found in a study by Brady[7] who found 100% of several

TABLE 1

Recoveries of Diazinon from Various Sampling Media

Sampling Medium	No. Samples	Range (%)	Avg Recovery (%)[c]
Polyurethane Foam[a]	17	71-100	91 ± 6
Cheesecloth Pads[b]	6	93-96	95 ± 2

[a]Amounts of diazinon added to aproximately 0.3 g foam varied from 1.0 to 5.0 μg.

[b]Amounts of diazinon added to approximately 0.5 g cheesecloth varied from 1.0 to 5.0 μg.

[c]±S.E.

pesticides in the first 25% of a similar-size foam plug. The data indicate that a considerable concentration of insecticide would have to be present in air to "break-through" the foam plug.

Airborne concentrations of diazinon are shown in Table 3. Residue levels were highest in the treatment room followed by the adjacent room. Generally, residues of diazinon were equivalent in the room above and below the treatment room. Over the sampling period the temperatures rose from an average of 27.2 C during the first replication to 28.1 C during the third replication. Analyses

TABLE 2

Distribution of Diazinon in Sections of Foam Plugs After a 4-h Sampling Period[a]

Plug No.[b]	No. Repli.	Fraction[c]	Amount Found (μg)[d]	% of Total Found
1	10	a	11.58 ± 0.42	99.3
		b	0.08 ± 0.02	0.7
		c	<0.005	
2	10	a'	<0.005	
		b'	<0.005	
		c'	<0.005	

[a]Air drawn through two foam-containing samples placed in an 18.9 L glass carboy in which a 500 μg diazinon-impregnated cheesecloth pad was placed.

[b]Plug No. 1 was closest (ca. 30 cm above) to the impregnated cheesecloth; No. 2 was connected in series to first sampler.

[c]Fractions a-c and a'-c' are from side closest to impregnated cheesecloth to side farthest from, respectively.

[d]±S.E.

of temperature and humidity effects on residues in rooms, other than the treated room, showed no significant differences due to either variable.

Concentrations of diazinon in the treated rooms at 21 days after application were 18.5% of day 0 levels. There was little change in residues found in the other rooms during the sampling period. The data indicate that diazinon will remain in a treated area for prolonged periods and will move, not only in the same general area, but up and down through cracks and crevices and by air currents.

A second objective of this study was to determine possible inhalation and deposition on skin surface during application. An average of 2.6 μg and 2.3 μg of diazinon were found on the respi-

TABLE 3

Airborne Concentrations of Diazinon in Rooms at Various Days After Application[a]

Room Location	Day After Application[b] 0 (μg/m^3)	1 (μg/m^3)	3 (μg/m^3)	7 (μg/m^3)	14 (μg/m^3)	21 (μg/m^3)
Treatment	38.4	30.4	16.2	9.7	9.3	7.1
Adjacent	0.9	0.9	0.8	1.0	1.1	1.0
Upper	0.4	0.7	0.6	0.6	0.6	0.6
Lower	0.5	0.4	0.4	0.5	0.5	0.4

[a]Application rate: 1.9 g a.i./room; each value an average of 3 replications

[b]Each room was sampled for 4 h at the same time during each sampling period

rator pads (eight replications) and waist pads (six replications), respectively, when the data were converted to an 8 min spraying time.

The average respiratory rate at an activity level of light work is 16 liters of air per min.[8] If the amount of diazinon found on the respirator pad (2.6 μg) is converted to a 15 min basis (4.9 μg) to correspond to the short-term exposure limit (STEL), the amount inhaled would be below the published threshold limit value (TLV)-STEL (Table 4).[9] These data are based on the assumption that the applicator would be working for 15 min continuously and that the airborne concentration of diazinon would be constant.

TABLE 4

Theoretical Amount of Diazinon Inhaled Continually over a 15 min Application Period[a]

Parameter	Value
Inhalation rate[b]:	16 L/min
No. m^3 inhaled/15 min:	0.24 m^3
Concn diazinon on respirator filter (15 min basis):	4.9 μg
TLV-STEL[c] basis (15 min) (Detected):	20.3 μg/m^3
TLV-STEL diazinon[a] (15 min):	200.0 μg/m^3

[a]American Congress of Governmental Industrial Hygienists, 1978.

[b]Assuming average amount inhaled by an adult male at a light work level and continuous exposure to the insecticide.

[c]Threshold Limit Value - Short Term Exposure Level

Thus, the data from this portion of the study indicate that a crack and crevice application of diazinon at the prescribed application rate would pose no serious hazard to an individual, even if one were located some distance from the application site.

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