Scientists find way to prevent mealybugs' negative impacts on vineyards

May 13 2024, by Jan Suszkiw

Credit: Pixabay/CC0 Public Domain

Fake pheromones offer a way to foil the love lives of vine mealybugs and keep populations of these prolific, soft-bodied insect pests from reaching damaging levels in vineyards of wine, raisin and table grapes.

Producing large amounts of the chemical insect sex attractants for release into the air to prevent lovelorn male mealybugs from finding females to mate with can be difficult and expensive. Now, however, clues to less costly synthetic pheromone alternatives are emerging from Agricultural Research Service (ARS) scientists' studies of the pest's olfactory system.

The paper is published in the journal *Current Research in Insect Science*.

Keeping vine mealybugs from meeting and mating is a big deal, considering they can produce multiple generations over the growing season. Unchecked, the pests suck sap from the grape plants, weakening them and reducing their fruit yields and quality. They also secrete honey dew, a waste that can drop onto grape clusters and promote the growth of black sooty mold—both of which can diminish the fruit's marketability.

Adding insult to injury, and perhaps most importantly, the pests also transmit a group of viruses that cause grape leafroll diseases. The presence of these viruses can necessitate the destruction of entire vineyards when infection rates hit 25% or higher.

Using a genomic map of the vine mealybug together with sophisticated analytical procedures, the scientists discovered two key olfactory receptors (from among 50 total) that alert male mealybugs that love is in the air in the form of lavandulyl senecioate, the sole chemical constituent in a female's pheromone.

The receptors are so specific that no other known chemical odorant found in nature will prompt the males to take flight in search of females to mate with, noted Jacob Corcoran, an entomologist with the ARS Biological Control of Insects Research Laboratory in Columbia, Missouri.

To confirm this specificity, Corcoran and colleague plant pathologist Walter Mahaffee at the ARS Horticultural Crops Disease and Pest Management Research Unit in Corvallis, Oregon, used a specialized cell line cultured in the lab to express (examine the function of) two of the vine mealybug's olfactory receptors.

Next, they exposed the cells to various doses of lavandulyl senecioate. This triggered the activation of cell signaling pathways indicating the receptors' detection of the pheromone. The cells were also exposed to grapevine odors that the mealybugs normally find attractive in nature. However, no signaling pathways were activated, confirming the two receptors were highly specific to the sex pheromone compounds.

With this method, the scientists have begun contemplating more diabolic ways to mess with the pest's love life.

On the one front, they envision using the method to screen for molecules called antagonists that could be used to deactivate the pest's olfactory receptors in nature, preventing their detection of pheromone and dooming male vine mealybugs to a sad, lonely life of buggy bachelorhood. Or, in the reverse, proteins called agonists could be formulated to put the receptors in "overdrive," compelling males to chase phantom pheromone signals where none exist.

On yet another front, the researchers are pursuing the use of the olfactory receptors in biosensors—pheromone-sniffing devices that can be deployed throughout a vineyard to alert growers to where and when the pest's numbers are on the rise so countermeasures can be timed accordingly.

As the scientists see it, the use of pheromone-based tactics like mating disruption is part of a multi-pronged fight against the mealybug that includes the application of insecticides, organically compatible products

like natural oils and biological or cultural control methods.

More information: Jacob A. Corcoran et al, Identification of a receptor for the sex pheromone of the vine mealybug, Planococcus ficus, *Current Research in Insect Science* (2024). DOI: 10.1016/j.cris.2024.100072

Provided by United States Department of Agriculture