# *Triatoma mexicana* (Hemiptera: Reduviidae) in Guanajuato, Mexico: house infestation and seasonal variation

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Triatoma mexicana *was described by Herrich–Schaeffer in 1848. In 1940, a male specimen was found in Hidalgo. In 1970, this species was recorded in the state of Queretaro. Later, it was registered in Guanajuato and San Luis Potosi. In the present paper we performed an investigation in 545 dwellings from three counties in the state of Guanajuato, Mexico, from March 2003 to May 2004. The search and capture of triatomines were seasonally performed indoors and outdoors. Entomological indexes were calculated. The risk and no risk relations between triatomine presence and housing construction materials were analyzed. Fourteen triatomines were collected indoors and 151 outdoors. The vectors were collected in houses built with either risky and non-risky materials. Adults go indoors but do not settle there, hence, no relationship was found between the building materials and infestation of houses. Conventional interventions like house improvement or insecticide spraying are not efficient for the control of* T. mexicana*, because its developmental cycle is accomplished outdoors in the area surrounding the houses.*

Key words: *Triatoma mexicana* - behavior - Chagas disease - Guanajuato

Currently, the subfamily Triatominae (Hemiptera: Reduviidae) is divided in six tribes, 19 genera and 137 species. In Mexico, the most important genera are *Triatoma* and *Meccus*. The most common is genus *Triatoma* with 19 species widely distributed, followed by *Meccus* with six species (previously in the *Triatoma phyllosoma* complex) (Galvão et al. 2003). Triatomine vectors have been reported in all Mexican states (Cruz-Reyes et al. 2006).

*Triatoma mexicana* was first described by Herrich–Schaeffer, in 1848, as *Conorhinus mexicanus*. Examples of *T. mexicana* have been scarcely captured in Metztitlan, Hidalgo, and in the neighboring state of Queretaro (Lent & Wygodzinsky 1979). The geographical distribution was widened when this species was found in the bordering states of Guanajuato and San Luis Potosi. Natural infection with *T. cruzi* in *T. mexicana* was reported for the first time in the state of San Luis, Potosi (Vidal-Acosta et al. 2000). López-Cardenas et al. (2005) extensively registered the presence and distribution of *T. mexicana* in Guanajuato.

Data on *T. mexicana* are scarce and mainly based on morphological description of males, and geographical distribution. The aim of this work is to acess the distribution, and developmental pattern (according to seasons) of *T. mexicana* in the northeast of Guanajuato. Furthermore, we describe indoor and outdoor ecotopes explored by this vector, as well as evaluate the influence of characteristics of the dwellings and the presence of *T. mexicana*. Additionally we aimed at estimating the entomological indexes in three counties of this state. All this in order to propose control measures to decrease the risk of *T. cruzi* natural transmission.

## MATERIALS AND METHODS

Guanajuato is located in the center of the Mexican Republic. It is divided in 46 counties and eight Sanitary Jurisdictions. This research was carried out in the northeast, in the Sanitary Jurisdiction-2, San Miguel de Allende. We selected 545 dwellings in three counties as follows: Victoria (234), Santa Catarina (55), and Tierra Blanca (256). They were located at 20º42' and 21º13' N, 100º 02' and 100º 17' W. The altitude ranged between 1,593 and 1,844 m above sea level (INEGI 1997) (Figure). These localities were chosen based on triatomine presence reported by the local vectors control personnel, as well as on the publications by Vidal-Acosta et al. (2000) and López-Cárdenas et al. (2002). Collections were performed from March 2003 to May 2004. The vectors´ personnel from the Sanitary Jurisdiction-2 were trained by our research team about Chagas disease and both worked together on the field.

The local climate is mild dry and warm, with 400 - 700 mm annual rainfall, with the heaviest precipitation reported in August and the lowest in March. Temperature range from 16 to 20ºC. Vegetation is bush-like, consisting of palo vidrioso (*Bursera* sp.), garambullos (*Myrtillocactus* sp.), pitayos (*Stenocereus* sp.) and mezquites (*Prosopis* sp.). In the agricultural area, corn (*Zea mays*) and beans (*Phaseolus vulgaris*) are grown.

