ALABAMA A&M AND AUBURN UNIVERSITIES

Battling Bed Bugs

Know the Enemy

ANR-1464

Common bed bugs, *Cimex lectularius* L. (Hemiptera: Cimicidae), have been a pest of human homes for most of recorded history. They have plagued people physically, psychologically, and financially, but no control efforts have been both sustainable and affordable. From the 1950s to the 1990s, bed bugs seemed to disappear and many people grew up without ever seeing or hearing about them. Unfortunately, over the past 20 years, bed bugs have made a sudden recovery and are once again common across the United States. Bed bugs are beginning to place increased pressure on Alabama residents, and the number of incidences is expected to rise in the coming years.

Identification

Adult bed bugs are slightly larger than 1/8 inch long. Their bodies are brown to reddish brown in color, and when not recently fed, they are very flat (figures 1 and 2), allowing them to fit into small holes, cracks, and crevices. After feeding, their bodies can more than double in size, and they appear drastically different (figure 3). Immatures (nymphs) are similar to the adults, but are usually lighter in color (figure 2) and range in size from 1/32 to 1/8 inch long. Eggs are white with a cap and approximately 1/32 inch long (figure 2).

Bed bugs resemble several other pests such as immature cockroaches, fleas, mites, and ticks (figure 4). However, they can usually be differentiated by their lack of wings, laterally flattened bodies, and oval body shapes. In addition to these insects, bed bugs look nearly identical to bat bugs, which are associated with bat roosting areas that may include attics. For a definitive identification, take any questionable specimens to a trained entomologist.

Figure 1. Adult bed bug (Photo by Zachary DeVries)

Biology

Development and Life History

Adult females lay 2 to 5 eggs per day and can lay 200 to 500 eggs in their lifetimes. Eggs are deposited in cracks and crevices around their living areas (harborage). Bed bugs have five immature stages and require a blood meal to molt (shed old skin and grow new skin) to each successive stage. Each immature stage looks nearly identical to the previous one, with the only noticeable difference being an increase in size. At room temperature, development from egg to adult takes about 2 months, but development time highly depends on temperature, humidity, and availability of a blood meal. In addition, bed bugs typically live for 1 year at room

Figure 2. Bed bug adult (top middle), immature (bottom right), and egg (bottom left) (Photo by Zachary DeVries)

Figure 3. Unfed (left) and fed (right) adult bed bugs (Photo by Zachary DeVries)

temperature while feeding, but reports indicate that bed bugs are capable of surviving for more than a year even without feeding.

Feeding

Bed bugs usually feed on human blood. Feeding occurs about once per week, but this is highly dependent on temperature and relative humidity. Feeding takes as little as 2 to 3 minutes for the smallest life stages and up to 10 to 15 minutes for adults (figure 3, unfed versus fed adult). Once fully engorged, bed bugs retreat to their harborage (living area) where they digest their meal. Hosts are located by some combination of body heat, carbon dioxide, and chemical scent given off by human skin. Feeding typically occurs at night, but depending on when the bed bug last fed (how hungry it is), feeding can occur at any time. In addition, bed bugs are capable of feeding on a number of other hosts including birds (chickens), dogs, cats, and rodents.

Behavior

Bed bugs are extremely cryptic and can be very difficult to detect until their numbers have grown out of control. They tend to remain hidden unless searching for food or to mate, making detection even more difficult. They prefer rough surfaces (wood,

(Photo by Gary Alpert, Harvard University, Bugwood.org)

carpet, fabric) over smooth surfaces (metal, glass, plastic) and often have a difficult time climbing up glass and some plastics. Bed bugs are also nocturnal and prefer to venture out at night. Typically, they aggregate in groups and can be found on or immediately surrounding a bed or commonly used furniture, such as couches or chairs. However, when populations grow large enough, they will disperse away from these areas, complicating control efforts. Bed bugs behave normally between 50 degrees F and 100 degrees F. Temperatures below 50 degrees F lead to an end of activity, and temperatures above 100 degrees F lead to an abandonment of the cryptic behaviors in favor of rapid and erratic movement in

Figure 4. Immature cockroach (left), bed bug (middle), and flea (right) (Photo by Zach DeVries)

an attempt to escape the heat. However, it is important to note that these temperatures are not extreme enough to kill bed bugs.

Harmful Effects

Bed bugs can individually and collectively cause a number of health problems, including skin rashes, lasting psychological effects, and allergic symptoms on their victims.

