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Journal
Journal of Entomological Science, 46(2)

ISSN
0749-8004

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Publication Date
2011-04-01

DOI
10.18474/0749-8004-46.2.169

Peer reviewed

N O T E

Undesirable Dispersal of Eggs and Early-Stage Nymphs of the Bed Bug (Hemiptera: Cimicidae) by Static Electricity and Air Currents[1]

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J. Entomol. Sci. 46(2): 169-170 (April 2011)

Key Words *Cimex lectularius*, eggs, nymphs, static charge

During our individual research with bed bugs, *Cimex lectularius* L., we became aware that static charges or air currents or a combination of both could occasionally cause the unwanted movement of bed bug eggs and/or early stage nymphs to surrounding areas. Because scientists working with bed bugs understandably want to prevent bugs from escaping into the general laboratory environment and perhaps establishing an infestation, we will share these observations of the unexpected, passive dispersal of bed bugs by static charge and airflow as a warning to other researchers.

The first situation can occur when selecting and sorting bed bug life stages for individual experiments. Because bed bugs do not move efficiently on slippery surfaces (Loudon and Boudaie 2009, 57th Annu. Mtg. Entomol. Soc. Am., Indianapolis, IN, Entomol. Soc. Am., Lanham, MD, p.95), it is common practice to work within a glass or plastic enclosure such as a Petri dish or pan, to confine the bugs and prevent their escape. However, static charges can build on plastic or glass surfaces during normal laboratory use, particularly in dry air. And, while viewing bed bugs in Petri dishes using a dissecting microscope, individual eggs were occasionally observed to move suddenly and rapidly through the air over short distances (on the order of centimeters), presumably in response to static charges. Static charge attraction, as opposed to airflow, was assumed to be providing the force for these movements for several reasons. First, these movements were extremely rapid (too quick to follow by eye), and would have required a relatively sharp gust of air (not detected). Second, these movements were usually confined to a single or small number of eggs or early stage nymphs, without affecting the other eggs or nymphs in the dish. Finally, the displaced eggs or nymphs would occasionally end up "stuck" on the vertical wall of the dish after this sudden, short movement. This behavior is reminiscent of the commonly observed movements by pieces of dry (shed) insect cuticle which clearly result from static

[1] Received 04 October 2010; accepted for publication 02 January 2011.
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electrical attraction, as these pieces will return to the same attractive spot if removed a small distance with forceps. While eggs and/or nymphs attracted to a container's surface by static charge may not pose a problem, investigators should be aware that these life stages also can be attracted to clothes or laboratory apparel, particularly when working in close proximity to the bugs, as when examining bugs under a dissecting microscope.

The second situation where we have noticed the unintentional and unwanted movement of primarily early-stage bed bug nymphs is during routine colony maintenance, particularly when exuviae (shed cuticles) are periodically removed from the rearing containers. Because all 5 nymphal stages of the bed bug must feed to molt to the next stage, exuviae can rapidly build within the confines of a colony container, depending on the number of bugs and the frequency of feeding. In fact, we have found that the bottoms of pint mason jars containing bed bugs fed weekly can acquire 10 - 20 cm^3 of exuviae and early-stage nymphs (unfed first instars and second instars) over an interval of several weeks. By counting 5- and 10-cm^3 aliquots of this "litter" (20 cm^3 total), we have determined that each cm^3 contains about 145 (60.8%) exuviae from various stages and about 87 (36.3%) living, unfed first-instar nymphs and small, second-instar nymphs. Whether these early-stage nymphs are trapped within the larger exuviae or are using the exuviae as harborages is unknown. The remaining material consisted of dead adults (about 7/cm^3) and a few eggs (< 2/ cm^3). In containers that are inverted over a blood source during routine feeding, exuviae need to be removed regularly because these castings can interfere with blood-feeding by dropping onto the feeding surface, thereby blocking access to the blood meal. The relatively large number of living, early-instar nymphs associated with these exuviae can, therefore, pose a problem when trying to remove the exuvial litter. In addition to static charge alone, we have observed the dispersal of these early-stage nymphs to unwanted surfaces by what appears to be a combination of the wafting of shed cuticles and static charge. Because exuviae are light-weight (on the average weigh only 96 µg/ fifth-instar exuvia; $n = 50$), their feather-like quality allows them to easily be moved by air currents. We have observed individual exuviae and groups of exuviae slowing floating through the air during colony maintenance and then either coming to rest on a horizontal surface, or rapidly moving to become attached to glassware or clothing, presumably due to a static charge. On many occasions, we found early-stage nymphs within these exuviae. The observation that these exuvia/nymph combinations could float over 6 cm, leads us to believe air currents are involved in the initial stages of this movement.

Movement of whole live insects or other small arthropods attributed to static electricity has been reported only rarely. Graham and Waterhouse (1964, An. Behav. 12: 368 - 373) reported that small beetles were "tossed in all directions" by static electricity when placed on a freshly-wiped plastic surface. Static electricity buildup on human heads from combing was even considered "sufficient to eject head lice from head" (Speare and Buettner 2000, Intl. J. Dermatol. 39: 872 - 880) although a later review did not include discussion of this mechanism (Burgess 2004, Annu. Rev. Entomol. 130: 257 - 262). In field situations, static electricity buildup on foraging bees has been proposed as a possible mechanism for the movement of parasitic mites from an inert support to their host bees (Colin et al. 1992, J. Insect Physiol. 38: 111 - 117). Whether static charge and/or airflow contributes to the passive dispersal of bed bugs under field conditions, their unwanted dispersal in the laboratory by these means should not be ignored.