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The household heads were fully informed of the purpose of this research, and were asked to sign a consent letter. In addition, they were interviewed to gain information on vectors and characteristic of dwellings. The building material from the roof, walls and floor was classified as risky or non risky (Table I) (García de la Torre 1998).

The search for triatomines was carried out indoors (on walls, floors, beds, and wood piles) and outdoors (in the henhouse, pigsty, stone walls, wood stick piles, and plants) through man/hour method. The search and capture of triatomines were carried out seasonally along the year. Taxonomic identification of adults was achieved with the triatomine keys of Lent & Wygodzinsky (1979).

Three entomological indexes were obtained: infestation index (houses positive for triatomine/number of investigated houses X 100), colonization index (houses with triatomine nymphs/number of houses positive to triatomine X 100) and natural infection index (positive triatomine for *T. cruzi*/number of examined triatomine X 100). The last index was obtained from the exam of the intestinal content of bugs diluted in saline solution to determine *T. cruzi* infection rate (Silveira et al. 1984)


Mexico, expanded area, state of Guanajuato, and states where *T. mexicana* has been reported.

TABLE I

Classification of construction material of the houses surveyed in the three counties in Guanajuato, Mexico, from March 2003 to May 2004

| Roof | Wall | Floor |
|---|---|---|
| Risk | | |
| Roof tile | Stone | Soil |
| Cardboard sheet | Cardboard Sheet | Stone |
| | Wood | |
| | Carrizo/bamboo | |
| | Adobe | |
| Without risk | | |
| Brick | Flattened adobe | Brick |
| Cement | Flattened and regular brick | Cement |
| Tin plate, galvanized, zinco | Flattened and plastered block | Mosaic |
| | Brick and plaster | Floor tile |
| | Block | |
| | Cement | |

*Statistical analysis* - Data were processed with SPSS V.10 software. A percentage descriptive analysis of the geographical distribution, the collected samples and developmental stages (according to season and site of capture), was performed. We analyzed risk and non-risk relations between the presence of triatomines and the construction materials, using $\chi^2$ test, and 95% coefficient intervals.

## RESULTS

From 545 houses, 43 were positive for triatomines, and 165 specimens of *T. mexicana* in different developmental stages were collected. When comparing triatomine captures among counties, significant difference was detected for any comparison, except between Santa Catarina and Tierra Blanca ($p > 0.05$). Fourteen (8.0%) triatomines were collected indoors, and 151 (92%) outdoors ($p < 0.05$) (Table II). Eggs were not found. The highest number of samples was from Victoria County, mostly composed of adults. The highest number of triatomines was collected during spring and summer ($p < 0.05$); no statistically difference ($p > 0.05$) was found between collections performed during summer and autumn. When comparing among seasons, all depicted statistical differences ($p < 0.05$).The highest number of nymphs was found in the autumn. A few insects were collected in the winter. Males were more abundant than females ($p < 0.05$), and adults were more frequently caught than nymphs ($p < 0.05$) (Table III).

The main indoor vector ecotope was the bedroom walls. The patio, outdoor wall and under the stone of walls were the main vector ecotopes outside the houses (Table IV). Table V shows results from infested houses: 22/234 (9%) ($p < 0.05$) were detected in Victoria, 10/55 (18%) ($p > 0.05$) in Santa Catarina, and 11/256 (4.3%) ($p > 0.05$) in Tierra Blanca. This Table also shows the results of different associations (dwellings with and without risk material, and presence or absence of triatomines) in the three counties, which showed to be significantly different ($p < 0.05$). The CI95% was calculated in the all different associations.

The infestation index in Victoria County was 9.4%, 18.1% in Santa Catarina, and 4.2% in Tierra Blanca. The colonization index was 36.3% in Victoria and Tierra Blanca counties, and 20.0% in Santa Catarina. The natural infection index was 2.6% in Victoria, 2.0% in Santa Catarina, and 4.7% in Tierra Blanca.

