Sexy Bug Talk – it's pure chemistry!

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Have you ever wondered how bugs communicate? New research at the Tasmanian Institute of Agriculture (TIA) is unravelling the flirty chemical talk of key rubus pests, mirids and green vegetable bugs.

The strategic levy investment project '*Using pheromones and traps in the management of mirids and vegetable bugs*' (RB21001) is part of the Hort Innovation Raspberry and Blackberry Fund and will help ramp up integrated pest management (IPM) of these key Rubus pests. The TIA research team of Dr Jonathan Finch and PhD candidate Seeger van Kints is working closely with the Rubus IPM team in Tasmania, Victoria and NSW (RB21000).

Seeger's research combines analytical chemistry, biology and delicate insect microsurgery. He will be extracting, identifying and synthesising the pheromones that get mirids and green vegetable bugs excited. The aim is to use these pheromones to monitor and manage these pests in raspberries and blackberries, reducing costly and disruptive pesticide use.

Pheromones – what are they?

Pheromones are chemical substances used for subtle and sometimes less subtle communication throughout the animal and even plant world. They are secreted outside the body and act as a signal to another individual to behave in a particular way.

Insects use pheromones for many different purposes. The more common ones signal for aggregation, alarm or sex. Aggregation pheromones are the 'let's get together' pheromones. It can be a message that there is something particularly tasty on offer or for safety in numbers. A locust swarm of millions of individuals forms with the help of pheromones. Insects which feel threatened or under attack release alarm pheromones. This is the familiar smell given off by some ants when squished.

With sex pheromones, it is usually the female of very mobile insects, like moths and bugs, that secretes a pheromone to attract a mate, sometimes from as far away as 10 km.

How we use pheromones in Integrated Pest Management (IPM)

Aggregation pheromones are used to attract and kill pests such as grain weevils and the fruit damaging carpophilus beetle. The Carophilus Catcha Trap uses both an aggregation pheromone and compounds found in rotting fruit to attract and kill beetles.

Sex pheromones help us monitor pest numbers or manage a pest by mass trapping or mating disruption. Monitoring using pheromone traps can provide an early warning system on the influx of a pest or be used to calculate when eggs will hatch. Mating disruption pheromones are used to manage light brown apple moth in many fruit crops including berries. Pheromone ties placed throughout a crop create a cloud of very confusing female pheromones. The overwhelmed male is lost in this haze of pheromones, making it difficult for it to locate a female mate. This reduces mating frequency and can plummet populations.

Mirid day surgery

Seeger is initially studying the Australian crop mirid (*Sidnia kinbergi*), a prevalent and difficult to control pest of Rubus crops. He describes the first stage of extracting, identifying and synthesising its pheromones.

PhD candidate Seeger van Kints isolating mirid pheromones in the laboratory. Photo credit: TIA

PhD candidate Seeger van Kints repotting raspberries for trial. Photo credit: TIA

Australian crop mirid, *Sidnia kinbergi*. Photo credit: Denis Crawford

"It is a very tiny insect with an even tinier scent gland. Dissecting it is like microsurgery, so I am also trialling a fully body extraction. I then separate each chemical component using a gas chromatograph. Working out which chemicals are the key sex pheromones is a little trickier and not so nice for the mirid! I cut the head off a live mirid and attach electrodes to the antennae. Each individual component of the extract is wafted with precise timing over the antennae. This means I can match a strong antennae response to the individual chemical compound causing it."

The next stage is synthesising then assessing the pheromone components in real world raspberry and blackberry crops. The fun doesn't stop there. Seeger will also delve in to chemical signalling of the green mirid (*Creontiades dilutus*) and test its pheromone as a potential mirid lure in crops.

Green vegetable bug – role reversal

Unlike mirids, it is the male green vegetable bug (GVB) that produces pheromones to attract the female. Quite a lot of research has been done on this species' chemical signalling, revealing that different populations secrete wildly varying ratios of chemical components.

Seeger will synthesise GVB pheromones in collaboration with the Chemistry Department at the University of Tasmania. The pheromones will be put to the test in in raspberry and blackberry crops in the coming season, comparing pheromone trap catches with traditional monitoring methods such as sweep netting. Seeger will also look at how many traps are needed (number of traps/ha), and the ideal placement of these in and around the crop. This will provide a GVB map in both space and time, showing how population numbers of GVB change during the season and the best position to place traps for early warning of a GVB outbreak.

Suppressing pests with pheromones

Pheromone traps can also be used as a method of pest control. The trapping trials will be matched with fruit assessment to establish whether traps can also limit pest damage to the crop.

IPM - the big picture

Unlocking the pheromone secrets of sucking bugs including mirids and GVB has the potential to provide a missing link for raspberry and blackberry integrated pest management. Currently, managing these pests relies on disruptive chemical management, which puts the biological control of other pests at risk. Pheromone technology is a step in the right direction for achieving reduced pesticide use, protecting the diverse ecosystem of beneficial species and producing sustainable yields of quality fruit.

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