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Hall, Loren D., "Height Perception of Bed Bugs, *Cimex lectularius*" (2016). *Senior Research Projects*. 187.
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Height Perception of Bed Bugs, *Cimex lectularius*

By Loren Hall

Introduction

Cimex lectularius, commonly known as Bed bugs, are small, brown, oval-shaped insects that survive on blood meals from mammals, particularly humans. Because Bed bugs are so small and able to fit into the tiniest of places, they are found in a variety of settings. The three most common places are apartments/condominiums, single-family homes, and hotels/motels (Potter, et al., 2015, pg. 7). Not only are Bed bugs pests for us today, but they that have been plaguing people for centuries. Fossil evidence of Bed bugs has been found from as far back as 1352 B.C (Panagiotakopulu & Buckland, 1999). In addition, a number of authors throughout history have documented their experiences or the experiences of their communities with Bed bugs such as the Greek dramatist Aristophanes (trans. 2000, p. 49) in his play *The Clouds* originally produced in 423 B.C., Roman scholar Pliny the Elder (trans. 1967, p. 225) in his work *Natural History* completed in 77 A.D., and English exterminator John Southall in his *A Treatise of Buggs* written in 1730.

Bed bugs have appeared all over the world, but made their first appearance in the Americas in the 18th century with the colonists (Pinto, et al., 2007, p. 24). They remained prevalent within the United States and abroad up until about 1950 when they seemed to disappear. This has been attributed mainly to the widespread and effective use of insecticides, especially DDT (Potter, 2011, pp. 21-22) Unfortunately, that was not the end of the Bed bug problem in America. Bed bugs infestations reemerged in the late 1990's and have continued to cause problems in the United States and in Canada, Australia, and parts of Europe and Africa (Pinto, et al., 2007, p. 29). In a 2011 National Pest Management Association survey, it was

reported that one out of five Americans had a Bed bug infestation in their home or knew someone who encountered Bed bugs in their home or in a hotel. By 2015, the National Pest Management Association Survey, showed that 99% of all the pest professionals that were surveyed reported treating Bed bugs in the past year, as opposed to only 10% who remembered being called to treat Bed bugs fifteen years before (Potter, et al., p. 6).

While the prevalence of Bed bugs is quite concerning, traditional treatments such as vacuuming, mattress and box spring encasements, thermal treatments, insecticides, and cold treatments, are typically not enough to control infestations with one application. For example, the 2015 National Pest Management Association Survey also reported that 75% of the pest control companies polled reported needing to make two or three visits to control infestations using an “insecticide-based treatment program” and 34% said the same while using a “heat-based treatment program” (Potter, et al., p. 8). In order to develop better treatments against Bed bugs in the long term, more information on the behavior of these insects is needed.

In a recent article, Singh, N., Wang, C., & Cooper R. (2015, p. 7) reported no significant difference in bed bug preference for colored columns of two heights, which prompted the question if Bed bugs would show a preference for a particular height if more heights were tested. Additionally, Aak, A., Rukke, B.A., Soleng, A., & Rosnes, M.K. (2014, p. 204), reported that Bed bugs tend to hide in harborages when unstimulated. No other literature indicating Bed bug perception or preference for different heights, however, was found in this literature review. The aim of the following study was to gain more knowledge on the visual perception of Bed bugs and general Bed bug behavior.

Methods and Materials



Figure 1. Equipment for containing Bed bugs and testing arena. A- Plastic screw top containers in which Bed bugs; B- Parafilm blood bag; C- Aerial view of testing arena; D- Inside view of testing arena.

Insects

The Bed bugs used in this study were obtained from the Entomology department at the University of Florida. The bugs were of a mixed population and were contained in a plastic screw top container with wire mesh glued on top (Figure 1, A). Folded filter paper was placed within the container as a harborage. The bugs were fed once a week on heparinized human blood obtained from the researchers of this study, and a Parafilm blood bag (Aak & Rukke, 2014, p. 51) was used as an artificial feeding system (Figure 1, B).

