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THE INFLUENCE OF BUILDING MATERIALS ON THE RESIDUAL ACTION OF BHC

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Residual insecticide activity of BHC vapors from various building materials in controlled humidity chambers in the laboratory were significantly different. Laboratory-reared first instar nymphs of Dipetalogaster maximus *were exposed to vapors of BHC which were being released from the treated surfaces of building materials taken from Mambaí, Goiás.*

Key words: building materials – BHC – triatomine bugs

The application of BHC on the wall surfaces inside of houses is the primary method to control triatomine bugs which are vectors of Chagas' disease in Brazil. Mortality of bugs to BHC can be caused by the bugs walking across BHC treated surfaces or by their exposure to BHC vapors. Residual activity of the insecticide BHC was studied on building materials taken from Mambaí, Goiás, Brazil (Penna et al., 1984). Results of experiments in the field and laboratory suggested that higher mortalities coincide with higher ambient relative humidities. Data presented by Fomm & Gandini (1971) and Nocerino (1981) demonstrated that old insecticide deposits of BHC had greater killing power at higher atmospheric humidities.

The objective of this study is to demonstrate the residual insecticidal activity of BHC vapors from different building materials in controlled humidity chambers in the laboratory. The study was restricted to the vapor effect because of our inability to control the actual amount of contact time of the bugs on the treated surfaces. Efforts to restrict the bugs to treated surfaces usually resulted in bugs grouping along the margins of the containers or on top of each other. By using only a single mode of insecticide entry (vapor), the resulting mortality data would be less skewed.

MATERIAL AND METHODS

Two experiments were used to show the effect of buildings materials on the insecticidal activity of BHC, 30% gamma isomer, on laboratory-reared, first instar nymphs of *Dipetalogaster maximus*. Nymphs were exposed to the vapors of BHC which were being released from the treated surfaces (0.5 gm of gamma BHC/m^2) of building materials taken from Mambaí, Goiás.

In the first experiment, six humidity chambers were prepared by using covered 30 cm glass desiccators with relative humidities regulated in each chamber by concentrations of glycerol solutions in the bottom. The humidities were measured by a miniature thermocouple psychrometer. The test material was fired roof tile sprayed with BHC 20 months earlier. Treated tiles were placed on porcelain trays in four chambers, three of which were calibrated at 50%, 60% and 80% RH respectively, and one chamber was left open to ambient conditions which ranged from 64% to 84%. Four control chambers without treated tiles were set up in the same way. Mean temperature during the experiment was 22 C (range 21.5 C to 26 C).

In the second experiment, six covered desiccator chambers were prepared for testing five different house construction materials which had been treated with BHC 24 months earlier. Fired roof tile, unfired mud brick, plaster with lime, plaster without lime and wood were placed on the porcelain trays in five chambers, only one substrate for each chamber. The sixth chamber used as the control had no substrate. Since it was demonstrated that high humidity resulted in better nymphs mortality, all chambers were regulated to 90% RH.

The LT50 activity of the insecticide was measured by observing and recording the mortality of the nymphs in terms of lethal time in days at which 50% of any given population of bugs had died. Each chamber had three replicates. A replicate consisted of 10 unfed nymphs placed in a flat round tin (5.4 cm in diameter and 8 mm deep) covered with fine nylon mesh netting. Three tins with bugs were spaced 5 mm from the netting to the test surface by cardboard rings. Observa-

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tions of bug mortality were made for 30 days in each experiment. One-way analysis of variance using the LT50 values of each replicate within any given chamber was made in both experiments with the level of significance set at 5%. Duncan's new multiple range method was used to test mean differences at a nominal 5% level of significance.

RESULTS

In the first experiment the mortality of nymphs in the test chambers with treated tiles was highest in the chamber with 80% RH, and lowest in the chambers with 50% and 60% RH (Table I). The chamber with ambient humidity conditions had intermediate effects on bug mortality. Significant differences in the mean LT50s were observed in the test chambers with different humidities. Survival of bugs in the control chambers without treated surfaces was similar to survival in the low humidity (50-60% RH) chambers.

