

Short communication

Field tests of carbon dioxide and conspecifics as baits for *Mepraia spinolai*, wild vector of Chagas disease

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Received 4 April 2001; received in revised form 27 July 2001; accepted 19 December 2001

Abstract

In spite of extensive evidence showing an association between host stimuli and insect finding behaviour, the importance of carbon dioxide in attracting Triatominae is not entirely understood. We assessed the potential of conspecific individuals and CO₂ in attracting free-ranging individuals of *Mepraia spinolai* in a Chilean semiarid locality. While the presence of conspecific individuals had no effect on the triatomine behaviour, solid CO₂—baited traps were more effective in attracting *M. spinolai* than control (empty) traps. We conclude that CO₂ trapping is an effective field technique for *M. spinolai* detection and potential control. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Triatominae; Hemiptera; Reduviidae; host-stimuli; host-finding

Host finding by Triatominae seems to depend on orientation to radiant heat, convection currents, carbon dioxide, visual stimuli and unspecified odours (Friend and Smith, 1977; Schofield, 1979; Taneja and Guerin, 1995). Heat alone is known to be sufficient to incite short-range orientation, probing and salivation in several triatomines such as *Triatoma infestans* and *Rhodnius prolixus* (Friend and Smith, 1977; Schofield, 1979; Lazzari and Núñez, 1989; Canals et al., 1999).

Carbon dioxide has been implicated as an olfactory cue for virtually all blood-sucking insects (Lehane, 1991) and particularly for triatominae (Guerenstein et al., 1995; Núñez, 1982; Taneja and Guerin, 1995; Rose and Boeckh, 1996a). Rose and Boeckh (1996b) demonstrated that human breath is a major stimulus used in the orientation of *T. infestans* toward their hosts. Even though there is extensive evidence showing a relationship between specific stimuli and host finding behaviour, the importance of host heat and odours, including carbon dioxide, is not entirely understood. In this paper, we document the importance of carbon dioxide and conspecific individuals as baits for *Mepraia spinolai*.

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M. spinolai (Porter, 1934) is a blood-sucking bug endemic to northern and central Chile that belongs to the subfamily Triatominae (Hemiptera: Reduviidae). Individuals are often found among stones, in rock crevices, in nest of birds and mammals, and occasionally in human dwellings (Lent and Wygodzinsky, 1979; Frias et al., 1995; Canals et al., 1999). *M. spinolai* has been reported as naturally infected by *Trypanosoma cruzi* (Ordenes et al., 1996). Unlike other triatomines, *M. spinolai* is a diurnal insect with a peak of activity at noon (from 10:00 to 16:00 h). It selects warm microenvironments within stones of quarries from which orientates and is attracted to potential host animals (Canals et al., 1997).

Canals et al. (1999) showed that *M. spinolai* exhibits the three components reported by Wigglesworth and Gillett (1934) as characteristic of orientation to a thermal key: antennae movements, locomotive activity, and extension of the proboscis. Most evidence for the detection of signals involved in host finding comes from laboratory experiments (e.g. Taneja and Guerin, 1995; Rose and Boeckh, 1996a; Rose and Boeckh, 1996b), but evidence about what signals are used as cues to find potential hosts under natural conditions is limited (Lorenzo et al., 1998). The aim of this study is to evaluate the role of carbon dioxide and conspecific individuals as baits for *M. spinolai* under field conditions in an endemic area for Chagas' disease in Chile.

This study was conducted in January 2000 at the Reserva Nacional Las Chinchillas, Aucó (3130'S, 7106'W), approximately 300 km north from Santiago (Chile). The climate is of a semiarid Mediterranean type with most rainfall concentrated in the winter season. Mean annual precipitation is 185.0 mm with large variations from year to year, and frequent droughts (di Castri and Hajek, 1976).

To determine if carbon dioxide and the presence of conspecific individuals elicit an attraction response by free-ranging specimens of *M. spinolai*, we set 8 cm high $\times$ 8 cm in diameter plastic containers with different baits. In the first treatment, we used 200 g of solid carbon dioxide. A second treatment involved the presence of four conspecific individuals inside the containers. Bait indi-

viduals corresponded to 3rd and 4th instar nymphs captured from the study site before initiation of experiments. A third set of containers were left empty as control. All treatments were replicated in seven sites, distant 100 m one from each other. All sites were located in equatorial facing-slopes with similar vegetation cover and density. Three traps (one for each treatment and control) were randomly placed at 5 m distant one from each other. At each site, in order to avoid undesirable intruders, traps were located inside a hole dug among stones, with the top border of containers at ground level. The type of traps used required that the insects fell inside actively and did not allow them to escape. The traps were set at noon (12:00 h) and checked 24 h later for captured insects. The number of captured insects in each treatment were compared using the Friedman's method for randomized blocks with a posteriori multiple comparisons (Sokal and Rohlf, 1995).

