

Insecticide and Community Interventions to Control *Triatoma dimidiata* in Localities of the State of Veracruz, Mexico

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Three different interventions to control *Triatoma dimidiata* in the State of Veracruz were implemented: X-1 = whole dwelling spraying, X-2 = middle wall spraying, X-3 = household cleaning. Cyfluthrin was sprayed 3 times with 8 month intervals. After each spraying, insects were collected and sent to the laboratory to be recorded and to determine genus and species of the adult triatomine bugs, and nymphs were counted. *Trypanosoma cruzi* presence was determined. With X-1, the infestation, colonization, and natural infection indexes were reduced to 0% in the 3 localities, with respect to t_0 . With X-2, the infestation index was reduced to 10% at t_3 in 3 localities; the colonization index was reduced to 0% in only 1 locality at t_3 , and the natural infection index was reduced to 0% at t_3 . With X-3 the 3 indexes were not effectively reduced but they decreased with respect to the baseline study. Insecticide application to the whole dwelling is a more efficient intervention than its application to only the lower half of the walls and to the cleaning of houses.

Key words: *Triatoma dimidiata* - control - pyrethroid insecticide spraying - entomological indexes - Mexico

Many trials have been performed to determine the distribution of the Triatominae (Hemiptera:Reduviidae) in Mexico (Lent & Wygodzinsky 1979, Tay et al. 1980, 1992, Zarate & Zarate 1985, Salazar et al. 1988, Magallon et al. 1998, Vidal et al. 2000). It has currently been established that the existent Chagas disease vectors in Mexico are 7 genera and 24 species of the *Triatoma* genus (Carcavallo et al. 1999). Based on this knowledge, an initiative (Salazar-Schettino et al. 2001) was launched in Mexico, in order to define the technical guidelines useful to control triatomines inside rural homes.

To contribute to the design of control measures in the country, the present work reports the results of 3 interventions. The first was residual spraying with a pyrethroid insecticide of the whole rural house, the second was partial spraying of the dwellings, and the third consisted of hygienic measures carried out by the community. These interventions, performed at 3 localities in the state of Veracruz were based on a previous transversal epidemiological study (Hernández 2000), in which house infestation with triatomines was evaluated in 11 Sanitary Jurisdictions of the state. In this research, the only vector domiciliated was *T. dimidiata*.

MATERIALS AND METHODS

Based on a previous transversal epidemiological study in 11 Sanitary Jurisdictions of the state of Veracruz, 3 localities were selected from 3 of these Sanitary Jurisdictions: Mesa de Tlanchinol (21°20'N, 97°53'W, at 220 m over sea level), from Sanitary Jurisdiction II, in the north of the state; La Luz (19°10'N, 96°53'W, at 1040 m over sea level) from Sanitary Jurisdiction VI, in the central part of the state and Úrsulo Galván (18°16'N, 94°41'W, at 180 m over sea level) from Sanitary Jurisdiction XI in the south of the state. Selection of the 3 localities was based on triatomine presence; 30 houses built with any type of material for ceiling, floor, and walls and any number of rooms, were selected as a minimum for each site. Easy accessibility, and no insecticide application during the 6 months prior to this study were also considered. Selection of houses was carried out at random from a map of each locality; which were divided in 5 zones: north, south, west, east, and downtown. From each zone was chosen 2 houses for each control measure making a total of 30 houses for each measure (Fig. 1).

Three control interventions were implemented. The first was residual insecticide spraying to the complete indoor and outdoor walls of the 10 houses (X-1), in the intra and peridomicile, second was the partial spraying of the same insecticide to another 10 houses (X-2); the third intervention was no application of the insecticide to 10 houses (X-3). For X-1 vertical swaths of insecticide of 75 cm width were applied from the top to the bottom, covering the whole surface of the indoor and outdoor walls of the house. Cracks, holes, doors, and window frames, and especially the wall and floor intersection, were sprayed with the insecticide. Paintings, pictures, and papers on the wall were sprayed on both sides; peridomiciliary struc-