The LT50 mortality of nymphs in experiment two varied significantly with different construction materials treated with BHC held in test chambers maintained at 90% RH (Table II). F was significant with the probability of a larger F at $<.025$. Comparison of means are shown by ranking the substrates from the fastest killing power to the substrate with the slowest killing strength. With the nominal level of significance set at the .05 level for the multiple range test, average LT50 means which were similar, not significantly different, are underlined with a single line.

TABLE I

The effects of relative humidity on the insecticidal activity of BHC applied as a residual insecticide on roof tile about 20 months before this test

	Relative Humidity			
	50%	60%	80%	Ambient (64%–84%)
Test LT50[1]	*	*	4.3 ± 0.5	15.0 ± 2.4
Test % alive[2]	93.3	100	0	0
Control LT50	*	*	*	*
Control % alive	96.7	100	100	100

*LT50 not reached in 30 days; [1]F is significant at $< \cdot 005$%; the mean LT50s are significantly different using the multiple range test at the nominal 5% level; [2]% alive after 30 days.

TABLE II

LT50 values caused by the residual insecticide activity of BHC which had been applied to different construction materials about 24 months before this test. Humidity was kept at a constant 90% RH

Mean LT50 Values for each construction material				
Roof tile	Wood	Mud brick (unfired)	Mud plaster (no lime)	Mud plaster (with lime)
4.3 ± 0.5	8.0 ± 0.9	9.7 ± 1.2	10.0 ± 1.4	14.3 ± 4.5

F = 5.30; the probability of a larger F is $< \cdot 025$. Mean LT50 values which are underlined by the same line are not significantly different using the nominal significance level of $\cdot 05$ for the multiple range test.

DISCUSSION

The absorption of insecticide by mud surfaces results in a rapid decay of its residual action (Fomm & Gandini, 1971; Nocerino, 1981). It has been observed that at times of high humidities, higher mortality of insects exposed to sprayed surfaces occurs (Nocerino, 1981; Penna et al., 1984). The greater killing power of BHC vapors at higher humidities in Table I might be explained by increased respiratory activity of the bugs at higher humidities. Increased mortality in *D. maximus* bugs does occur with higher vapor pressure deficits during low humidities and high temperatures (Johnson, Oakley & Marsden, 1984). This suggests that regulatory mechanisms of opening and closing spiracles are important in control of water loss in these bugs. At higher humidities, open spiracles might allow greater exposure to insecticide vapors. However, the results of Table II, the objective of this study, shows that significant differences in LT50s occur with different construction materials at the same humidities.

The insecticide does not degrade on contact with the surface, but penetrates inside the material (Hadaway & Barlow, 1952). A high humidity brings the insecticides to the surface, exposing the insects to a greater amount of the compound (Nocerino, 1981). Fomm & Gandini (1971) studying the absorption of gamma BHC by different kinds of mud in the field, used water sprays to regenerate BHC activity. Nocerino (1981) suggests spraying water on house walls to reactivate insecticides, and the present work again points to this possibility.

Our data on the influence of the surface agree with those obtained by other authors (Fomm & Gandini, 1971; Hadaway & Barlow, 1952), which show differences in absorption velocities of BHC in different types of mud or differences in the persistance of insecticide activity in different materials. The composition of the surface plays an important role in the persistance of insecticide activity (Penna et al., 1984).

RESUMO

A atividade residual dos vapores do inseticida BHC de vários materiais de construção em câmaras com controle de umidade, no laboratório, foram significativamente diferentes entre si. Ninfas do primeiro estágio de *Dipetalogaster maximus,* criados em laboratório, foram expostas a vapores de BHC liberados da superfície tratada dos materiais de construção trazidos de Mambaí, Goiás.

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