Cunning super-parasitic wasps sniff out protected aphids and overwhelm their defenses

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The super-parasitic wasp, *Aphidius ervi*, attacks the pea aphid, *Acyrthosiphon pisum*. Credit: Alex Wild

In the war between parasite and host, the parasitic wasp, *Aphidius ervi*, and the pea aphid, *Acyrthosiphon pisum*, are locked in a battle for survival. New research published in BioMed Central's open access journal *BMC Biology* shows that this cunning parasite sniffs out differences between protected and unprotected aphids, and alters its egg-laying strategy, in order to overwhelm aphid defenses and ensure survival of wasp offspring.

The wasp, A. ervi, lays an egg inside the pea aphid, where the egg hatches and converts the aphid's insides into a wasp nursery. The wasp

larva uses the still-living aphid as a food source, eventually pupating inside the aphid and emerging as a fully-formed mature wasp. However the pea aphid is not defenseless. It is protected by a bacterial symbiont Hamiltonella defensa (and its associated bacteriophage APSE).

Although the wasps still lay their eggs, wasp larvae are unable to develop normally. Researchers from the Universities of Georgia and Arizona collaborated with researchers from Akita Prefectural University, Japan, to investigate what tactics the wasps might use to overcome the aphids' symbiont defense strategy. The researchers found that wasps which laid two eggs (superparasitism) in aphids infected with H. defensa and APSE were much more successful at producing live offspring.

However laying two eggs in uninfected hosts had little effect on the number of surviving wasps as only one wasp can complete development in each aphid. This suggests that having twice the amount of factors secreted by the developing wasp overpowers the protection due to bacterial infection, and is an adaption to ensure the survival of one wasp at the cost of two.

In a twist it seems that the wasps are able to work out which aphids are harboring the symbionts and which are not. Dr Kerry Oliver, who led this study, explained, "We discovered that A. ervi would preferentially lay two eggs in infected hosts, and a single egg if the aphids were unprotected. We don't for sure how wasps discriminate, but, when we looked for differences between the aphids, we found that infected aphids produced less of the compound trans-b-farnesene. This compound is a major component of aphid alarm pheromone and wasps are known to use this cue to find hosts."

Whatever the trick that they are using to work out which aphids are infected, wasps appear to be able to lay just enough eggs to stay ahead in the arms race.

More information: Parasitic wasp responses to symbiont-based defense in aphids, Kerry M Oliver, Koji Noge, Emma M Huang, Jamie M Campos, Judith X Becerra and Martha S Hunter, *BMC Biology* (in press) www.biomedcentral.com/bmcbiol/

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