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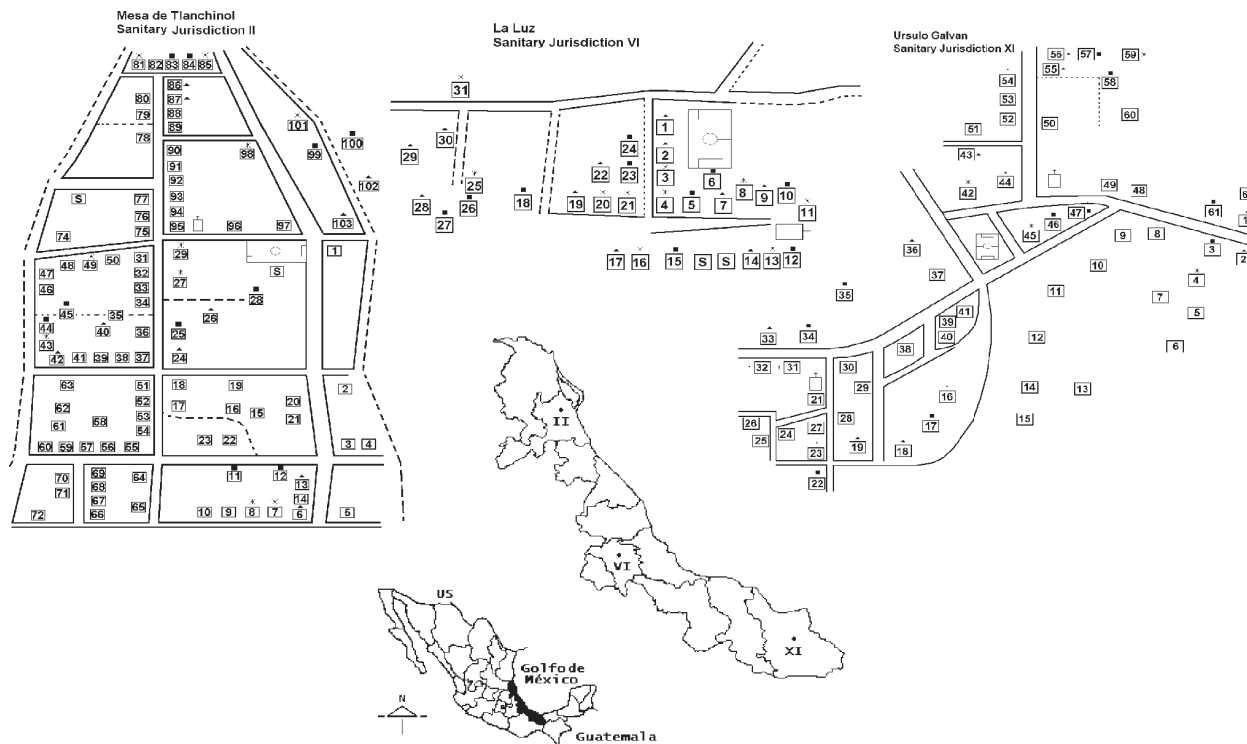


Fig. 1: map of Veracruz, Mexico. Distribution of houses for three control interventions to three localities. ★ whole dwelling spraying; ● partial spraying of houses; ■ household cleaning; S school

tures, such as animal quarters were treated in the same way as human bedrooms. X-2 consisted of the partial application of insecticide to 10 houses, from the middle of the wall downwards, indoors and outdoors, following the same methodology described above. This partial application was based on the behaviour of *T. dimidiata*, (adults and nymphs) which is generally found on the wall from the floor up to 1.40 m height and in the intersection of the wall and the floor as reported elsewhere (Hernández 2000). X-3 consisted of no insecticide application to 10 houses. Here we recommended hygienic measures, such as order and cleanliness of the interior of the house, airing and changing of place of accumulated elements (clothes, boxes, foods) at least 4 times per year; to reduce the number of dogs, cats and birds within the house and to avoid that they sleep with people; to smooth the ceilings and the walls of the house with local materials: mud or cement plaster; to construct separate storage areas and corrals away from sleeping areas.

The 20 houses of each locality selected for insecticide application were sprayed with cyfluthrin 10 WP (Solfac, Bayer) at a dose of 50 mg a.i./m² with a Hudson X-PERT spraying pump of 4-US gallon capacity and 50 psi pressure.

Before applying the insecticide, a baseline entomological survey was carried out in all houses, which we designated t_0 . Afterwards, 3 applications were made at 8 months intervals. Insects were captured each month and grouped after the first, second, and third insecticide application (named t_1 , t_2 , and t_3 , respectively). Three ento-

mological indexes, infestation, colonization and natural infection, were assessed (Silveira et al. 1984).