## DISCUSSION

House infestation index and seasonal variation of abundance of *T. mexicana* have never been accessed. Vidal-Acosta et al. (2000) reported the vector's presence in the states of San Luis Potosi and Guanajuato, and described *T. cruzi* natural infection in *T. mexicana* for the first time in the states of Hidalgo and Guanajuato. Lopez-Cárdenas et

TABLE II

Indoors and outdoors seasonal number and percentage of *T. mexicana* captured in three counties in Guanajuato, Mexico, from March 2003 to May 2004

| | Victoria | | | | Santa Catarina | | | | Tierra Blanca | | | | Total (N=165) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Indoors | | Outdoors | | Indoors | | Outdoors | | Indoors | | Outdoors | | Indoors | | Outdoors | |
| | N | % | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Spring | 3 | 1.8 | 35 | 21.2 | 2 | 1.2 | 31 | 18.8 | 2 | 1.2 | 28 | 17.0 | 7 | 4.2 | 94 | 57.0 |
| Summer | 4 | 2.4 | 18 | 10.9 | 0 | 0 | 5 | 3.0 | 2 | 1.2 | 3 | 1.8 | 6 | 3.6 | 26 | 15.7 |
| Autumn | 0 | 0 | 15 | 9.0 | 0 | 0 | 1 | 0.6 | 0 | 0 | 6 | 3.6 | 0 | 0 | 22 | 13.3 |
| Winter | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 5.5 | 1 | 0.6 | 0 | 0 | 1 | 0.6 | 9 | 5.5 |
| Total | 7 | 4.2 | 68 | 41.2 | 2 | 1.2 | 46 | 27.8 | 5 | 3.0 | 37 | 22.4 | 14 | 8.5 | 151 | 91.5 |

TABLE III

Number and percentage of *T. mexicana* nymphs and adults collected per season in three counties of Guanajuato, Mexico, from March 2003 to may 2004

| Seasons | Nymphs | | Adults | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | Females | | Males | | | |
| | N | % | N | % | N | % | N | % |
| Spring | 10 | 6.1 | 7 | 4.2 | 82 | 49.7 | 99 | 60.0 |
| Summer | 3 | 1.7 | 7 | 4.2 | 25 | 15.2 | 35 | 21.2 |
| Autumn | 14 | 8.5 | 1 | 0.6 | 6 | 3.6 | 21 | 12.7 |
| Winter | 1 | 0.6 | 3 | 1.8 | 6 | 3.6 | 10 | 6.1 |
| Total | 28 | 16.9 | 18 | 10.9 | 119 | 72.1 | 165 | 100 |

TABLE IV

Indoor and outdoor ecotopes distribution of *Triatoma mexicana* nymphs and adults in three counties of Guanajuato, Mexico, from March 2003 to may 2004

| Ecotopes | Nymphs | | | | | Adults | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | n1 | n2 | n3 | n4 | n5 | ♀ | ♂ | N | % |
| Indoors | | | | | | | | | |
| Bed | - | - | - | - | 1 | 2 | 1 | 4 | 29 |
| Bedroom - Walls | - | - | 2 | - | - | 2 | 4 | 8 | 57 |
| Kitchen - Lamp | - | - | - | - | - | - | 2 | 2 | 14 |
| Total | - | - | 2 | 1 | - | 4 | 7 | 14 | 100 |
| Outdoors | | | | | | | | | |
| Outdoor walls | - | - | - | - | - | 4 | 77 | 81 | 54 |
| Patio | - | - | 1 | 1 | 1 | 2 | 10 | 15 | 10 |
| Light post | - | - | - | - | - | - | 7 | 7 | 5 |
| Under stone wall | 4 | 4 | 10 | 3 | 1 | 1 | 3 | 26 | 17 |
| Patio lamp | - | - | - | - | - | 2 | 16 | 18 | 12 |
| Windows | - | - | - | - | - | - | 3 | 3 | 2 |
| Water Tank | - | - | - | - | - | - | 1 | 1 | 1 |
| Total | 4 | 4 | 11 | 4 | 2 | 9 | 117 | 151 | 100 |

al. (2002) reported that *T. mexicana* was found in eight counties (32%) and in 107 villages (66%) of the state of Guanajuato. Other four triatomine species *Triatoma barberi*, *Meccus pallidipennis*, *M. longipennis*, and *T. dimidiata* were reported in this state.

