# EVALUATION OF TRIATOMINE BEHAVIOR UNDER THE EFFECT OF CONTACT WITH CALCIUM HYDROXIDE [$Ca(OH)_2$]: MORTALITY RATES OF *Triatoma infestans* AND *Rhodnius neglectus* (HEMIPTERA, REDUVIIDAE)

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## RESUMO

Avaliação do comportamento de Triatomíneos sob ação do Hidróxido de Cálcio [$Ca(OH)_2$]: - Taxas de Mortalidade de *Triatoma infestans* e *Rhodnius neglectus* (Hemiptera, Reduviidae).

O uso anti-septico da cal hidratada ou hidróxido de cálcio [$Ca(OH)_2$] é conhecido desde muito tempo. Entretanto, seu uso como inseticida, tem sido muito limitado. O presente trabalho é um ensaio inicial com vistas a pesquisa de um método de controle alternativo e de baixo custo. Populações de *Triatoma infestans* e *Rhodnius neglectus* foram mensalmente aspergidos com com suspensão aquosa de hidróxido de cálcio a 50% (Grupo Exposto) e água destilada (Grupo Controle) e observada a mortalidade durante 30 dias. Diariamente foram tomadas temperatura e umidade do ambiente e a mortalidade ocorrida nos dois grupos. Obteve-se para *T. infestans* uma taxa de mortalidade de 28% para o grupo exposto e 15% para o controle. Para *R. neglectus* as taxas foram respectivamente 39% e 17%. Aplicando-se o teste de associação Qui-quadrado verificou-se que a diferença nas proporções mencionadas eram estatisticamente significantes. Foram calculadas ainda as correlações das variáveis umidade relativa, temperatura máxima e temperatura mínima com os lógitos das proporções de óbitos no grupo exposto. Para as duas espécies as três correlações não se mostraram significantes, indicando que a maior mortalidade no grupo exposto não é devido as variáveis mencionadas. PALAVRAS-CHAVE: Controle alternativo de triatomíneos; cal hidratada; hidróxido de cálcio.

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## ABSTRACT

The use of hydrated lime or calcium hydroxide as antiseptic is well know. However, as an insecticide its use has been very limited. This paper relates a first experimental research project on an alternative, low cost, control technique. Populations of *T. infestans* and *R. neglectus* were sprayed with a 50% suspension of calcium hydroxide (Exposed Groups) and of distilled water (Control Groups). Temperature, humidity and mortality were recorded daily. A mortality rate of 28% ocurred in the Exposed Group and of 15% in the Control Group for *T. infestans*. For *R. neglectus* the rates were 39% and 17% respectively. Chi-square tests showed, at the 5% level, that the differences between the proportions are significant. Correlation tests for each of the variables: relative humidity and maximum and minum temperatures with the logit of the proportion of deaths in the Exposed Group showed them not to be significant: the higher mortality in these groups was not due to these variables. KEYWORDS: alternative control of triatomines; hidrated lime; calcium hydroxide.


## INTRODUCTION

As a result of the ever more rapid increase of the resistance of insects to pesticides, a large number of new products are launched onto the market each year. In the attempt to solve this problem, particularly as regards agricultural vermin, a catastrophic wave of environmental pollution has been produced which has often resulted in much more serious consequences than the problems that it sought to control. Thus began a new phase: the search for alternative products and techniques which would eliminate the problem without provoking the already well-known consequences of the pesticides in use at this time.

The use of hydrated lime or calcium hydroxide as an antiseptic has not only been known since antiquity, but its application has been widespread among pratically all peoples. The same is not true, however, of its use as a fungicide or pesticide.

Some authorities, such SEARLE (1935) and BOYTON (1966), reccomend the use of hydrated lime, either alone or in association with other substances, as a potential insecticide. The repellent effect on certain populations of insects seems to suggest a promising application of this substance. (ANÔNIMO, 1986). Further, its success as a larvicide in combating flies, as seen in its use against the problematic infestation of 1984 in the counties of Assis, Echaporã and Platina in the State of São Paulo, Brazil (SULEM, 1984), seems to ofter a sure indication of the possibility of its use for the control of some insects.

Transmission of *Trypanosoma cruzi* by blood-sucking bugs (triatomines) is still today responsible for a significant percentage of five million people with positive serology for Chagas' Disease in Brazil (SILVEIRA & SAKAMOTO, 1983). In 1986 alone, SUCAM sprayed about 1 700 000 homes of the 5 400 000 suspected of harboring blood-suckings bugs in the endemic region of the disease in Brazil.

