Air Concentrations and Food Residues from Use of Shell's No-Pest® Insecticide Strip

by R. D. COLLINS and D. M. DEVRIES
Shell Development Company
Biological Sciences Research Center
Modesto, Calif.

In the past, several trials have been run to determine the air concentrations that might occur when VAPONA® Insecticide[a] strips were placed in various types of facilities, i.e. homes, restaurants, etc. The purpose of these early trials was to establish product safety and included air concentration and food residue measurements. In these trials the strips were used at or above the maximum conditions permitted by label, i.e. one or more strips were used in each 1000 cubic feet of enclosed space. In Arizona trials, as many as 18 strips were used in one home.[1]

The above does not represent practical use of the strip since it is known that homeowners do not treat every 1000 cubic feet and, in fact, the actual practical use of the product is of the order of 2-3 strips per household. Since air concentration and residue data were not available under these practical use conditions, the trial reported below was initiated. Similar tests under conditions of use outside the United States are being reported by ELGAR & STEEN (Pesticide Science in Press). Fifteen homes in the Modesto, California area were selected for these trials. The homes consisted of five centrally air-conditioned, five window air-conditioned and five non-air-conditioned homes. The latter two types are typical of homes in the central San Joaquin Valley in which the windows and doors are open during a large portion of the summer months. Often the window air-conditioners are placed in only one room which may be either the living room, family room or bedroom. In many homes they are used only when temperatures are extreme; otherwise, cooling is accomplished by opening the windows and doors.

Application. Three or four 10" strips were installed in each of the fifteen homes at Modesto on the morning of May 20, 1970, between 6 AM and 8 AM. Ten of the homes were each treated with three strips with at least one being placed in the kitchen; five were treated with four strips with two of these being placed in the kitchen/dining area and the remainder in other locations at the discretion of the homeowner. The rate of use in the kitchen/dining

a) VAPONA® Insecticide contains not less than 93%w 2,2-dichlorovinyl dimethyl phosphate and not more than 7%w of insecticidally active related compounds.

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area for homes containing three strips ranged from 1230 to 6790 cubic feet per strip; those homes treated with four strips had one strip per 720 to 1680 cubic feet in the food handling area. The homeowners taking part in the test maintained their normal daily routine, cooling either with air-conditioning or by opening doors and windows.

Four of the centrally air-conditioned homes contained three bedrooms, the other had four. These homes ranged in size from 1500 to 2950 square feet. Generally, the kitchen/dining areas contained a table and chairs, drapes and vinyl floors, although in two homes the dining areas were carpeted. The usual ventilation practice was to open the windows during the night and close them in the mid-morning at which time the air-conditioning was used, if necessary.

The window air-conditioned homes included a 730 square foot two-bedroom apartment and a 1700 square foot two-bedroom house. The other three houses contained three bedrooms. Furnishings were about the same as in the centrally air-conditioned homes, with one home having a carpeted dining area. Ventilation practices were also about the same, although in two of the homes, the air-conditioning units cooled only the family room. Ventilation in these cases was greater in the food handling areas.

The non-air-conditioned homes were ventilated the most, with doors and/or windows always being open in four of the five treated homes. They varied in size from 1040 to 2200 square feet and included two, three and four bedroom houses. Dining area furnishings were about the same as in the other homes, although one contained extra furniture, i.e. an upholstered chair, hide-a-bed and a vinyl rocker while two others contained carpeting or throw rugs.

Air Samples. Forty liters of air were collected from the dining area at table-top height. The sampling was accomplished by drawing the air at about two liters per minute through a glass impinger and trapping the VAPONA in ethyl acetate, as described in Shell Development Company's method MMS-R-222-1. Samples were collected following the breakfast food sampling at approximately the same time of day for each home throughout the test.

Food Samples. Food samples were secured for the breakfast and dinner meals only. No lunch samples were taken, since many of the participants did not prepare or eat their lunches at home. Food samples consisted of a composite sample, wherein the individual servings were combined, including beverages. It was obtained by preparing one extra adult portion of each meal on sampling days and leaving it exposed to the home environment similar to the meals being consumed. After the normal interval for meal consumption, the contents were transferred to a glass jar, sealed and stored in the refrigerator. The meals were collected and extracted within 18 hours after sampling. Pretest evaluations had shown VAPONA to be stable under storage conditions used.

