Parasitic fig wasp hypodermic egg injector sniffs out host larvae to lay eggs

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It takes a special kind of insect to pollinate an inside-out flower, which is exactly what the wasps that pollinate figs do. Crawling inside the firm swelling lined with microscopic flowers that will eventually ripen into a fleshy fig, tiny fig wasps pollinate the flowers within while laying their own eggs. However, the fig wasps' robust nursery is not entirely secure.

Renee Borges from the Indian Institute of Science explains that some parasitic wasp species seek fig wasp larvae to nurture their own young, and these and other parasitic species that lay their eggs directly in the fruit are equipped with a sharp hypodermic needle (ovipositor) that drills into the hard fig before the wasp injects her eggs. However, it is not sufficient for these parasitic interlopers to inject their eggs at random. Parasitic wasps that target fig wasp larvae must locate the developing youngsters within the flesh of the fruit. Knowing that pockets of gas could indicate the presence of fig wasp larvae developing within ripening figs, Borges and her student Pratibha Yadav wondered whether the tip of the parasitic wasp's egg injector could be guided by odour sensors that could literally sniff out potential host larvae within. They publish their discovery that parasitic fig wasp ovipositors literally sniff out their egg laying sites in *Journal of Experimental Biology*.

But before Yadav could test the hypothesis, she had to obtain elusive *Apocrypta westwoodi* parasitic wasps. 'We collected figs that are about to release wasps from trees on our campus', says Borges, who kept the fruit in the lab until the male wasps gnawed the holes in the fruit that would allow the females to emerge. Then, Yadav released the wasp's ovipositor

from within its protective sheath. 'The hardest thing was to obtain electrophysiological recordings from the extremely thin ovipositor', says Borges, who had to experiment with different techniques to amplify the faint electrical signals produced by the ovipositor in response to odours.

Knowing that the wasp larvae that were already developing in the fruit exhale carbon dioxide, Yadav blew a dilute stream of carbon dioxide over the tip of the exposed ovipositor and was impressed to see that the gas triggered nerve signals. And when she tethered the insects at the tip of a hypodermic syringe and blew a thin stream of air over the wasps, the ovipositor only twitched in the direction of the jet of air when she added a puff of carbon dioxide. *Apocrypta*'s ovipositors were capable of sniffing out carbon dioxide, which could help guide the ovipositors to their larval egg laying sites. And when Yadav photographed the tip of the ovipositor using a scanning electron microscope, she could clearly identify sensory structures that resembled the carbon dioxide sensors found on the antennae of other insects.

Curious to find out how the ovipositors of other parasitic fig wasps would respond to odours, Yadav extracted scents from developing figs that were at the stage when Sycophaga fusca fig wasps—a parasitic species that injects its eggs directly into the fig—make a visit. Blowing the fruit scent over Sycophaga's ovipositor, Yadav saw it twitch strongly when it caught a whiff of the fruit. But how would *Apocrypta*'s ovipositor respond to the fruity odours? Yadav blew the same scents over the *Apocrypta* ovipositors and this time they were unresponsive; *Apocrypta* attend the fruit later, when the fig smells different.

Having confirmed that the ovipositors of *Apocrypta* parasitic wasps are capable of sniffing out wasp larvae upon which to lay their eggs, while Sycophaga's ovipositors can find the ideal locations for their eggs inside fleshy fruit, Borges is keen to learn more about how other parasitic wasps select their egg-laying locations, site unseen.

More information: Yadav, P. and Borges, R. M. (2017). The insect ovipositor as a volatile sensor within a closed microcosm. *J. Exp. Biol.* 220, 1554-1557. DOI: 10.1242/jeb.152777