Probably the treatment of the houses in the endemic zone with hydrated lime would slow down the process of adaptation of the triatomines to the domestic environment. This possibly wide-spectrum effect probably varies from the repellent action which the white color or the reflection of light might exercise on the blood-sucking bugs to the lethal action which this substance might have on them.

In the light of this, it was decided to study the behavior of some species of blood-sucking bugs when submitted to the action of hydrated lime or clacium hydroxide [$Ca(OH)_2$] with a view to the choice of a alternative method of easy application, low cost and low toxicity to man. In this initial stage, the mortality rates of *T. infestans* and *R. neglectus* were investigated, over a period of 30 days, after spraying with 50% calcium hydroxide in suspension.

## MATERIAL AND METHODS

Five hundred and sixty specimens of each species, *T. infestans* and *R. neglectus*, were used, séparated into groups of 35 bugs, each group being made up of 5 samples of each nymphal stage and 5 adults of each sex, all of them coming from the Triatomine Insectarium of the Epidemiology Department of the School of Public Health of the University of São Paulo (ESP/USP) at its Special Health Service in Araraquara, São Paulo. Four glass crystallizers, 26 cm in diameter and 10 cm in height, were used, each of them containing 16 divisions made of thick cardboard and one only of the aforement ioned sub-groups. Two crystallizers containing, respectively, *T. infestans* and *R. neglectus* were sprayed with a 50% solution of calcium hydroxide and constituted the Exposed Group; two others with sub-groups of the same two species were sprayed only with distilled water and constituted the Control Group. Over 16 months, during the period from March 1988 to June 1989, a monthly application was made to each of these four sub-groups after each of which the daily mortality rate was observed for the following 30 days. Each sub-group was renewed monthly and the same method applied. Each day the relative humidity of the air and the maximum and minimum temperatures of the insectarium where the sub-groups of triatomines under study were housed were recorded.

The Chi-square test to the 5% level (BERQUÓ *et al.*, 1981) was applied with a view to comparing the proportions of survivors of the two groups. The occasional influence of the variables relative humidity, maximum temperature and minimum

temperature on the mortality of the Exposed Group was analysed by means of the correlation between these variables and the logit of the proportions of deaths. The correlation significance test was applied, also at the 5% level.

## RESULTS AND DISCUSSION

The monthly mortality rate for *T. infestans* recorded during the period from March 1988 to June 1989 (Table 1) for the group exposed to spraying with the 50% calcium hydroxide solution varied between a minimum of 2.86% in May 1989 to a maximum of 54.29% in December 1988, thus giving a general average for the period of 27.67%. On the other hand, for the Control Group - those submitted to spraying with distilled water only - the variation recorded oscillated between 0.0% in May 1988 and 45.71% in December of the same year, giving an average for the period of 15.17%. Application of the Chi-square test (Table 3) showed that the proportion of deaths in the Exposed Group (28%) is significantly greater than that of the Control Group (15%).

The monthly mortality rate for *R. neglectus* for the same period (Table 2) for the group exposed to the 50% calcium hydroxide solution showed a variation between a minimum of 17.14% in the months of March and May 1988 and March 1989 and a maximum of 80% in April 1988, giving a general average for the period of 39.10%. For the Control Group - sprayed with distilled water only - the variation recorded was between 0.0%, registered in May 1988 and March 1989, and 77.14% in December 1988, with an average for the period of 17.32%. Application of the Chi-square test (Table 4) showed that the proportion of deaths for the Exposed Group (39%) is significantly greater than for the Control Group (17%).

The relative humidity of the air and the maximum and minimum temperatures of the insectarium where the bugs were housed were recorded for both species. The respective monthly averages are given in Tables 1 and 2. The correlations of these variables with the logits of the proportions of deaths of the exposed sub-groups were calculated but showed no significance, thus indicating that the greater mortality of the Exposed Group is not a result of the variables relative humidity, maximum temperature and minimum temperature.

Even though the analysis of these variables did not result in statistically significant values, the occurrence of maximum and minimum values, simultaneously, in the same months, for the two (Exposed and Control) groups, seems to indicate that some climatic factor may have had some influence on the mortality rates. Thus, for *T. infestans* (Table 1) the highest rates, both for the Exposed Group (54.29%) and for the Control Group (45.71%), were recorded in December 1988. The same phenomenon may be observed for *R. neglectus* (Table 2), for which the simultaneous minimum rate (0.0%) is to be observed in May 1988 and March 1989 both for the Control Group and for the

Exposed Group (17.14%). However, as these facts relate to only some of the 16 months in which observations were made they were insufficient to provide significant correlations. It is to be noted that, even with this simultaneous occurrence, the trend of the variation of the mortality was the same for both the groups and does not conflict, therefore, with the general results presented.

