CLUB BED BUG

THE PRACTICAL IMPLICATIONS OF BED BUG BIOLOGY AND BEHAVIOUR

When it comes to bed bugs, the more you know, the more effective you'll be at treating an infestation, Dr Jette Knudsen, a researcher from Nattaro Labs, Sweden shares her detailed insights into bed bug behaviour and biology, so you too can join the bed bug club.

ONLINE CPD

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PestEX SPEAKER

SPEED VIEW

- **Inbreeding adapts bed bugs to passive dispersal with humans and a single mated female can start a new infestation**
- **Although human pathogens have been isolated from bed bugs, there are no documented cases of disease transmission**
- **Mating is traumatic to the female as the male pierces and ejaculates directly into her body cavity**
- **Claws help bed bugs to cling to rough surfaces, and the tibial pad helps them move on smooth surfaces**
- **Bed bugs are attracted from a distance to aggregation by volatiles and a non-volatile part such as histamines**
- **Proactive monitoring can detect small introductions before they become established infestations.**

As pest management professionals you will know bed bugs are well adapted to a secluded life in indoor environments: that their flat bodies fit well into cracks and crevices; that they are tolerant to desiccation and can withstand long periods without food. A (maybe not so) fun fact is they can engorge several times their own body mass every few days when a host is present, and moulting in nymphs is determined by access to food.

Control of bed bugs is challenging because tolerance of inbreeding makes them well adapted to passive dispersal with humans and their belongings. A few individuals or a single mated female can start a new infestation. On top of this, bed bugs also move actively between rooms, especially if food becomes scarce, in case of lack of suitable harbourage sites or if disturbed.

To be absolutely clear, although several human pathogens have been isolated from bed bugs, there are no documented cases of actual disease transmission. The major hassle with bed bugs, besides mental stress, is the allergic reaction their bites may trigger.

Increased public awareness of bed bugs and the professional development of pest management services have resulted in a slower increase in the number of treatments per year in several countries. Although the discovery of bed bugs in, for example, hotels, may lead to a bad reputation and economic loss, some hotel owners now announce that they work proactively against bed bugs, assuring customers who are becoming more educated and recognise that bed bugs can still enter adversely in spite of pest management programmes being in place.

EAT

Both the Common and the Tropical bed bug are ectoparasites, living exclusively on blood, chiefly from humans. Both species have rudimentary wings and reddish-brown, flat bodies when unfed.

They vary in size from 1mm (first instar nymphs) to about 10mm in length in recently fed females.

SLEEP

They form dense aggregates or harbourages of adults and nymphs usually in close proximity to the human host. Aggregated living protects both adults and nymphs, but nymphs are especially shielded against desiccation and their speed of development is increased.

Bed bugs feed at our exposed body parts and being asleep most people do not feel their bite, but later a majority get itchy bumps. However, if people do not react on bites an infestation can go on unnoticed and reach a level where eradication is difficult.

MATE

Usually, mating occurs shortly after feeding. Mating is traumatic to the female as the male pierces and ejaculates directly into her body cavity and excessive matings may shorten females life expectancy. Nymphs gradually increase in size as they pass through five stages before they moult into adults.

REPEAT

A female can take blood meals every 3-4 days, and if mated every 4-5 weeks she can continue to lay 2-5 eggs per day for months. Males do not eat as often as females. The length of the whole bed bug life cycle from eggs to adults depends on temperature and access to food. Below 13°C development ceases and all stages enter into a quiescent state, in which adults can survive for more than a year.

MOVES LIKE JAGGER

Bed bugs have strong legs each with a tibial pad and two simple claws at the end of each tarsus. The claws help bed bugs to cling to different rough surfaces, and the tibial pad helps them move on smooth surfaces.

Bed bug foot claws

The tibial pad is more developed in the Tropical than in the Common bed bug and makes the former a better climber. Furthermore, bed bugs have a tendency to move upward, which along with their climbing ability must be considered when developing traps.