Extraction. The entire meal was blended in a Waring blender, using additional water when necessary to effect a homogeneous puree. A measured aliquot of the puree was weighed into a 250-ml Erlenmeyer flask and 20 grams of anhydrous sodium sulfate, 2 grams of phosphotungstic acid and sufficient ethyl acetate to effect a known sample-to-solvent ratio (preferably one gram per milliliter) were added. The flask was stoppered and the contents mixed vigorously by hand for two minutes. The mixture was allowed to settle and the phases to separate. A portion of the ethyl acetate was then decanted into a storage bottle, dried with anhydrous sodium sulfate and stored in a refrigerator.

Cleanup. Food samples which contain fatty and oily components that partition into ethyl acetate can cause erroneous responses upon GLC analysis. To alleviate this problem, one gram each of calcium stearate and activated carbon per ten milliliters of sample extract were added to the storage bottles. The extract was mixed well, allowed to settle overnight, centrifuged and filtered. Adequate extract cleanup was effected and sample recoveries remained at high levels.

Analysis. Analyses were performed with either of the instruments described below.

1. Varian Aerograph gas chromatograph, Model 1200, equipped with a cesium bromide phosphorus detector, using a 4' x 1/8" stainless steel column containing a one-to-one mixture of 2% Reoplex 400 and 10% QF-1 on 80/100 mesh Chrom W hp. The carrier gas was helium at about 60 ml/min, and the hydrogen and air flows were about 25 ml/min and 500 ml/min at the inlet, respectively. The other parameters were: injection port temperature, 165°C; detector temperature, 160°C; and column temperature, 155°C.

2. Micro-Tek gas chromatograph, Model 220, equipped with a Melpar flame photometric detector and a 526 mμ interference filter for phosphorus detection, using the same column as in (1) above. The carrier gas was helium at about 80 ml/min; the hydrogen flow rate was 200 ml/min; air was at 45 ml/min and oxygen at 25 ml/min. The temperatures used were: injection port, 170°C; detector, 160°C; column, 145°C. Standards were prepared from 99%+ pure 2,2-dichlorovinyl dimethyl phosphate. Dilutions were made in glass-distilled acetone and ethyl acetate. Quantitations were based on peak height.

Recoveries. To test the procedure, meals fortified with VAPONA prior to blending at 0.20 ppm were analyzed and recoveries calculated.

Results. Air concentrations in micrograms of VAPONA per liter of air in the treated homes are shown in Table 1. As would be expected, the homes having a minimum ventilation had the highest air concentration.

TABLE 1.

Test Home[a]	Treatment Rate Cu. Ft./Strip[b]	Interval, From Installation to Sampling, Days 1	7	14	28	56	91
1W	1270	.02	.02	.02	< .01	< .01	< .01
2C	1440	.08	.07	.07	.05	< .01	.02
3C	1410	.04	.03	.03	.01	.01	< .01
4N	1410	.02	.02	.01	< .01	< .01	< .01
5N	1730	.05	.02	.02	.01	< .01	< .01
6N	720	.11	.06	.02	.03	.01	< .01
7W	1080	.11	.05	.06	.02	.02	< .01
8W	2130	.02	.02	.02	.01	< .01	< .01
9C	6790	.01	.01	.02	< .01	< .01	< .01
10C	1500	.07	.09	.06	.04	.02	.02
11C	2050	.05	.04	.02	.02	< .01	< .01
12N	1550	.05	.07	.02	.03	.01	< .01
13W	1230	.07	.08	.04	.04	.02	< .01
14W	1500	.08	.05	.04	.03	.01	< .01
15N	1680	.04	.02	.02	.02	< .01	< .01
Avg.	1797	=.06	=.04	=.03	=.02	=.01	=<.01

a) C - Centrally air-conditioned.
W - Wall or window air-conditioning unit.
N - No air-conditioner.

b) In the areas where air samples were taken.

The meal data for houses equipped with no air-conditioning, a wall unit air-conditioner and central air-conditioning are contained in Tables 2, 3 and 4, respectively. All data are reported in parts per million.

