Scientists map key enzymes behind locust swarming pheromone production

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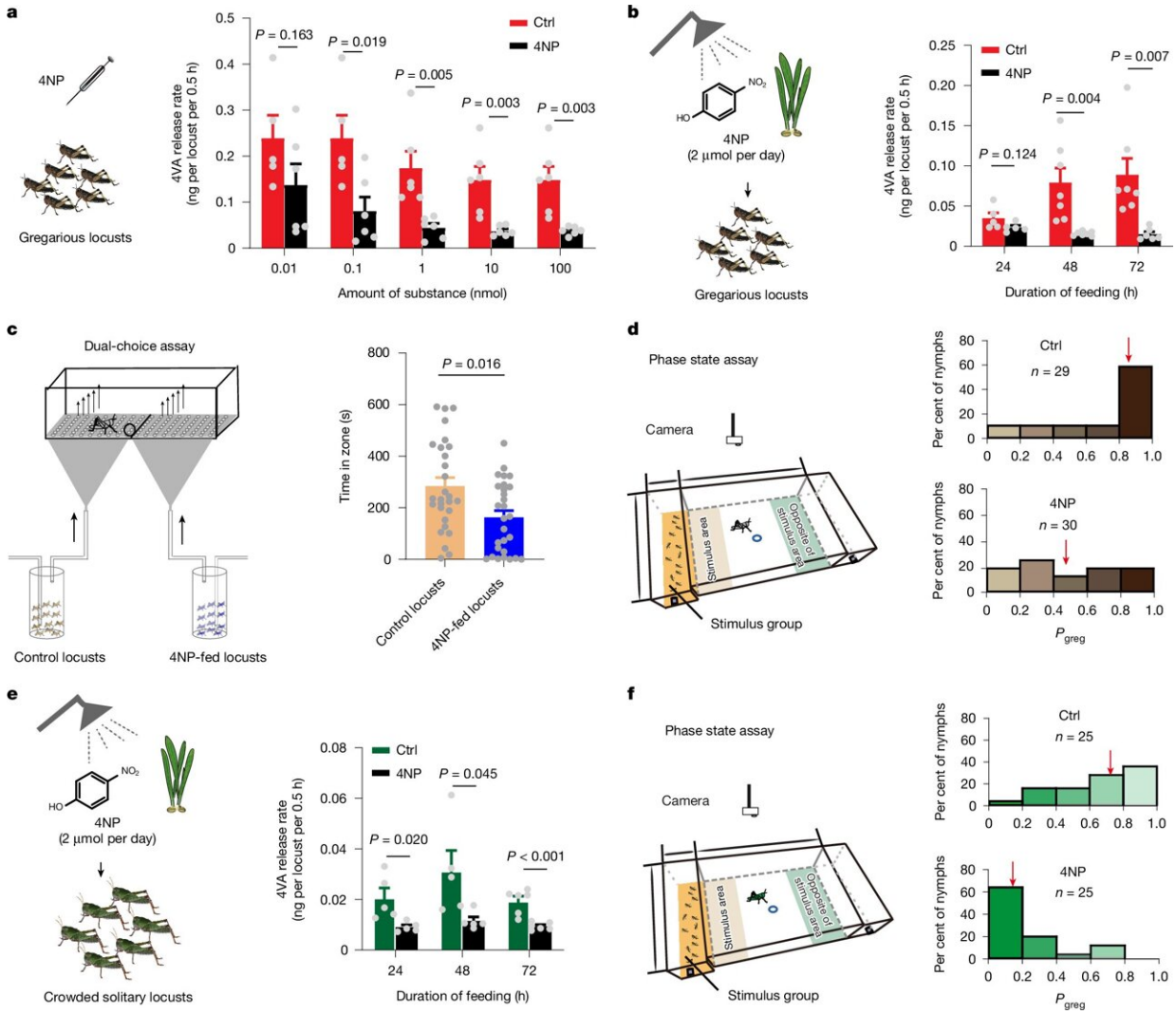
Comparison between gregarious locusts (right) and solitary locusts. Credit: Xiaojiao Guo et al

A team of zoologists, molecular engineers and pest control specialists at the Chinese Academy of Sciences, working with a small team of

colleagues from Peking University, has identified some of the enzymes and precursor compounds involved in the biosynthesis of 4VA in locusts. In their study, published in the journal *Nature*, the group conducted genetic deactivation on sample locusts to find the precursors to the biosynthesis of 4VA, a pheromone that induces swarming in the insects.

Humans have been battling crop-eating locusts for thousands of years—they are mentioned in the Bible as one of the 10 plagues of Egypt. But it has been only in the modern era that humans have gained the edge, mostly by using pesticides. More recently, pesticides have been found to cause a host of environmental problems; thus, a new solution is needed.

For this new study, the research team followed up on prior research from 2020 that found that a pheromone called 4VA played a major role in causing locusts to switch from a solitary state to swarms capable of destroying whole fields of crops. The researchers sought to learn more about the mechanism behind the production of 4VA in locusts in hopes of finding ways of inhibiting it, and thus control swarming.



4NP effectively inhibits gregarious behavior of locusts. Credit: *Nature* (2025). DOI: 10.1038/s41586-025-09110-y

The researchers deactivated genes in the hind legs of several of the insects close to where 4VA is produced until they found some that suppressed the pheromone. The researchers identified enzyme 4VPMT1, which catalyzes a precursor called 4VP into becoming 4VA. The researchers also identified several molecules involved in binding 4VP with other chemicals during the catalyzation process.

Feeding the locusts a meal mixed with the compound 4-nitrophenol stopped the phase shift to swarming. This finding shows that 4-nitrophenol could be sprayed on crops or areas near them to prevent locusts from forming swarms. Unfortunately, prior research has shown that 4-nitrophenol is also harmful to the environment. The team plans to continue their work to find other compounds that might prove just as useful but without harm to the environment.

More information: Xiaojiao Guo et al, Decoding 4-vinylanisole biosynthesis and pivotal enzymes in locusts, *Nature* (2025). DOI: 10.1038/s41586-025-09110-y