Insecticide application as well as capture of triatomine bugs before and after insecticide sprayings were performed by us and personnel from the vector department of the Health Ministry of the State. Vector personnel was trained to recognize the triatomine, and each Sanitary Jurisdiction team was given a box with *T. dimidiata* life cycle (which was the only domiciled vector found in the previous study) so that they could show it to each member of the family, for insect identification purposes.

RESULTS

People recognized the vector, and the previous finding of *T. dimidiata* as the only domiciled triatomine was confirmed. Insects were found mainly on the bedroom earth floors and on walls near the beds. In the 90 dwellings studied, the baseline entomological study showed the presence of insects in 80 of them. This decreased when insecticide was applied, and, to a lesser extent also decreased where cleaning actions were recommended.

Comments about insecticide use among the population were positive in the sense that there were no complaints regarding smell or irritation either in themselves or in their animals; on the contrary, they made reference to the beneficial effects on other insects, such as cockroaches and mosquitoes.

With the application of the insecticide to the complete house (X-1) a clear decrease in the infestation index was observed in the 3 localities. Although this was sustained

in the northernmost site, Mesa de Tlanchinol, in the other 2 localities it decreased gradually and reached 0% only 24 months after the beginning of the study.

This index also diminished in the 3 villages with respect to the baseline capture when the intervention was partial spraying of the dwellings with insecticide (X-2), although at t_3 all towns still showed 10% of the houses infested with triatomines. In the homes where no insecticide was applied the infestation index decreased compared to t_0 , however, in 2 homes located in the north and in the centre of the state, infestation rose at t_3 . Overall results in the locality of the north of the state, showed that infestation had clearly decreased (Fig. 2).

The colonization index decreased to 0% in the 3 localities after 3 applications of insecticide to the complete house. With the application of the insecticide to half walls of the houses this index decreased to 0% in one locality by t_3 and in the other 2 localities it fluctuated between 20% and 33% at t_3 . In homes with no insecticide applica-

tion (X-3) the colonization index diminished to 14% in the south of the state, the locality of Úrsulo Galván. But in the other 2 localities this index was variable; in the north it was 0% at t_2 but increased at t_3 , and in the centre of the state, it stayed high along all of the study (Fig. 3).

A decrease in *Trypanosoma cruzi* infection was observed in the vectors captured in the localities where insecticide was applied. In homes where hygienic measures were recommended the index of natural infection remained between 7% and 14% (Fig. 4).

With respect to the vectors in the peridomestic area they were collected only in the locality of the south of the state mainly in the chicken yard: 5 insects in one house at t_0 and t_1 when whole dwelling was spraying, 2 vectors in 1 dwelling at t_2 with partial spraying and 11 insects in 2 houses in t_0 and t_1 where no insecticide was used.

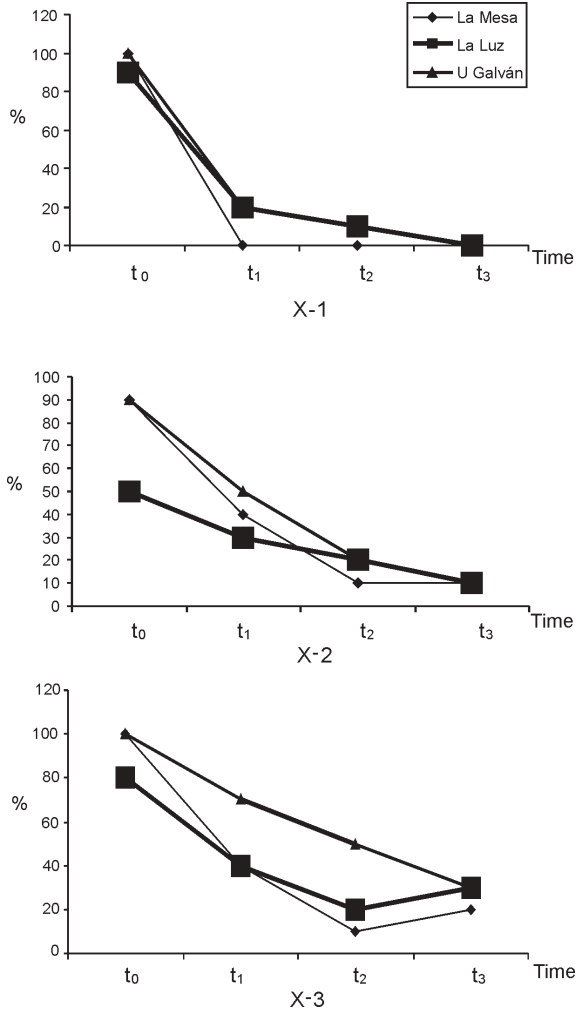


Fig. 2: infestation index in 3 localities of the state of Veracruz under 2 different insecticide application programs and with hygienic measures. X-1: insecticide spraying to the whole house (10 houses); X-2: insecticide spraying from the middle of the wall downwards (10 houses); X-3: hygienics measures (10 houses)