Table 1 shows the number of insects captured in each treatment and control trap for the seven sites. The number of individuals captured in CO₂ traps were always higher than that captured in conspecific individual and control traps. Except for one case, no insect was captured in control traps. In almost half of the conspecific individual traps at least one bug was captured. The number of captured insects differed significantly between traps (mean number of insects $\pm$ S.D., CO₂ traps: 16.14 ± 10.87 ; conspecific individual traps: 1.29 ± 2.22 ; control traps: 0.29 ± 0.76 , $n = 7$; Friedman

Table 1
Number of captured insects in each trap for the three conditions tested in this study

Site	CO ₂ traps	Conspecific individual traps	Control traps
1	12	0	0
2	5	1	0
3	3	0	0
4	23	6	2
5	12	0	0
6	29	2	0
7	29	0	0
Total	113	9	2

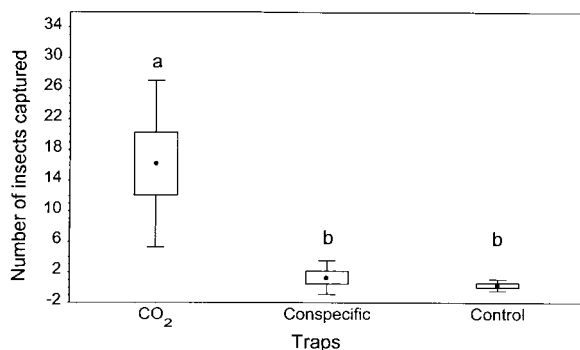


Fig. 1. Mean number of captured insects in each condition. Similar letters indicate no statistical differences. Lines represent 1 S.E.

test, $X^2 = 13.0$, $n = 21$, $P < 0.01$, Fig. 1). A posteriori multiple comparisons showed that CO₂ traps captured more insects than conspecific individual and control traps ($U_s = 47$, $P < 0.01$; $U_s = 49$, $P < 0.001$, respectively). Conspecific individual and control traps did not differ in the number of captured insects (Fig. 1).

The data presented here demonstrate that *M. spinolai* perceives and responds to carbon dioxide as an attractant in field conditions. Notwithstanding, our results do not support the existence of relevant signals from conspecific individuals effective as baits for this trap design.

Since carbon dioxide has been implicated as an olfactory cue for virtually all blood-sucking insects (Lehane, 1991), our evidence that CO₂ elicits an attractive response by free-ranging individuals of *M. spinolai* is not surprising. For instance, Núñez (1982), using an actograph, showed that CO₂ was an important orientation factor for *Rhodnius prolixus*. Similarly, Taneja and Guerin (1995) recorded orientation responses of *R. prolixus* and *T. infestans* to one of the mouse-odour components, CO₂, using a servosphere. Rose and Boeckh (1996a) examined different sensory stimuli for *T. infestans* using a T-shaped olfactometer, and found that the most effective stimulus was a combination of a previously worn cotton sock and CO₂ (concentration in the olfactometer ranged from 0.05 to 0.1%). Finally, yeast-baited traps, which release CO₂ as a by-product, have an attractive effect for *T. infestans* when temperature

conditions are suitable for CO₂ production (Lorenzo et al., 1998). In spite of the above laboratory and field evidence, there has been a notorious lack of field evidence for the role of CO₂ as a long-range attractant for triatomine bugs.

The presence of conspecific individuals did not play any important role in the orientation of *M. spinolai* to these traps. Previous reports for triatomines have shown that two types of aggregation signals might be important as landmark allowing bugs to find the refuge and arresting the bugs once they are inside the shelters (Lorenzo Figueiras et al., 1994; Lorenzo Figueiras and Lazari, 1998). The lack of positive response to conspecific individual traps reported here may be due, in part, to the following reasons. Firstly, the number of conspecific individuals inside the traps may have been insufficient to elicit a response by free-ranging insects. Secondly, 3rd and 4th nymphs may be unable to elicit a response by free-ranging individuals. Thirdly, conspecific individuals may elicit a short-range response rather than a long one, meaning that only individuals waiting for prey nearby the traps could be attracted. Lastly, the trap design used might require host related signals in order to draw insects inside, and conspecific related ones could not be able to evoke such a response from free-ranging insects. Clearly, detailed laboratory experiments are needed to evaluate these possibilities.

In conclusion, our preliminary results suggest that solid carbon dioxide traps can be a useful technique to determine the existence of triatomine insects in the field, and in turn, be a suitable alternative for their control.

Acknowledgements

We thank M. Acuña, M. Ehrenfeld, C. Garín, and M.A. Pinochet for their enthusiastic collaboration during the field work. R. Medel made important suggestions that improved the clarity of this manuscript. CONAF IV Región authorized this study in the Reserva Nacional Las Chinchillas and provided logistic support. This research was funded by FONDECYT grants

1980768 to PE Cattán and 2010022 to C Botto-Mahan. In addition, CBM acknowledges a fellowship from CONICYT for supporting her graduate studies.

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