Bed bug bites usually occur on the parts of the body exposed during sleep, such as the head, arms, or legs. Bed bug bites may cause a range of skin reactions from no visible effect to small macular spots, itchy red welts, and prominent blisters. Biting symptoms usually occur in clusters (figure 5) or lines (figure 6) because bed bugs often puncture their host more than once when feeding. Bite marks generally don't appear until some days (usually 1 to 10 days) after the first time bites have occurred, depending on the host's sensitivity. However, if one is repeatedly bitten, more exaggerated skin reactions often occur, and the latency between bites and skin reactions is often shortened because people become sensitized to the salivary proteins of bed bugs.

Despite their negative effects, bed bugs are currently not known to transmit any diseases. However, even after successful control, those who have had to deal with an infestation can become troubled psychologically for years following the experience.

Control

Prevention

The best control method for bed bugs is prevention. Prevention includes many steps and methods, but the driving idea behind all of these is to avoid bringing bed bugs into your home.

Preventative Measures

- Always check your belongings and yourself after traveling to any high traffic area, as these are the most likely places to have bed bugs (airports, hotels, movie theaters, department stores, etc.).
- Avoid bringing home used furniture or mattresses if you do not know where they came from.
- When staying at a hotel, always inspect your room, paying specific attention to the mattress and area surrounding the bed (figure 7). Look for fecal stains and shed skins of bed bugs (figure 8).

Figure 5. Bed bug bites, clustered (Photo by Xing Ping Hu)

- Decrease clutter around the bed. This reduces the number of hiding places for bed bugs and makes inspection and identification of an infestation much easier.
- If you suspect that you have encountered bed bugs, wash and dry (high heat) your belongings or place them in the freezer for several days.

Signs of an Infestation

When a home becomes infested, control is always easiest if the problem is caught early. This is done by quick identification of an infestation. It is always advisable to minimize clutter under and around beds. This allows for a much faster inspection for bed bugs. Bites are typically the first indication of an infestation (figure 5 and 6). Bite marks typically appear in lines on areas of skin exposed while sleeping (arms, legs, neck, and face). Bed bugs can typically be identified by searching around the mattress and box springs or commonly used furniture. Signs of bed bugs include, but are not limited to, blood stains (from bed bug feces), shed skins (exuviae), and bed bugs themselves (figures 7 and 8). In addition to searching the bed and commonly used furniture, search areas immediately surrounding these items. Check nightstands or dressers, electrical outlets, behind pictures, and along the wall/floor intersection (around the baseboard).

Traps should also be used to determine if bed bugs are present in a home. Such traps include sticky traps, pitfall traps (positioned under bed legs), and baited traps. All of these can be very beneficial in early detection of a bed bug infestation. Finally, in heavily infested apartments, a sweet, somewhat almondlike smell can be detected upon entering the home, in which case professional help should be sought immediately.

Inspection Checklist

- **Blood Stains**—Found along seams and crevices of mattresses and other commonly used furniture
- **Bed Bug Skins**—Usually found along with blood stains in the same locations.
- **Live or Dead Bed Bugs**—Difficult to find, but will provide the best evidence of an infestation. Commonly found along and in seams, cracks, and crevices of mattresses and other commonly used furniture.

Figure 6. Bed bug bites, in a line (Photo by Xing Ping Hu)

Nonchemical Control

Successful bed bug management can only occur through an integrated approach involving both chemical and nonchemical strategies. Nonchemical strategies include increasing the level of sanitation and cleanliness around the bed and commonly used furniture. This reduces the places bed bugs have to hide and makes pesticide application much more effective. Regular vacuuming is also useful in reducing populations. Vacuuming immediately removes bed bugs from the home, reducing reliance on pesticides. Vacuum bag contents should be treated with an insecticide and immediately disposed of or frozen to prevent reinfestations. If clothes are infested, the easiest control method is to launder all infested items, being sure to dry on the highest heat setting. If laundering is not an option, freezing items for several days can also be used to kill all stages. Steam has also been reported to be an effective strategy in controlling bed bugs. Using steam in combination with the above methods can help eliminate bed bugs that may be hiding in cracks or crevices where vacuuming doesn't reach. Using mattress encasements is another method to control bed bugs. These encasements limit harborage areas, making bed bug control and location much easier.

In addition to these methods, some of the commonly used detection methods can also be used to help reduce populations. Sticky traps and pitfall traps placed under bed legs can help catch bed bugs moving to or away from the bed leading to an immediate reduction in numbers.

