Insect gene allows reproductive organs to cope with harmful bacteria

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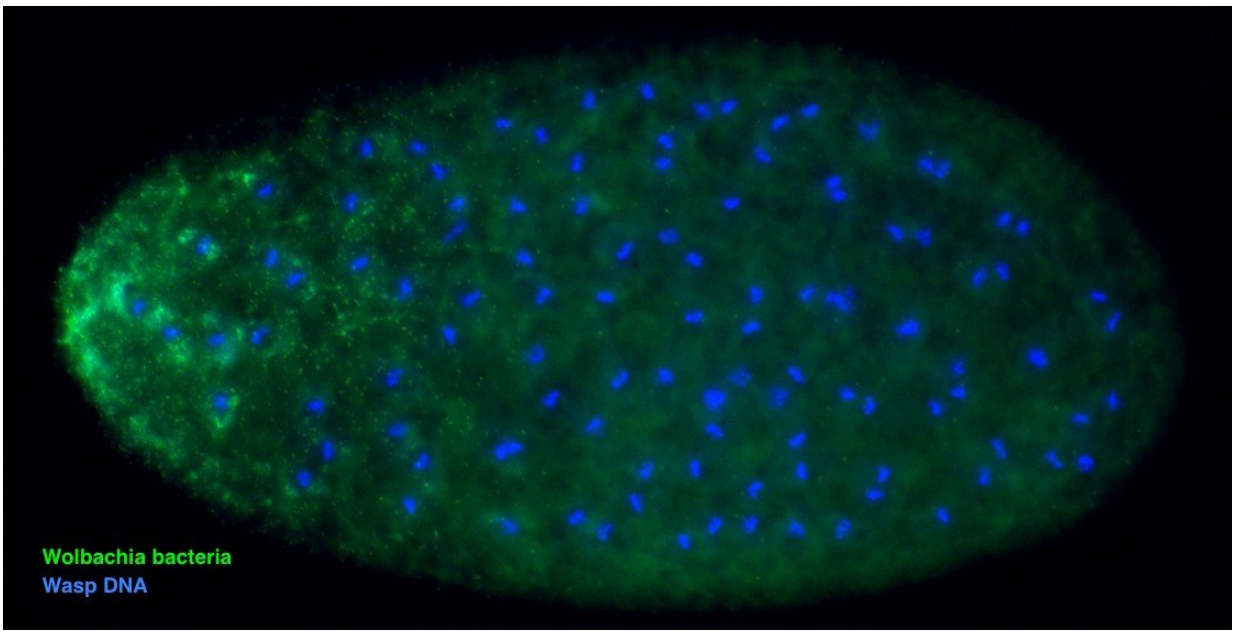

This Nasonia wasp egg is infected with *Wolbachia*, a bacteria that can cause mothers to make fewer offspring. Credit: Michael Clark and Bordenstein Lab

A damaging bacteria with an uncanny ability to pass itself from insect mothers to eggs meets its genomic match in a tiny variety of parasitic wasp, a recent discovery by Associate Professor of Biological Sciences Seth Bordenstein and his team has shown.

Offspring of insects infected with the bacteria *Wolbachia* often die or

are converted from male to female. Bordenstein's team studied Nasonia parasitic wasps that are only about the size of a sesame seed, and they serve as one of the best models to dissect and characterize the evolution of insect genomes.

Inside the wasp's reproductive organs, *Wolbachia* hide out and pass from the mother's ovaries to developing eggs to ensure the bacteria's hidden survival to the next generation.

While high levels of *Wolbachia* in the ovaries are key for the bacteria's transmission to insect offspring, too much *Wolbachia* comes at a heavy cost. The host suffers from reduced lifespan in some insects and fewer eggs in others, specifically in the Nasonia wasps. To balance the opposing evolutionary interests of the wasp and bacteria, an ongoing arms race can occur between the Nasonia wasp genome and that of the *Wolbachia* infection.

The wasp's defense system to combat unchecked Wolbachia remained unknown until Ph.D. student Edward van Opstal in the Bordenstein Lab helped detect it. Through the use of several different genetic and fluorescent microscopy tools, one gene from among the many thousands was found to suppress *Wolbachia* and its transfer to the developing egg.

A Nasonia wasp walks along her fly host to lay eggs. Credit: Jitte Groothuis

The genetic signatures in this gene can be used to infer evolution that happened in the past. They indicate that the wasp's countermeasure to suppress Wolbachia gave it an evolutionary benefit over wasps that lacked this same genetic signature.

The team also found that, in distant relatives of the wasp, the genetic signatures in this gene are different, and it becomes difficult to detect the presence of this gene in their genomes. Thus, it appears that the genetic toolkit used by this wasp species could be highly specific to its own arms race with *Wolbachia*.

"The broad lesson is that across the kingdom, animals may evolve to control their transmitted bacteria by independent and different means. Mom knows best, but moms in each animal species likely control proliferation of infections in their offspring in unique ways," Bordenstein states.

More information: Lisa J. Funkhouser-Jones et al, The Maternal Effect Gene Wds Controls Wolbachia Titer in Nasonia, *Current Biology* (2018). DOI: 10.1016/j.cub.2018.04.010

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