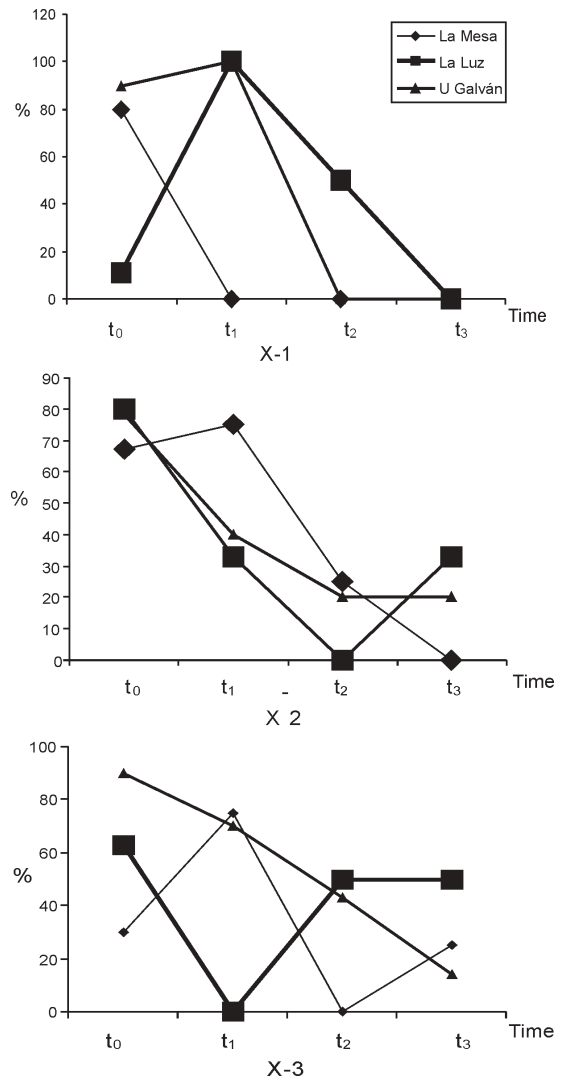


Fig. 3: colonization index in 3 localities of the state of Veracruz under 2 different insecticide application programs and with hygienic measures. X-1: insecticide spraying to the whole house (10 houses); X-2: insecticide spraying from the middle of the wall downwards (10 houses); X-3: hygienics measures (10 houses)