It is further to be recognized that the mortality rates due to the action of calcium hydroxide for *T. infestans* (28%) and *R. neglectus* (39%), though statistically significant, represent a relatively low lethal effect, especially when the highly lethal effect of modern chemical pesticides is considered; such results would, when thus considered, come to the levels of "tolerance" or "resistance". It is not intended, in fact, to establish comparisons with such products as no attempt has yet been made to investigate the toxic effects of calcium hydroxide. On the basis of this initial research, studies into the effects of this substance on the behavior and evolution of the blood-sucking bug can be undertaken, both as regards its repellent or its irritant qualities and, secondly observation and evaluation of the development of colonies of these insects may be undertaken and this is, in fact the proposal which is being made with a view to the continuation and deepening of this investigation.

## CONCLUSIONS

For *T. infestans* a mortality rate of 28% was obtained for the group exposed to the 50% solution of calcium hydroxide, and a rate of 15% for the Control Group. For *R. neglectus* the rates obtained were, respectively, 39% and 17%. In both cases these values were statistically significant.

For the two species mentioned the greater mortality of the Exposed Group is not due to the variables: relative humidity, maximum temperature, minimum temperature - because the correlations between these variables and the logits of the proportions of the deaths of this group were not satistically significant.

Although the values found were statiscally significant, comparisons have not been stablished with the lethal qualities of present-day chemical pesticides, in comparison with which the values found would not be seen as more than "tolerance" or "resistence".

It is suggested, in the light of the results obtained, that this study be continued and further developed with regard to the response of the triatomines to the action of calcium hydroxide.

Table 1 - Monthly mortality of *Triatoma infestans* exposed to the action of a 50% solution of calcium hydroxide or hydrated lime [$Ca(OH)_2$] and of distilled water ($H_2O$), temperature and relative humidity, during the period from March 1988 to June 1989.

| Date (month/year) | Relative humidity | Temperature (°C) | | Nº of triatomines exposed | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Control Group ($H_2O$) | | | Exposed Group [$Ca(OH_2$] | | |
| | | Maximum | Minimum | Dead | Survivors | % | Dead | Survivors | % |
| Mar. 88 | 94.1 | 25.8 | 24.0 | 8 | 27 | 22.86 | 7 | 28 | 20.00 |
| Apr. 88 | 90.4 | 25.3 | 23.0 | 4 | 31 | 11.43 | 10 | 25 | 28.57 |
| May. 88 | 93.2 | 22.0 | 20.6 | 0 | 35 | 0 | 6 | 29 | 17.14 |
| Jun. 88 | 97.9 | 20.3 | 18.6 | 3 | 32 | 8.57 | 6 | 29 | 17.14 |
| Jul. 88 | 94.6 | 18.6 | 17.5 | 2 | 33 | 5.71 | 7 | 28 | 20.00 |
| Aug. 88 | 78.1 | 23.9 | 21.8 | 3 | 32 | 8.57 | 10 | 25 | 28.57 |
| Sep. 88 | 76.6 | 24.8 | 23.1 | 3 | 32 | 8.57 | 8 | 27 | 22.86 |
| Oct. 88 | 88.5 | 32.1 | 30.2 | 10 | 25 | 28.57 | 15 | 20 | 42.86 |
| Nov. 88 | 86.6 | 25.3 | 23.5 | 6 | 29 | 17.14 | 12 | 23 | 34.29 |
| Dec. 88 | 96.0 | 24.7 | 23.0 | 16 | 19 | 45.71 | 19 | 16 | 54.29 |
| Jan. 89 | 95.5 | 25.3 | 23.5 | 10 | 25 | 28.57 | 18 | 17 | 51.43 |
| Feb. 89 | 94.1 | 26.0 | 24.5 | 4 | 31 | 11.42 | 5 | 30 | 14.29 |
| Mar. 89 | 89.7 | 26.1 | 24.4 | 2 | 33 | 5.71 | 7 | 28 | 20.00 |
| Apr. 89 | 92.5 | 23.7 | 22.2 | 6 | 29 | 17.14 | 11 | 24 | 31.43 |
| May 89 | 89.7 | 21.0 | 19.8 | 2 | 33 | 5.71 | 1 | 34 | 2.86 |
| Jun. 89 | 94.2 | 18.9 | 17.9 | 6 | 29 | 17.14 | 13 | 22 | 37.14 |
| Total | - | - | - | 85 | 475 | 15.17 | 155 | 405 | 27.67 |

