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Take-off activity and orientation of triatomines (Heteroptera: Reduviidae) in relation to the presence of artificial lights

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Abstract

We analysed the flying activity of *Triatoma infestans* and *Rhodnius prolixus* when confronted to artificial lights of different spectral quality. We found that the presence of light sources (white or ultraviolet) did not affect their spontaneous take-off rate. The comparison between species showed that *R. prolixus* was more prone to fly than *T. infestans*. Females of *T. infestans* initiated flight more frequently than males of the same species. Although the same tendency was observed in *R. prolixus*, no significant differences were assessed between sexes. Concerning the orienting behaviour of triatomines at take-off in relation to the position of the light source, *T. infestans* showed a significant tendency to fly towards white light, but a non-oriented response when confronted to UV light or in the absence of a light source. *R. prolixus* also preferred to fly towards a source of white light and exhibited a non-oriented response with no light. However, when the UV light was presented, these bugs exhibited a bimodal attraction/repellence-behaviour. Our results support true attraction by white light rather than menotaxis or arrival by chance. These findings are discussed in relation to the colonization of human dwellings by Chagas disease vectors.

Keywords: Triatomines; Orientation; Light; Flight; Chagas disease

1. Introduction

Triatomines are vectors of the flagellate parasite *Trypanosoma cruzi*, causative agent of Chagas disease in Latin America. More than 130 species of these haematophagous insects so far described occupy a broad variety of habitats, but always keeping a close relationship with their vertebrate hosts. Some species are strictly sylvatic, others live almost exclusively associated to humans, and the rest exhibit middle-way behaviour between these two opposite conditions. Epidemiologically, the more human-associated species are the ones that bear the highest sanitary importance as vectors of Chagas disease. These species usually colonize and recolonize human housings, as well as peridomestic buildings.

Flying is one of the main mechanisms involved in long-distance movements in insects, and thus, in their colonization capability. The search of new habitats, food and mates are some of the phenomena that instigate them to fly. Nutritional (Lehane et al., 1992; McEwen and

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Lehane, 1993) and reproductive (McEwen and Lehane, 1994) states, as well as population density (McEwen et al., 1993) and environmental conditions (Lehane et al., 1992; Schofield et al., 1992) are factors known to modulate this activity in triatomines. Although they are mainly walking insects, the active arrival to new habitats seems to occur mostly by flight. In this way, flight might be an important factor not only for the colonization of new houses by domestic bugs coming from nearby dwellings, but also for the arrival of sylvatic bugs to human houses to feed and eventually establish. The last becomes of great importance when colonies of domestic species are removed from houses or when new urban areas grow up in wild areas.

The capture of triatomines with the aid of light traps has been repeatedly reported (Noireau et al., 2000; Noireau and Dujardin, 2001; Schweigmann et al., 1988; Tonn et al., 1978; Vazquez-Prokopec et al., 2004). Moreover, in endemic areas of Argentina and Brazil, reports of arrivals of flying triatomines to house lights are frequent. In this context, the study of the attractiveness of artificial light sources for these bugs, and in particular the comprehension of the orientation mechanisms involved in guiding flight, become relevant in several aspects. On the one hand, the efficiency of light traps could be improved by selecting the most attractive lights for triatomines. Conversely, the arrival of bugs to houses could be reduced by employing light sources less attractive.

It is worth asking why to study flight behaviour in triatomines in relation to light sources, provided that a lot of insects are known to be attracted to it. Several arguments support the need of this kind of study. On the one hand, the comprehension of the behavioural and physiological mechanisms guiding bugs to human housings attains epidemiological relevance. The colonization of new habitats by dispersing triatomines depends, among other factors, on the ability of these insects to find and follow distant guiding cues. Understanding how these cues are detected and employed by the insects could help us to find less attractive lights for house illumination (e.g. differing in spectral components used to produce white light). Conversely, the most attractive one could be employed to improve the performance of light traps. Moreover, if we consider that triatomine bugs are insects characterized by a strong negative response to ambient light, the fact that they spontaneously fly towards light sources becomes a puzzle. The comprehension of this dual behaviour is not just a matter of physiology, but it also becomes relevant for a better understanding of how triatomines make use of their habitat and what is the effect it has on the vectorial transmission of Chagas disease.

It should be noted that the response of triatomine bugs to lights cannot be clearly understood from field reports or observations, as factors other than light could be affecting the arrival frequency of the bugs to traps (e.g. odours, heat and humidity released by the investigator, wind, chance, etc.) and houses (odours, heat and humidity released by potential hosts, microclimate, chance, etc.). Our aim in this work has been to analyse specifically the response of flying triatomines to punctual light sources, in the absence of other orienting cues. We studied the flying behaviour in relation to the presence and position of artificial lights of two species of triatomines naturally found in domestic environments: *Triatoma infestans* and *Rhodnius prolixus*. We analysed three main aspects: (1) the effect of artificial punctual lights on their flying tendency (i.e. activation), (2) the occurrence of interspecific and sexual differences in their flying activity and (3) their orientation behaviour during flight in relation to the position of artificial lights of different spectral quality.

2. Materials and methods

2.1. Insects

Insects of both species, *T. infestans* and *R. prolixus*, were reared in the laboratory at $27 \pm 2\,^{\circ}C$ temperature and $60 \pm 20\%$ relative humidity, under a 12:12 h L/D illumination regime (photophase from 06:00 to 18:00 h). The insectary is regularly supplied with the first generation of field collected insects by the Servicio Nacional de Chagas, Cordoba, Argentina. For the essays, animals belonging to the fourth or fifth laboratory generation were used. All instars were fed once a week on live hens until their imaginal moult. Adults were maintained unfed for 11–22 days after moulting and then used in the experiments.

2.2. Experimental design

All assays were carried out inside a 2 m side cubic tent of white semitransparent cloth, which allowed insects to fly freely in it (Fig. 1). In the centre of the cube, a circular dish of Plexiglass (15 cm diameter and walls of 5 cm height) with a wooden stick (15 cm long) fixed in its centre (Fig. 2), was suspended. On the free end of the stick, a circular cardboard platform (5 cm diameter) was attached. Solid vaseline prevented bugs to climb up the dish walls, so they were only able to leave the dish climbing the stick, reaching the circular platform and taking off in any desired direction.