Insect 'anti-antiaphrodisiac' tells males when females are ready to mate

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A Lygus male (right) approaches a recently mated female. He antennates her abdomen to assess her reproductive status. The seminal compounds that have antiaphrodisiac properties are not very volatile, so the male must approach closely. Credit: Brent et al., 2017

Researchers have identified a pheromone released by female insects after mating that tells males exactly when they are ready to mate again.

The pheromone, discovered in the western tarnished plant bug *Lygus hesperus* (*L. hesperus*), reverses the effects of an antiaphrodisiac found in the male's semen, which stops them from harassing females during the egg-laying period after copulation.

This so-called 'anti-antiaphrodisiac', described in the journal *eLife*, adds a new level to the complex communication mechanisms already identified in insect reproduction. Fully understanding these mechanisms could help inform novel control strategies for *L. hesperus*, a major agricultural pest insect known for its destructive feeding habits.

In many animal species, males guard females to prevent rivals from mating so they can be sure to father the offspring. Such mate guarding can be more passive than active, and can persist even when the male is absent. For example, some male insects transfer an antiaphrodisiac along with their sperm, the smell of which repels other males from inseminated females.

Previous studies have shown that on the first day of mating, *L. hesperus* females are less likely to be courted by a male than virgin females due to the effect of a seminal antiaphrodisiac. "However, this effect only persists for a few days," says Research Entomologist Colin Brent from the US Department of Agriculture's Agricultural Research Service, who led the current study. "Over time, those females regain their attractiveness so that, by five days after mating, they are as likely to be courted as virgins. But the mechanism by which this is accomplished has not been determined."

Immediately after his brief assessment, the male's response, upon detecting the antiaphrodisiac (myristyl acetate) left by the female's previous mate, is quite rapid and pronounced. His antennae swing back away from the female and he assumes a crouched stance, much like a defensive posture. After such encounters, males move away from these females quickly and seek a more available partner. In the days that follow mating, females gradually regain their attractiveness as the repulsive seminal compounds disappear or are converted into newly discovered anti-antiaphrodisiacs. Credit: Brent et al., 2017

To discover this, Brent and his colleagues - John Byers from the Hebrew University of Jerusalem and Anat Levi-Zada from the Agricultural Research Organization, Volcani Center, Israel - tested odourants emitted

from mated *L. hesperus* females. Using a technique called gas chromatography mass spectrometry, coupled with behavioural tests, they identified three compounds in the male accessory glands and in capsules containing sperm that were taken from females at various stages after mating.

"Our analyses confirmed the presence of a previously identified antiaphrodisiac called myristyl acetate, and revealed two additional compounds that repel other males from recently mated females," Brent explains. "The female converts one of these internally before releasing it as a third compound, which counteracts the antiaphrodisiac effect caused by the myristyl acetate but does not actually increase male attraction to the female."

Brent adds that although this is the first recorded instance of an anti-antiaphrodisiac, such compounds may not be rare - they may have simply been overlooked until now.

"While male Lygus bugs have evolved a chemical mate-guarding mechanism, female evolution favoured a counter mechanism, providing males with an accurate indication of when they are ready to mate again following their egg-laying activity," he says.

"Given the advantages of this two-dimensional chemical signalling system, other examples of anti-antiaphrodisiacs are likely be found. These systems could then be manipulated and turned against the pests, causing them to change their behaviours in a way that could help reduce their population."

More information: Colin S Brent et al, An insect anti-antiaphrodisiac, *eLife* (2017). DOI: 10.7554/eLife.24063

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