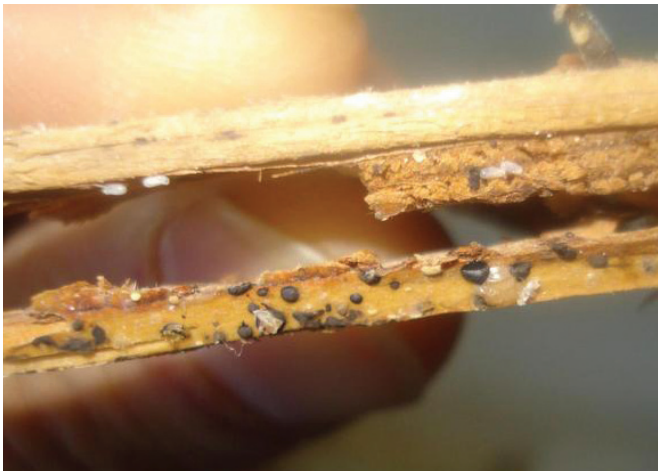
Nonchemical Control Methods

- Keep areas surrounding bed free of clutter.
- Vacuum regularly on and around bed and commonly used furniture.
- Launder infested items using hot water and the highest heat setting.
- Freeze items for several days.
- Steam clean (if available).
- Use mattress encasements.
- Set sticky traps and pitfall traps.

Figure 7. Mattress with bed bug stains (Photo courtesy of Brittany Delong, Virginia Polytechnic Institute and State University)

Chemical Control

After all efforts have been made to use nonchemical control methods, pesticides should be used. Pyrethroids are the most popular insecticide in combating bed bugs, because they are effective and very safe to use around humans and companion animals (except fish). In addition to pyrethroids, halogenated pyrroles (such as chlorfenapyr), have also been successfully used to control bed bug populations. These insecticides work by preventing bed bugs from turning food into energy. Another commonly used class of insecticides is the insect growth regulators (IGRs, such as Zenprox EC by Zoëcon Professional Products). These insecticides work by preventing bed bugs from developing (molting); however, they do not control adults. Neonicotinoids, such as Alpine, a reduced risk compound by BASF, have also been used with some success.



(Photo by Mohammed El Damir, Pest Management, Bugwood.org)

Figure 8. Paper with bed bug fecal stain and shed skin (Photo by Zach DeVries)

When applying insecticides, a useful strategy for bed bugs is to combine insecticide classes that have different modes of action (effects on bugs). Bed bugs are becoming highly resistant to insecticides, particularly the pyrethroids, but success can often be found when using a combination of pyrethroids and other insecticide classes. Also, when treating a home, pesticides should be applied at least twice at least 2 weeks apart. This allows time to kill all bed bugs not in eggs and then to kill all bed bugs that were still inside eggs during the first application. This strategy holds true regardless of the insecticide being used. When using pesticides, it is important to always follow the label's instructions. On mattresses, ONLY use insecticides *labeled for mattresses*. Insecticides should never be directly applied to linens (sheets, comforters, pillow cases, etc.).

Most of these insecticides are liquid formulations (emulsified concentrates, microencapsulated particles, or aerosol sprays). These formulations are usually effective at killing on contact, but their effectiveness over time is questionable. Another formulation commonly used to combat bed bugs is dusts. Dusts do not usually provide an immediate relief; however, they tend to provide longer residual protection. It should be noted that dusts, although effective, usually require the expertise of a professional to apply correctly.

One last form of insecticidal treatment that is widely used by residents is the total release aerosol or "bug bomb." Currently, there are many such products, which release a cloud of insecticide (usually a pyrethroid) throughout a house in an attempt to kill insects. Many of these products are labeled for bed bugs (in addition to fleas, ticks, roaches, etc.); however, recent studies have shown that these products are highly ineffective at killing bed bugs. In addition to not killing bed bugs, these products are likely irritating bed bugs and causing them to disperse throughout the home, making control much more difficult. Due to their ineffectiveness, over-the-counter bug bombs should not be used.

Bed bug infestations are very difficult to control. More often than not pest management professionals need to be hired. This is especially true when dealing with heavily infested homes. Professionals are often able to provide more effective insecticides and are trained to inspect and treat for bed bugs. Some pest management professionals are trained in newer methods of control, such as ambient heat treatments, where the internal temperature of the house is increased to 126 degrees F for several hours—a temperature lethal to bed bugs. This strategy has proven to be successful in areas with bed bugs highly resistant to commonly used insecticides. However, it should be noted that this strategy can be dangerous and should ONLY be done by a licensed and trained professional.

(Photo by Clemson University, USDA Cooperative Extension Slide Series, Bugwood.org)

ALABAMA COOPERATIVE Extension SYSTEM

ANR-1464

Zachary DeVries, Graduate Research Assistant; **Xing Ping Hu**, *Extension Specialist*, Professor; and **Arthur Appel**, Alumni Professor and Chair, all in Entomology and Plant Pathology at Auburn University

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

Published by the Alabama Cooperative Extension System (Alabama A&M University and Auburn University), an equal opportunity educator and employer.

New April 2013, ANR-1464

www.aces.edu