Bed bugs are less active in daytime than at night and they actively seek out dark areas to hide in. They can orientate at very low light intensities and detect light in the range from ultraviolet to blue-red. Bed bugs seem to prefer darker colours to lighter ones, perhaps as an adaptation to hide and become less visible.

CHEMICAL BROTHERS (AND SISTERS)

Volatile and tactile cues are of utmost importance in bed bug intraspecific communication and foraging.

Volatile cues are perceived by different types of scent receptors on the antennae. Bed bugs are attracted from a distance to aggregation by volatiles and a non-volatile part such as histamines. The volatile part of the aggregation pheromone derives from faeces and emissions from bed bug scent glands.

The glandular emissions have dual functions: low amounts are attractive, but large amounts are a deterrent and will be employed as an alarm pheromone used to alert conspecifics in case of danger or to stop male mating attempts. Two nymph specific compounds protect nymphs against detrimental male mating attempts.

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Learn the lingo

Intraspecies communication
The interchange of information from one member of a species to another member of the same species

Aggregated living
Cohabiting in ultra-dense environments

Desiccation
The act or process of drying

Conspecific
A member of the same species

Satiated
Containing or holding as much food as possible ie full up!

Bed bugs are alerted by CO_2 in human breath and human heat and odours attract them at short distances. However, the value of a specific signal varies: a satiated bed bug reacts differently to a host signal than a hungry one. Thus, any monitor trap with a lure will only alert and attract a subset of the present bed bugs and is a challenge to bed bug lure and trap developers.

STANDING IN THE WAY OF CONTROL

Of course, strategies based on knowledge of bed bug biology and behaviour are more likely to be successful. But if you don't define issues present through a thorough survey, you could risk applying a strategy which isn't the most relevant to the site.

Combining visual inspections with canine detection and passive or active monitors increase the chance of early detection of infestations.

Passive monitors, like interceptors, used in large numbers, are likely to catch some bed bugs if they are present.

Active monitors attract bed bugs from a distance to traps baited with either a host or harbourage lure. Continuous active monitoring is one approach, used often in the hospitality industry, which can bring bed bugs to bay as soon as they are introduced.

To avoid the unintentional spread of bed bugs I would suggest low or no preparation should be requested of customers. Treatment programmes can integrate a number of methods like vacuuming and a heat/steam/cold treatment together with diatomaceous earth (DE) and a chemical treatment.

DE is mainly used loose, though a DE tape to be installed on bed frames, to maintain the availability of the dust. Recently, a fungal pesticide for bed bug control was also introduced.

However, I have to stress the most successful community-wide bed bug management programmes employ an integrated approach that incorporates education, proactive inspections and monitoring, and appropriate use of both chemical and non-chemical methods.

GIMME THE FUTURE

In my opinion, education is the most significant barrier the world faces against bed bugs.

Bed bugs will continue to pose problems especially in multifamily housing and in a growing number of hotels and other multi-occupancy accommodation providers. Proactive monitoring to detect small introductions before they become established infestations will help to protect such sites, as well as professionals keeping up-to-date with proactive innovations such as diatomaceous earth restrained in tape or bands of fungi on beds and behind skirting boards.

Both now and in the future, introductions and low-level infestations need different treatment approaches than high-level infestations. Improved formulations of certain insecticides in combination with synergists directly applied onto bed bugs can still work but must be applied with care to maintain use.

I think the effect of histamine from bed bug faeces needs further investigation as it has been suggested to trigger asthma attacks which aren't a good headline for the pest management industry. However, recent mappings of the bed bug genome form a promising base from which to innovate new control methods.

When it comes down to it, Integrated Pest Management (IPM) practice of applying knowledge of bed bug biology and behaviour will enable professionals to combine appropriate measures and innovations depending on the result of their inspection.

WANT TO LEARN MORE?