Testing Arena

A large storage bin with high walls served as the arena for the experimental tests. Double sided carpet tape was then placed around the upper, inside perimeter of the bin to prevent Bed bugs from escaping, and one strip of black paper (1" x 6") was placed on three walls at 3, 6, and 9 inches. The fourth wall was used as a control (Figure 1, C and D). One half a Bed bug interceptor, with a glass back, was placed centrally on each side of the arena. A random organizer was utilized to switch the order that the strips were placed along the walls of the bin for each test. Each test began with Bed bugs placed in the middle of the arena. After two hours, the number of bugs that climbed into the interceptors and those attached to the outside surface, underneath, or just around the base of the interceptor were counted. The number of bugs that were found in the middle of the arena or somewhere that was not in close proximity to any one interceptor were grouped into a fifth category.

Results

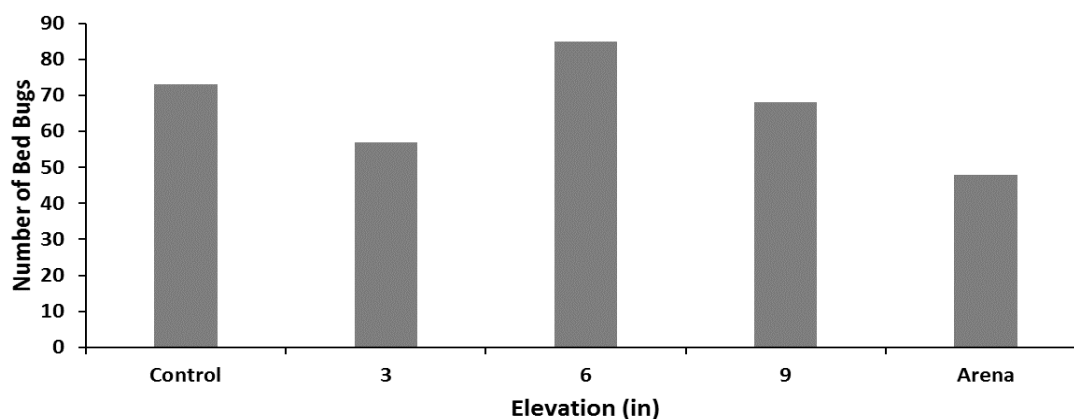


Figure 2. Number of Bed Bugs that Migrated Toward Interceptors Representing Different Elevations.

In total, fifteen tests were performed and the total number of Bed bugs found within and in close proximity to the Bed bug interceptors and the general arena were 73 (control), 57 (3"), 85 (6"), 68 (9"), and 48 (arena) as seen in Figure 2. Therefore, the percentage of Bed bugs found around each elevation and in the general area of the arena were twenty-two percent, seventeen percent, twenty-six percent, twenty-one percent, and fifteen percent, respectively.

Discussion

A one-way chi-square analysis revealed that there was a significant difference between the number of Bed bugs that migrated to the different areas of the arena. This is because the bugs showed a preference for the different experimental elevations as opposed to the general arena area. The bugs, however, did not show a preference for any one particular elevation. This was unexpected because it was originally hypothesized that the control elevation of zero inches would be the preferred elevation of the Bed bugs.

This study also revealed some things about the general nature of Bed bugs. It was observed that Bed bugs like to aggregate together, for they were most often found in groups of two or more bugs. It was also observed that Bed bugs like secluded areas and dark places. The majority of bugs in each test were found underneath the interceptors, especially in the crevices, rather than in the open air inside the interceptors. Lastly, the Bed bugs were found to be weaker than expected. There is much literature that mentions how difficult these insects are to eradicate, but it was very hard to keep them alive throughout the duration of the testing period (Benoit & Attardo, 2013, p. 234; Doggett, et al., 2012, p. 179).

In conclusion, the data did not support the original hypothesis that the bugs would show a preference for the elevation of zero inches. Some valuable information, however, about the

general behavior of Bed bugs was obtained through this study. Future work needs to continue in order to learn more about bed bug behavior and the nature of their senses.

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