THE EFFECT OF WALL PLASTER ON A DOMESTIC POPULATION OF *TRIATOMA INFESTANS*[1]

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Thorough wall-plastering of a house infested with the Chagas' disease vector Triatoma infestans *substantially reduced the vector population in that dwelling for a year. These results suggest that plastering with inexpensive locally available materials can markedly reduce infestation levels if the plastering is thorough and complete, and if litter and other objects capable of providing hiding places for the bugs are removed.*

Introduction

It has long been recognized that improvement of rural housing in Latin America might reduce the numbers of triatomine bugs infesting houses, and might thus reduce transmission of Chagas' disease *(1, 2)*. This idea is based largely on observations that triatomine bugs usually inhabit poor-quality rural houses built of mud or mud-brick (adobe), and that the bugs are less common in more modern houses with smoothly finished walls *(3, 4)*.

This report describes an experiment designed to test the hypothesis that the size of a domestic triatomine bug population is limited by the space available (e.g., the number of wall crevices), and that the application of wall plaster should therefore reduce the size of such populations.

Methods

The study was carried out in the municipality of Mambaí, which is located in the state of Goiás, some 300 kilometers northeast of Brasília. The triatomine species most commonly encountered in Mambaí houses was *Triatoma infestans* Klug *(5)*. Most of these houses had ceramic tile roofs, in which bugs were rarely found, and walls made of adobe or mud pressed onto a wooden frame *(6)*. Most of the bugs were found in wall crevices, beds, and chicken roosts.

One isolated house (designated "Hum. 1") was selected for detailed study. This building served as the home for a family of eight people. Built of adobe with a roof of locally made ceramic tiles, it measured approximately 7.8 m by 8.6 m. This house was eight years old when the study commenced; according to family members, it has been infested with *T. infestans* for most of that period.

The house was examined for bugs at approximately monthly intervals for two and a half years. Two men, each equipped with a torch and long forceps, searched the house for 45 minutes and collected all the live bugs they could find. These bugs were sorted, counted, and then destroyed. Although improved sampling methods were developed and used at other houses *(7)*, the original sampling procedure was maintained throughout the study period at Hum. 1. Bug population estimates made by the Zippin withdrawal method *(8)* indicated that in December 1976, when the study began, the house contained 92 ± 9 adults and 168 ± 24 fifth instars (*7*—Table Vb). The numbers of the other stages present could not be estimated; however, life-table

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House "Hum. 1" in May 1977. The left-hand side of the house was plastered over in December 1976; the right-hand side was plastered in June 1977, after the picture was taken.

studies indicate that these figures are consistent with a total bug population (including eggs) of approximately 2,200 individuals (Schofield, unpublished data).

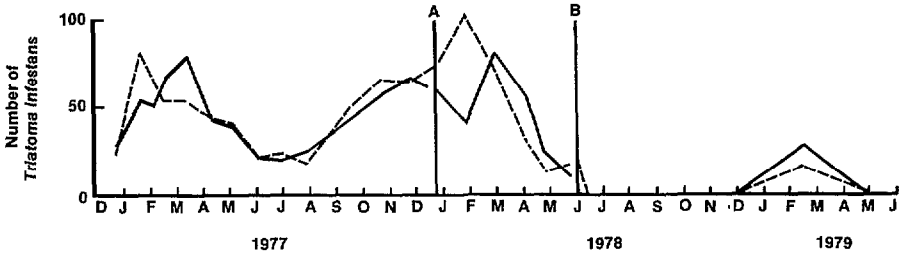
After one year half of the house was plastered inside and out (see photograph), and six months later the rest of the house was plastered. A traditional local mixture consisting of approximately six parts sand, one part earth, one part fresh cow dung, and one part lime was mixed with a small amount of water to form a soft paste. The sand, earth, and cow dung were collected locally. The lime was prepared by heating locally collected limestone rocks in an open wood-fired kiln for 24 hours and then pulverizing the white residue with a hammer. The plaster was applied by hand and smoothed with a wooden trowel; care was taken to seal the tops of the walls, since it had been noted that bugs in poorly-plastered houses were commonly found in unsealed crevices remaining at the upper edges of the walls. After plastering, a white paste of lime and water was applied to the walls to improve their aesthetic appearance.

Results

The results of this experiment are shown in Figure 1. Plastering half the house had no apparent effect on the size of the bug population; although no bugs were found in the plastered half of the house, they were plentiful in the unplastered half. The increase in the numbers of fifth instars and adults during the rainy season, reaching peaks in January and March, followed the pattern observed during the previous year before the house was plastered.

In contrast, after the remainder of the house was plastered no bugs were found (nor

Figure 1. The numbers of *Triatoma infestans* adults (solid line) and fifth instar nymphs collected from house "Hum. 1" monthly. Note the yearly cycle of peak adult emergence during February-April of 1977 and 1978. Half the house was plastered over at time A, the other half at time B.



were any reported by the householders) until eight months later, during the rainy season, when 108 bugs in all stages of development were collected. There was a high proportion of young nymphs in this sample, but it was not possible to estimate the size of the total population by the withdrawal method due to irregularities in the rate of capture. These irregularities were caused by the fact that the bugs were found concentrated under sacks placed on top of the interior walls and in the beds. No bugs were found in the walls themselves.

