Scientists develop first effective and affordable bedbug bait and trap

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SFU biologists Robert Britton (left), Gerhard Gries and Regine Gries smile with pride, knowing that they may have cornered and put to bed the dreaded bedbug for life.

The world owes a debt of gratitude to Simon Fraser University biologist Regine Gries. Her arms have provided a blood meal for more than a thousand bedbugs each week for five years while she and her husband, biology professor Gerhard Gries, searched for a way to conquer the global bedbug epidemic.

Working with SFU chemist Robert Britton and a team of students, they have finally found the solution—a set of chemical attractants, or pheromones, that lure the bedbugs into traps, and keep them there.

This month, after a series of successful trials in bedbug-infested apartments in Metro Vancouver, they have published their research, "Bedbug aggregation pheromone finally identified," in *Angewandte Chemie*, a leading general chemistry journal.

They're working with Victoria-based Contech Enterprises Inc. to develop the first effective and affordable bait and trap for detecting and monitoring bedbug infestations. They expect it to be commercially available next year.

"The biggest challenge in dealing with bedbugs is to detect the infestation at an early stage," says Gerhard, who holds an NSERC-Industrial Research Chair in Multimodal Animal Communication Ecology.

"This trap will help landlords, tenants, and pest-control professionals determine whether premises have a bedbug problem, so that they can treat it quickly. It will also be useful for monitoring the treatment's effectiveness."

It's a solution the world has been waiting for.

Over the last two decades the common bedbug (Cimex lectularius), once thought eradicated in industrialized countries, has reappeared as a global scourge. These nasty insects are infesting not just low-income housing but also expensive hotels and apartments, and public venues such as stores, movie theatres, libraries and even public transit.

And while these blood-sucking pests were previously not considered a

carrier of disease, scientists have recently discovered they can transmit the pathogen that causes Chagas disease, which is prevalent in Central and South America. Yet until now, tools for detecting and monitoring these pests have been expensive and technically challenging to use.

The research was funded with a Natural Sciences and Engineering Research Council of Canada industry grant in partnership with Contech Enterprises Inc.

Backgrounder: The research story—180,000 bedbug bites later

The Gries' began their research eight years ago when Gerhard, who is internationally renowned for his pioneering work in chemical and bioacoustic communication between insects, began searching for pheromones that could lure and trap bedbugs.

Regine worked with him, running all of the lab and field experiments and, just as importantly, enduring 180,000 bedbug bites in order to feed the large bedbug colony required for their research. She became the unintentional "host" because, unlike Gerhard, she is immune to the bites, suffering only a slight rash instead of the ferocious itching and swelling most people suffer.

The Gries' and their students initially found a pheromone blend that attracted bedbugs in lab experiments, but not in bedbug-infested apartments. "We realized that a highly unusual component must be missing—one that we couldn't find using our regular gas chromatographic and mass spectrometric tools," says Gerhard.

That's when they teamed up with Britton, an expert in isolating and solving the structure of natural products, and then synthesizing them in

the lab. He used SFU's state-of-the-art NMR spectrometers to study the infinitesimal amounts of chemicals Regine had isolated from shed bedbug skin, looking for the chemical clues as to why the bedbugs find the presence of skin so appealing in a shelter.

It was like looking for a needle in a haystack.

After two years of frustrating false leads, Britton, his students and the Gries duo finally discovered that histamine, a molecule with unusual properties that eluded identification through traditional methods, signals "safe shelter" to bedbugs. Importantly, once in contact with the histamine, the bedbugs staid put whether or not they have recently fed on a human host.

Yet, to everyone's disbelief, neither histamine alone nor in combination with the previously identified pheromone components effectively attracted and trapped bedbugs in infested apartments. So Regine began analyzing airborne volatile compounds from bedbug faeces as an alternate source of the missing components.

Five months and 35 experiments later, she had found three new volatiles that had never before been reported for bedbugs. These three components, together with two components from their earlier research and, of course, histamine, became the highly effective lure they were seeking.

Their research isn't over yet, however. They continue to work with Contech Enterprises to finalize development of the commercial lure—which means Regine is still feeding the bedbugs every week. "I'm not too thrilled about this," admits Regine, "but knowing how much this technology will benefit so many people, it's all worth it."

More information: "Bed Bug Aggregation Pheromone Finally

Identified" *Angew. Chem. Int. Ed.*. doi: 10.1002/anie.201409890

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