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OUTSIDE JEB

Symbionts silence the alarm to remote-control killers

Aphids are a bit like the mosquitos of the plant world. Using their straw-like mouths, they feed on plants by sucking out their sugary contents, much like mosquitos dining on our blood. But whereas we can swat a mosquito, plants are fixed in place. So how do they defend themselves? Several decades ago, scientists discovered that plants under aphid attack secrete volatile compounds that attract parasitoid wasps. These tiny wasps kill aphids by injecting them with wasp eggs, effectively turning them into living incubators for wasp babies. But, as shown in a recent study in Nature Communications led by Enric Frago and a group of international collaborators from The Netherlands, France and the UK, aphids aren't just sitting ducks. They can fight back by silencing the plant's cry for help.

The aphid diet is mainly composed of plant sugars and not much else. To compensate for these dietary shortcomings, aphids harbour microbial symbionts that supply them with essential nutrients. In addition, aphids associate with a diverse set of non-essential microbes that, in various ways, protect their hosts from different threats and stresses. One species, called *Hamiltonella defensa*, even directly protects aphids against wasps by arresting wasp development after the eggs have been injected. But the protection isn't guaranteed and many aphids still succumb. Frago and his colleagues, reasoned that it would be better still if symbionts could keep aphids from getting attacked at all.

To test this possibility, the research team created aphid clones that were identical except for the presence or absence of *Hamiltonella*. They then allowed these aphids to feed on plants while measuring how attractive they were to wasps. Remarkably, wasps spent significantly less time hovering around the plants harbouring aphids with symbionts. And this resulted in around a 50% decrease in the rate of wasp parasitism.

Armed with the understanding that plants recruit wasps using volatiles, the team next analysed the odours emanating from the two plant types. In both cases, they identified a complex mixture of compounds that was almost identical in composition. The key difference was in the concentrations of some components. Plants eaten by aphids carrying the *Hamiltonella* symbionts simply produced less of the signals used to recruit wasps. This, in turn, kept wasps away and ensured that aphids were left in peace to feed at leisure.

The authors don't yet know how *Hamiltonella* manipulates plants, but the mechanism is likely to be something simple and general because *Hamiltonella* isn't the only symbiont that can pull off this trick. Indeed, four other bacterial symbionts of aphids could also suppress the production of plant volatiles – and it makes sense that they should. Symbionts make a living by moving from aphid to aphid, so keeping wasps away is a matter of symbiont survival. After all, a dead aphid is a dead end for these bacteria. So, while it is convenient to view this interaction as a case of outsourced defence orchestrated by the aphid, the reverse is actually more likely. As is increasingly clear across many systems, bacteria run the show while aphids are merely the puppets they call home.

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Frago, E., Mala, M., Weldegergis, B. T., Yang, C., McLean, A., Godfray, H. C., Gols, R. and Dicke, M. (2017). Symbionts protect aphids from parasitic wasps by attenuating herbivore-induced plant volatiles *Nat. Commun.* **8**, doi:10.11038/s41467-017-01935-0.

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