In agreement with Vidal-Acosta et al. (2000) we found the same vector in San Miguel de Allende and Tierra Blanca counties. In the present research, the year long collection of *T. mexicana* samples showed that its frequency was higher in the spring, followed by summer, autumn and winter. The collection rates revealed that *T. mexicana* dwells essencially outdoors. The highest numbers were collected outdoors in all three counties, during the spring. We collected nymphs from the first to

TABLE V

Number and percentage of dwellings with risk and non risk building material and presence or absence of *Triatoma mexicana* in three counties of Guanajuato, from March 2003 to May 2004.

| | Victoria | | Santa Catarina | | Tierra Blanca | | Total | | CI95 % |
|---|---|---|---|---|---|---|---|---|---|
| | N | % | N | % | N | % | N | % | |
| w/r-w/t [a] | 16 | 2.9 | 4 | 0.7 | 9 | 1.6 | 29 | 5.3 | 0.71-0.03 |
| w/r-n/t [b] | 124 | 22.7 | 41 | 7.5 | 139 | 25.5 | 304 | 55.8 | 0.59-0.51 |
| n/r-w/t [c] | 6 | 1.1 | 6 | 1.1 | 2 | 0.3 | 14 | 2.6 | 0.03-0.01 |
| n/r-n/t [d] | 88 | 16.1 | 4 | 0.7 | 106 | 19.4 | 198 | 36.3 | 0.39-0.33 |
| Total | 234 | 42.9 | 55 | 10.0 | 256 | 46.9 | 545 | 100 | |

*a*: risky material houses and triatomines; *b*: risky material houses and no triatomines; *c*: non risky material houses and triatomines; *d*: non risky houses and no triatomines.

fifth instars outdoors in the autumn, in Victoria County, especially under stone walls. In the winter, only one third stage nymph was collected indoors, and three adult specimens outdoors.

In total, three nymphs and 11 adults were captured indoors, and 25 nymphs and 126 adults outdoors. These results agree with those found for *M. pallidipennis* in the state of Morelos (Bautista et al. 1999), where nymphs from first to fifth instars and adults were collected under stone walls.

We found that the highest number of adults was collected in the spring, and the highest number of nymphs was detected during the autumn. Which is in accordance to Dumonteil et al. (2002). Thus, we expected that nymphs of *T. mexicana* would appear in the summer time. If hatching occurs during spring, nymph stages are expected in the summer (considering that the change from one stage to another takes approximately 30 days). Nevertheless, in this study, nymph development occurred in autumn, meaning that the life cycle was longer in nature. Dumonteil et al. (2002) collected the highest number of vectors in places where the rainfall ranges from 600 to 1,400 mm/year. In Guanajuato it ranged from 400 to 700 mm/year; this difference in rainfall may induce to a longer life cycle in this triatomine.

We observed flying adults of *T. mexicana* (like to *T. dimidiata* in Yucatan), arriving to the perimeter of the houses, in the spring, right before the raining season. They probably lay their eggs indoors, nevertheless we did not find nymphs from first to third instars indoors. Therefore, we concluded that *T. mexicana* does not settle indoors. On the other hand, we found all different developmental stages outdoors. We noticed that *T. mexicana* accomphishes its entire biological cycle in the area around the house, especially under wall stones.

Vidal-Acosta et al. (2000) mentioned that *T. mexicana* is usually found nearby to human dwellings, stating that it is attracted by light or blood sources. We suggest that the vector is in adaptation process or perhaps fully adapted in the outdoors environment, but not indoors.

This study shows that traditional dwellings improvement to avoid triatomine infestation (Rojas-Wastavino et al. 2004) is not effective against *T. mexicana* because vectors were irrespectively collected in houses built with risky and non-risky materials. We found only 1.4% and 6.6% of the dwellings with vectors inside (8/545), and in the surroundings (36/545), respectively. Thus, the contact of *T. mexicana* with inhabitants of house seems to be unfrequent.

The natural infection index of *T. mexicana* reported by Vidal-Acosta et al. (2000) in the state of Guanajuato was 0.29% (1/342), lower than those detected in the present study (2.6% in Victoria, 2.0% in Santa Catarina, and 4.7% in Tierra Blanca), and by Lopez et al. (2002) (9.3%). The role played by this triatomine bug in *T. cruzi* transmission in Mexico needs to be better evaluated.

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