TABLE 2.

House No.		6[a]	4	12	15[a]	5
Ft./Strip Kit./Din. Area		720	1410	1550	1680	1730
Treat-Sample Interval, Days	Meal					
1	Breakfast	.02	<.02	<.02	<.02	<.02
	Dinner	<.02	.02	.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
7	Breakfast	.02	<.02	<.02	<.02	<.02
	Dinner	.02	<.02	.03	<.02	<.02
	Total[b]	.02	<.02	.02	<.02	<.02
14	Breakfast	<.02	<.02	.02	<.02	<.02
	Dinner	<.02	<.02	.03	.02	<.02
	Total[b]	<.02	<.02	.03	<.02	<.02
28	Breakfast	<.02	<.02	.02	<.02	<.02
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
56	Breakfast	<.02	<.02	<.02	<.02	<.02
	Dinner	.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
91	Breakfast	<.02	<.02	<.02	c)	<.02
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02

a) Two strips in kitchen/dining area; all others had one.
b) Calculated on weight basis of breakfast and dinner assuming <.02 to equal .01.
c) No sample submitted or sample lost during analysis.

TABLE 3.

House No.		7[a]	13	1	14	8
Ft./Strip Kit./Din. Area		1080	1230	1270	1500	2130
Treat-Sample Interval, Days	Meal					
1	Breakfast	.02	.03	c)	<.02	.04
	Dinner	<.02	.02	c)	<.02	<.02
	Total[b]	<.02	.02	c)	<.02	.03
7	Breakfast	<.02	.03	<.02	.03	<.02
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	.02	<.02	<.02	<.02
14	Breakfast	<.02	<.02	<.02	<.02	<.02
	Dinner	<.02	.04	.03	.02	<.02
	Total[b]	<.02	.03	.02	<.02	<.02
28	Breakfast	<.02	.02	<.02	<.02	<.02
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
56	Breakfast	.02	.02	<.02	<.02	<.02
	Dinner	<.02	.02	.02	<.02	<.02
	Total[b]	<.02	.02	<.02	<.02	<.02
91	Breakfast	<.02	<.02	<.02	<.02	d)
	Dinner	d)	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02

a) Two strips in kitchen/dining area; all others had one.
b) Calculated on weight basis of breakfast and dinner assuming <.02 to equal .01.
c) Dinner sample taken night before strip installation and breakfast taken 1/2 hour after strip installation, both <.02.
d) No sample submitted or sample lost during analysis.

Of the 174 meals collected during the test, 24 contained 0.02 ppm VAPONA, seven contained .03 ppm and five contained .04 ppm VAPONA. Of the 36 meals containing discernible VAPONA residues, 18 were breakfasts and 18 were dinners.

The average of 70 whole meal recoveries, fortified with VAPONA at the 0.20 ppm level, was 85% with a standard deviation of ± 10%.

TABLE 4.

House No.		3	2[a]	10[a]	11	9
Ft./Strip Kit./Din. Area		1410	1440	1550	2050	6970
Treat-Sample Interval, Days	Meal					
1	Breakfast	<.02	.04	.02	<.02	<.02
	Dinner	<.02	<.02	<.02	.04	<.02
	Total[b]	<.02	.02	<.02	.03	<.02
7	Breakfast	<.02	.02	.04	.03	<.02
	Dinner	<.02	<.02	.02	.02	<.02
	Total[b]	<.02	<.02	.03	.02	<.02
14	Breakfast	<.02	<.02	<.02	.02	<.02
	Dinner	<.02	.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
28	Breakfast	<.02	<.02	<.02	<.02	<.02
	Dinner	<.02	<.02	.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
56	Breakfast	<.02	<.02	<.02	<.02	<.02
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02
91	Breakfast	<.02	<.02	<.02	<.02	c)
	Dinner	<.02	<.02	<.02	<.02	<.02
	Total[b]	<.02	<.02	<.02	<.02	<.02

a) Two strips in kitchen/dining area; all others had one.
b) Calculated on weight basis of breakfast and dinner assuming <.02 to equal .01.
c) No sample submitted or sample lost during analysis.

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Reference

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