Jette will be talking about bed bug monitoring at PestEx 2019. Register for PestEx for free now.

pestex.org/register

Bitesize bed bug basics

WHERE TO LOOK FOR BED BUGS

Bed bugs usually hide close to the host, so first place is in and around the bed:

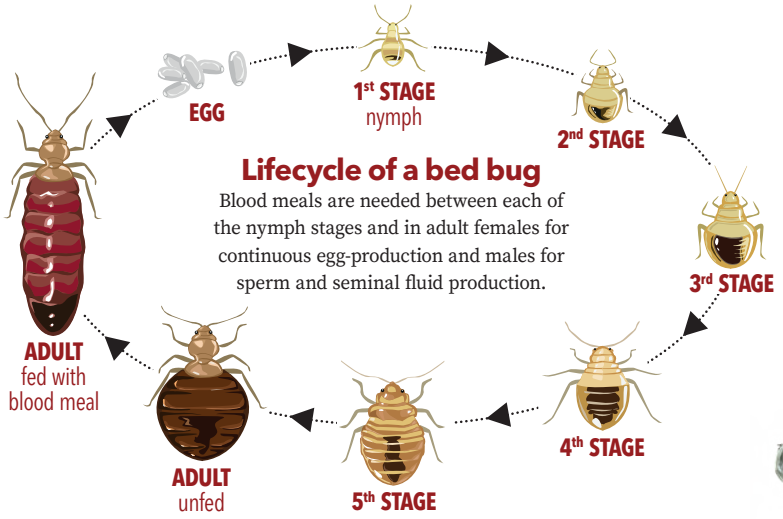
- Search mattresses and bed frames, bedroom fittings, and sofas and chairs in adjoining rooms where the hosts spend some time
- If not found there, they may hide behind skirting boards and in electrical installations, actually, any place that is dark and narrow may potentially hide bed bugs.

WHAT TO LOOK FOR

Dark spots of defecated blood may indicate the presence of bed bugs and spotting becomes more intense in the vicinity of a harbourage, where dead bed bugs and cast skins, eggs and live nymphs and adult bed bugs may be found.

REASONS WHY WE FAIL TO ERADICATE BED BUGS

- Low treatment efficacy
- Lack of resident and staff awareness
- Presence of clutter
- Lifestyle choices
- Lack of adequate cooperation with management programmes.



Lifecycle of a bed bug

Blood meals are needed between each of the nymph stages and in adult females for continuous egg-production and males for sperm and seminal fluid production.

ACTIVE BED BUG MONITORING SYSTEM

A lure imitating harbourage pheromones and a pitfall trap to restrain the captured bed bugs.

Pitfall trap, holder and lure pot

UNNOTICED INHABITANTS

Under optimal conditions at 22°C it may take less than ten weeks to complete the whole bed bug life cycle. Consequently, if unnoticed, a bed bug infestation founded by a single mated female laying 2-5 fertilized eggs/day may in less than ten weeks count hundreds of nymphs, and the first adults of the next generation will start to appear.

Unfed and fed bed bugs

At this point, the population will grow exponentially and reach a level where eradication is very difficult. Such a situation is likely to happen when people do not react to bites because an infestation then can go on unnoticed.

RESISTANCE

A bed bug population often exhibit a combination of two or more resistance mechanisms and resistance varies between populations. Bed bugs secluded way of living makes the likelihood of a spray to hit and kill all adult bed bugs, nymphs and eggs minimal. Thus, treatments relying solely on insecticides are more likely to fail to eradicate an infestation than when integrating spraying with additional methods.

BED BUG TAPE - EFFICACY TESTS OF TAPE WITH DIATOMACEOUS EARTH

The wings are opened for better visualization of the construction. The setup simulates the situation bed bugs encounter in a bed with the tape installed: bed bugs pass through the tape on their way to the food (human in bed) and again after they have fed on their way back to their harbourage.

Adult bed bugs were released in the middle of the bed bug rectangle left for an hour, then they were collected and fed on a human volunteer, after which they again were released in the middle of the rectangle. All adult bed bugs died within a week.

Above: pitfall trap with lure pot and captured bed bugs, with close-up (below)

WANT MORE INFORMATION ON BED BUG MANAGEMENT?

European Code of Practice for Bed Bug Management manual is provided free of charge at:

bedbugfoundation.org