Table 2 - Monthly mortality of *Rhodnius neglectus* exposed to the action of a 50% solution of calcium hydroxide or hydrated lime [$Ca(OH)_2$] and of distilled water ($H_2O$), temperature and relative humidity, during the period from March 1988 to June 1989.

| Date (month/year) | Relative humidity | Temperature (°C) | | Nº of triatomines exposed | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Control Group ($H_2O$) | | | Exposed Group [$Ca(OH)_2$] | | |
| | | Maximum | Minimum | Dead | Survivors | % | Dead | Survivors | % |
| Mar. 88 | 94.1 | 25.8 | 24.0 | 5 | 30 | 14.28 | 6 | 29 | 17.14 |
| Apr. 88 | 90.4 | 25.3 | 23.0 | 5 | 30 | 14.28 | 28 | 7 | 80.00 |
| May 88 | 93.2 | 22.0 | 20.6 | 0 | 35 | 0 | 6 | 29 | 17.14 |
| Jun. 88 | 97.9 | 20.3 | 18.6 | 9 | 26 | 25.71 | 21 | 14 | 60.00 |
| Jul. 88 | 94.6 | 18.6 | 17.5 | 4 | 31 | 11.43 | 21 | 14 | 60.00 |
| Aug. 88 | 78.1 | 23.9 | 21.8 | 3 | 32 | 8.57 | 12 | 23 | 34.29 |
| Sep. 88 | 76.6 | 24.8 | 23.1 | 3 | 32 | 8.57 | 14 | 21 | 40.00 |
| Oct. 88 | 88.5 | 32.1 | 30.2 | 10 | 25 | 28.57 | 15 | 20 | 42.86 |
| Nov. 88 | 86.6 | 25.3 | 23.5 | 9 | 26 | 25.71 | 10 | 25 | 28.57 |
| Dec. 88 | 96.0 | 24.7 | 23.0 | 27 | 8 | 77.14 | 16 | 19 | 45.71 |
| Jan. 89 | 95.5 | 25.3 | 23.5 | 7 | 28 | 20.00 | 17 | 18 | 48.57 |
| Feb. 89 | 94.1 | 26.0 | 24.5 | 2 | 33 | 5.71 | 13 | 22 | 37.14 |
| Mar. 89 | 89.7 | 26.1 | 24.4 | 0 | 35 | 0 | 6 | 29 | 17.14 |
| Apr. 89 | 92.5 | 23.7 | 22.2 | 5 | 30 | 14.28 | 12 | 23 | 34.29 |
| May 89 | 89.7 | 21.0 | 19.8 | 1 | 34 | 2.86 | 9 | 26 | 25.71 |
| Jun. 89 | 94.2 | 18.9 | 17.9 | 7 | 28 | 20.00 | 13 | 22 | 37.14 |
| Total | - | - | - | 97 | 463 | 17.32 | 219 | 341 | 39.10 |

TABLE 3 - Monthly mortality of *T. infestans* exposed to the action of a 50% solution of calcium hydroxide or hydrated lime [$Ca(OH)_2$] and distilled water ($H_2O$).

| Survival | Dead | | Survivors | | Total | |
|---|---|---|---|---|---|---|
| Group | nº | % | nº | % | nº | % |
| Exposed Group [$Ca(OH)_2$] | 155 | 28 | 407 | 72 | 560 | 100 |
| Control Group ($H_2O$) | 85 | 15 | 475 | 85 | 560 | 100 |
| Total | 240 | 21 | 880 | 79 | 1120 | 100 |

$x^2 = 25.25$ $y = 0.36$ SIGNIFICANT

TABLE 4 - Montly mortality of *R. neglectus* exposed to the action of a 50% solution of calcium hydroxide or hydrated lime [$Ca(OH)_2$] and distilled water ($H_2O$).

| Survival | Dead | | Survivors | | Total | |
|---|---|---|---|---|---|---|
| Group | nº | % | nº | % | nº | % |
| Exposed Group [$Ca(OH)_2$] | 219 | 39 | 341 | 61 | 560 | 100 |
| Control Group ($H_2O$) | 97 | 17 | 463 | 83 | 560 | 100 |
| Total | 316 | 28 | 804 | 72 | 1120 | 100 |

$x^2 = 64.54$ $y = 0.51$ SIGNIFICANT

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