A final inspection of the house was made in August 1979, when 20 nymphs (but not adult *T. infestans)* were collected from underneath the sacks on top of the interior walls. At this time, 14 months after the house was plastered, only three serious cracks in the plaster had occurred, all at junctures of the walls and wooden door frames. Such cracks can be sealed easily with a paste of lime and water.

A further inspection of the house was made in November 1980, almost three years after the house was plastered. The plaster was still in good condition. No bugs were found, and none were reported by the householders.

Discussion

As the foregoing results show, complete removal of the wall-crevice habitat caused a significant reduction in size of the *T. infestans* population. However, partial removal of the wall-crevices, by plastering only half the house, produced no apparent reduction in the bug population. This suggests that the physical limitations of suitable wall-crevice microhabitats are not normally a factor limiting the size of these bug populations. Instead, the maximun size of a domestic bug population, at the carrying capacity of the environment, is normally limited by other factors—so that not all the available physical space is taken up. This is an important point to consider in view of the suggestion that wall plastering could provide a useful way of reducing domestic bug populations and thus reducing the rate of Chagas' disease transmission *(1)*. Our findings indicate that wall plastering will only be successful if it is done thoroughly, so as to seal all the cracks and crevices in the house walls.

The return of the bug population to detectable levels six to eight months after the final wall plastering is consistent with a bug popula-

tion's rate of recovery after treatment with an insecticide such as γ -BHC (R. Pinchin, personal communication). However, instead of recovering fully (as it typically would after insecticide treatment) the bug population did not return to its original size—because a permanent modification of the habitat had been made. Hence, the residual population survived only in beds and under objects on the walls and floor, but not in the walls themselves. Presumably the reduction of the triatomine population would have been complete had the sacks of produce been kept outside in a shed, rather than inside the house where they provided shelter for the bugs.

Because the house was isolated by more than a kilometer of woods and fields from its nearest neighbor, we do not believe that the house was reinfested by flying adult bugs *(9, 10)*. It is more likely that a small residual population remained at undetectable levels after the plastering was done. Application of slow-release insecticides to discrete areas such as bed-legs might well have eliminated this residual population *(11)*.

Intuitively, we expected that the factors of greatest importance in limiting the size of a domestic bug population would be either physical space, predation, or the food supply. However, the results reported here suggest that space is normally unimportant unless it is severely restricted.

We found little evidence of predation. Spiders and other predatory arthropods were uncommon in the house; and although 16.5 per cent of a sample of 109 eggshells had been parasitized by the scelionid wasp *Telenomus fariari,* this is unlikely to be an important limiting factor since, as Rabinovich *(12)* has shown, the egg stage of *T. infestans* carries less than 1 per cent of the total reproductive value of a generation.[4]

It seems unlikely that predation by vertebrates such as chickens was very great, since chickens depend on sight to locate their prey and the bugs' activity is nocturnal *(15)*. However, if the most important limiting factor is the size of the host biomass available as a blood source, then removal of domestic animals such as chickens from the house should help to reduce the bug population by reducing the bug-carrying capacity of the environment.

The material costs of our experiment were negligible, although other costs were relatively high. Specifically, we paid the equivalent of more than US$75 to the householder for permission to use his house and for his labor in helping to apply the plaster. On a larger scale, however, we expect that this type of operation could be carried out at a much lower unit cost. Since the methods used are simple and traditional, the labor of householders themselves can be employed. It is therefore possible that wall plastering such as that employed in this instance could provide an inexpensive way of rendering rural homes permanently less prone to infestation by triatomine bugs. It is gratifying to note that, following our work, most of the homeowners in Mambaí are now plastering the walls of their houses.

[4]The reproductive value of a stage may be defined as the number of individuals in the stage that will not be present one generation after destruction of an individual of the same stage in the previous generation *(13, 14)*.

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SUMMARY

A mud-brick (adobe) house in central Brazil was examined monthly over a period of two and a half years for triatomine bug vectors of Chagas' disease. One year after this sampling began, half the adobe walls were plastered over with a traditional mixture of sand, earth, cow dung, and lime; the other half of the house walls were similarly plastered over six months later.

The size of the triatomine bug population showed no reduction after half the walls were plastered, but it declined to undetectable levels after all the walls were plastered. Eight months later the bug population had risen to low detectable levels. However, it did not return to its original high density because a permanent modification had been made in the habitat.

These results indicate that unless severely restricted, physical space in the bugs' wall-crevice habitat does not normally limit the size of a domestic triatomine bug population. Thus, wall plastering will only succeed in reducing domestic triatomine bug populations if it is carried out thoroughly, in conjunction with the removal of litter and other materials that can provide places of concealment for the bugs. It is also true, however, that thorough wall plastering with local materials (such as that performed in this instance) could provide an inexpensive way of rendering rural homes permanently less prone to infestation.

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