Scientists use bed bugs' own chemistry against them

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Scientists here have determined that combining bed bugs' own chemical signals with a common insect control agent makes that treatment more effective at killing the bugs.

The researchers found that stirring up the bed bugs by spraying their environment with synthetic versions of their alarm pheromones makes them more likely to walk through agents called desiccant dusts, which kill the bugs by making them highly susceptible to dehydration.

A blend of two pheromones applied in concert with a silica gel desiccant dust proved to be the most lethal combination.

In the past decade, bed bugs have become an increasing problem in industries ranging from agriculture and housing to travel and hospitality, so much so that the Environmental Protection Agency hosted a National Bed Bug Summit in April of this year.

The species, *Cimes lectularius*, also is developing resistance to the insecticides approved to spray infested areas, treatments that belong to a group of compounds called pyrethroids.

Desiccant dusts that are sprinkled in infested areas, however, are among the oldest forms of insect control and are still considered effective killers as long as the bugs walk through them.

"Once we put the alarm pheromone in the places bed bugs hide, boom,

they instantly started moving around and moving through the desiccant dust," said Joshua Benoit, lead author of the study and a doctoral candidate in entomology studying under David Denlinger at Ohio State University.

"Consistently, the addition of a pheromone blend to desiccant dust was more effective than adding either chemical by itself or by using desiccant dust alone."

The research is published in the current issue of the *Journal of Medical Entomology*.

The two bed bug alarm pheromone ingredients are known as (E)-2-hexenal and (E)-2-octenal. When bed bugs are disturbed or excited, they secrete these two pheromones and tend to want to move around.

While some pheromones are known to attract species for reproductive purposes, these particular pheromones act more as a repellent, Benoit explained.

"These pheromones also can be bought from any chemical company. They're well-established chemicals, are easy to make in the lab, and are readily available," he said.

Two types of desiccant dusts were used in the experiments: diatomaceous earth, a naturally occurring, chalky substance, and a compound called Dri-die, made from a silica gel. Desiccant dusts are designed to disturb the bed bugs' cuticle, particularly the waxy outer layer on insects that allows bugs to stay hydrated. Without the waxy protection, insects are more prone to dry up and die.

The researchers first tested the chemical combination on five bed bugs at

a time for 10-minute exposures in petri dishes. They tested both types of desiccant dusts as well as each pheromone component alone and in a blend more typical of natural secretion.

Bed bugs exposed to Dri-die and a blend of pheromones lost water at a much faster rate than did bed bugs treated with the desiccant dust alone. The scientists found that bed bugs exposed to Dri-die alone lost 21 percent more water than untreated control bugs. Water loss nearly doubled with either (E)-2-hexenal or (E)-2-octenal applied alone and tripled with a blend of both pheromones.

Young bed bugs exposed to the combination died in about a day, three days earlier than control bed bugs. Adult female bed bugs exposed to the combination survived for about 6 ½ days, compared to females exposed only to the desiccant dust, which lived for an average of 17 days.

In petri dish tests, the scientists found that the combined treatments using Dri-die consistently worked better than those using diatomaceous earth at generating rapid water loss in the bed bugs.

Turning to a more natural setting for bed bugs, the researchers set up a small plastic container in which a folded piece of paper offered bed bugs a place to hide. Bed bugs tend to stay hidden in wall and floor cracks, moldings or mattresses by day and feed on human or animal blood at night. The researchers created this experimental habitat to see if alarm pheromones would bring bed bugs out of hiding.

After the bed bugs stopped moving within the paper, called a harborage, the scientists applied the desiccant dust followed by the alarm pheromone. They used the most effective blend of pheromones as determined in the petri dish experiments, as well as Dri-die, the more effective of the two desiccant dusts.

All of the bed bugs came out of hiding within five minutes of the application of the alarm pheromones, Benoit said. And the combination of a blend of pheromones and Dri-die reduced survival by 50 percent of both young and adult bed bugs, he said. At least half the young bed bugs were dead within 10 days, and about 60 percent of adult female bed bugs died within 40 days.

"Desiccant dust is messy, but it's not toxic, so it can be used in agricultural settings, such as chicken coops, where bed bugs can be a big problem," Benoit said. The dust method also can be used in housing, where it would be sprinkled on carpet and eventually vacuumed.

These results were achieved in small areas, but Benoit and colleagues hope the technique could also be applied to large environments infested with bed bugs. Benoit is reluctant to suggest the use of desiccant dusts with alarm pheromones until additional experiments are conducted.

"Before companies start selling desiccant dusts laced with alarm pheromones, more tests need to be carried out in room-sized arenas to determine any possible negative effects," Benoit said. Even so, the researchers believe the use of alarm pheromones could increase the effectiveness of desiccant dusts and other kinds of residual insecticides used to kill bed bugs as well.

Benoit noted that repeated use of spray pesticides to which bed bugs are resistant boosts the survival of bed bugs with that resistance, forcing the use of higher and higher concentrations of toxic chemicals to eradicate the insects.

"We think that rather than pursue completely new pesticides, it's better to use old pesticides in new ways," he said.

Source: The Ohio State University (news : web)