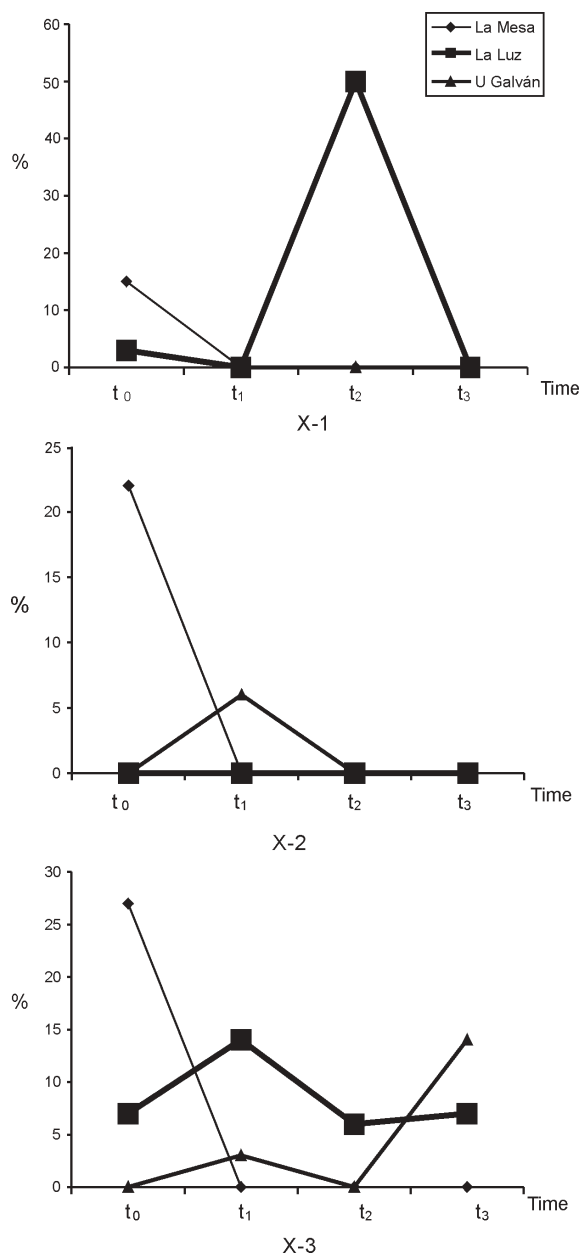


Fig. 4: natural infection index in 3 localities of the state of Veracruz under 2 different insecticide application programs and with hygienic measures. X-1: insecticide spraying to the whole house (10 houses); X-2: insecticide spraying from the middle of the wall downwards (10 houses); X-3: hygienic measures (10 houses)

DISCUSSION

The experience of the *T. infestans* control in Bolivia (Guillen et al. 1997) or on *T. dimidiata* in Nicaragua (Acevedo et al. 2000) and in Guatemala (Nakagawa et al. 2003) has shown the efficiency of pyrethroids in eliminating domestic Triatominae. In this research, cyfluthrin spraying, applied to the whole dwelling and on half of the walls, from the middle downwards, showed that these 2 interventions functioned differently in the 3 localities. However, triatomine presence was reduced to zero after 3

applications of the insecticide when applied to the whole houses. In most previous studies of triatomine control using pyrethroid insecticides, these are applied only once after the baseline capture. In this study it was done 3 times, once every 8 months.

Pyrethroid application from the middle of the wall downwards also showed results indicating a decrease in *T. dimidiata* infestation, however, total disappearance was not accomplished, although the number of houses with triatomines had decreased at the final stage of the study. The colonization index always remained above zero. This might be due to the presence of eggs in the houses before the spraying, since pyrethroids have no effect on eggs (Dias et al. 2001).

Community participation, (X-3) was variable in the 3 localities. In the town located to the north of the state it was prominent and even though the infestation index was not reduced to zero, it fell significantly ($p < 0.05$) at t_2 and t_3 , compared with t_0 . However, the colonization index, although at t_2 had fallen to 0%, at t_3 it had increased again. In the town located at the centre of the state all indexes stayed high. The reason was the almost null cooperation of some inhabitants, who were reluctant to follow the indications with respect to the cleaning of the house. Inhabitants who were highly sensitive at first to the risk of cohabiting with the *T. dimidiata*, did not show interest in cleaning their dwellings later. In this locality the infestation index was variable, only in 2 houses were triatomines captured at t_2 , but infestation rose again at t_3 . The colonization index was zero at t_1 , but at t_2 and t_3 it had increased to 50%. In this locality, natural infection remained the same at t_0 although at t_1 it was 14%.

In the southern locality the community was very receptive to all cleaning actions, and infestation was lower at t_1 , t_2 and t_3 than at t_0 . However, at the end of the study vectors were found in 3 houses, therefore the colonization index was increased, but it was the lowest in the 3 localities and it was also observed on 2 occasions that captured insects were positive to infection with *T. cruzi*. This was the only community where triatomines were collected in the peridomestic area.

Based on the present results, it is important at the time when decisions have to be made, that the relevant authorities take into account available resources. If enough are at hand and results are expected in the short term, intervention X-1 can be adopted. If resources are limited, intervention X-2, or spraying the walls from the middle to the floor, can be employed. In case no resources are available, health education must be imparted teaching communities the necessary hygienic measures to avoid triatomine infestation. It must be stressed that two localities, center and south, had been favored by the "Solid Floor Program" consisting of cementing the earth floors and sponsored by the state government office, an important improvement to houses, since *T. dimidiata* is often found mainly on bedroom walls, up to a height of 1.40 m, and mainly associated to the earth floor (Zeledón 1981), a condition that we verified in the 3 localities.

Although house infestation can be controlled with 2 insecticide sprayings (whole or partial), the application to the complete house, indoors and outdoors, is the most

effective action. At the end of the study, 100% of the sprayed houses in the 3 localities showed no triatomines, whereas with partial spraying, it was controlled in 90% and with the hygiene program in 80% in the northern, 70% in the central and 70% in the southern localities of the state.

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