

Could “Trojan horse”-type microorganisms that exploit symbiotic systems be candidates for new biological pesticides?

Discovery of a pathogenic microorganism that invades the symbiotic organ of stink bugs and proliferates abnormally, by mimicking symbiotic microorganisms

Summary Text: The study discovered a new insect pathogen that invades the gut symbiotic organ of stink bugs by mimicking their symbiotic microorganism, and this pathogen ultimately kills the host bugs.

News Release Keywords: Insects, Symbiosis

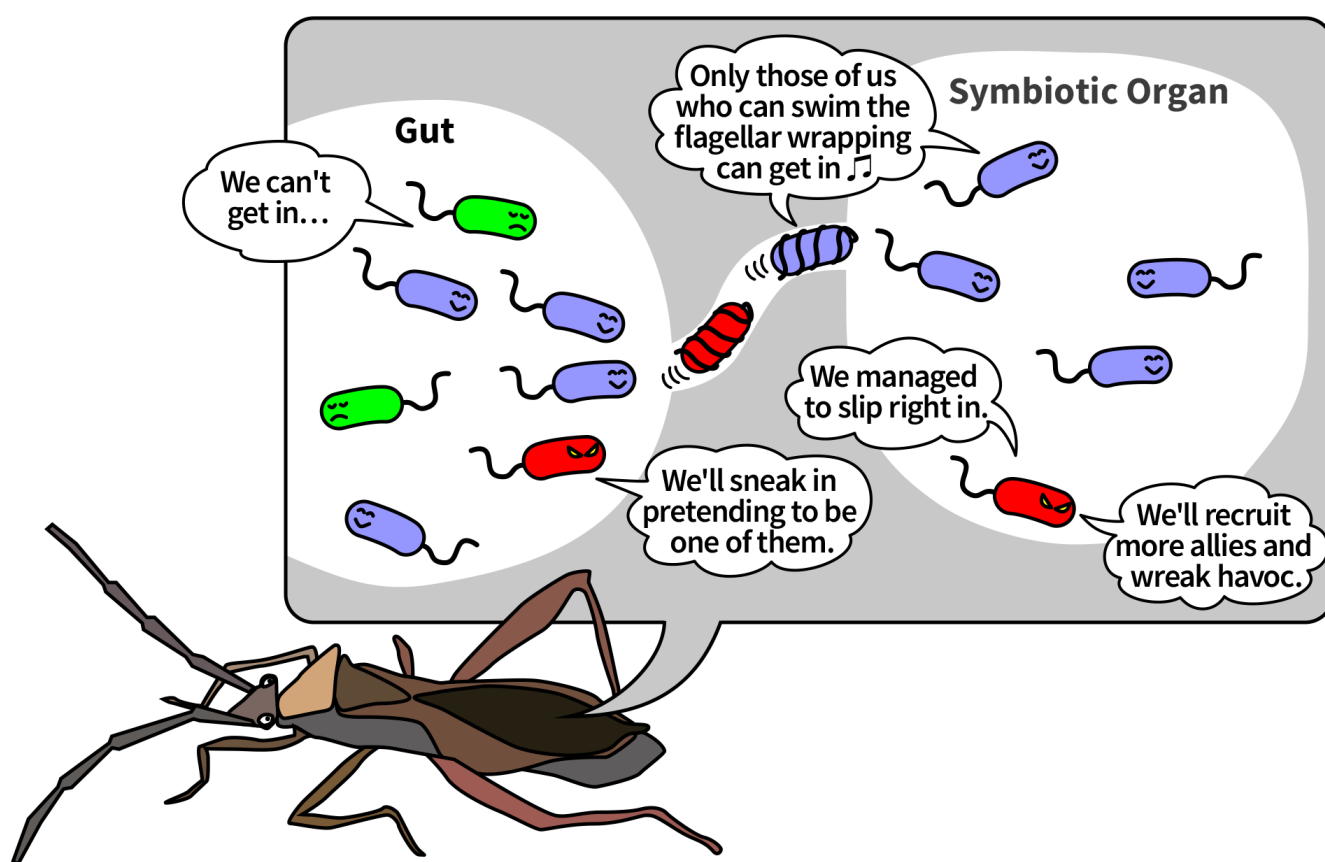


Figure Caption: Scientists have discovered a pathogenic microorganism that behaves like a symbiotic microorganism, invading symbiotic organs and killing its host pest!

Researchers at National Institute of Advanced Industrial Science and Technology (AIST), in collaboration with researchers from The University of Electro-Communications (UEC) and Akita Prefectural University, have discovered a new insect pathogen that invades the gut symbiotic organ of stink bugs by mimicking their symbiotic microorganism, and this pathogen ultimately kills the host bugs.

Many pests harbor symbiotic microorganisms within their bodies and rely on them for functions essential to their survival, such as obtaining essential nutrients that cannot be obtained from food alone. Stink bugs are a

well-known example of maintaining a symbiotic relationship like this. They do this by housing symbiotic microorganisms, which they acquire from the environment, in a well-developed, sac-like symbiotic organ located within the posterior region of their gut.

In this study, we discovered a new pathogenic microorganism that mimics the symbiotic microorganisms of stink bugs to invade their bodies. This pathogen enters the gut from the soil and uses the same “wrapping motility” mode employed by symbiotic microorganisms to reach the symbiotic organ. Researchers revealed that this pathogen proliferates abnormally after establishing itself in the symbiotic organ. It then breaches the organ and spreads into the host's hemolymph, causing sepsis and killing the host stink bug with nearly 100% certainty within 10 days. This is the first reported case of an insect pathogen killing its host by colonizing the symbiotic organ while masquerading as a symbiotic microorganism. These findings are expected to lead to the development of new, eco-friendly pest control technologies.

Details of this technology were published online in the “*Proceedings of the National Academy of Sciences of the United States of America (PNAS)*” on April 28, 2026.

Background

The natural environment is home to a wide variety of insects, including agricultural pests that damage crops. There are also stored-product pests that infest homes and food. And there are public health and nuisance pests that transmit pathogens. These pests adversely affect health and sanitation. Chemical pesticides are widely used to control these pests; however, concerns have arisen regarding their impact on biodiversity and the development of pesticide resistance in pest populations. Consequently, biological pesticides are gaining attention as they utilize insect-pathogenic microorganisms and natural enemies with high species-specificity against pests. Biological pesticides target pests more specifically and have a lower environmental impact than chemical pesticides. This makes them an important option for sustainable agriculture. Among agricultural pests, stink bugs are known to be difficult to control, and they damage many crops by sucking sap. Until now, chemical pesticides were the only effective control method.

Many pests harbor symbiotic microorganisms within their bodies and rely on them for important nutritional metabolic functions, such as compensating for insufficient nutrients obtained from food and breaking down indigestible food. These symbiotic microorganisms are essential for the pests' survival, growth, and reproduction. Among insects that harbor symbiotic microorganisms, there are species known to have evolved specialized organs called “symbiotic organs” to maintain these microorganisms stably. Stink bugs have a sac-like symbiotic organ developed within a portion of their gut. This organ stores symbiotic microorganisms that they absorb from the soil and utilizes them for nutrient supplementation.

Points

- The search for microorganisms, pathogenic to stink bugs, led to the discovery of an insect-pathogenic microorganism that exhibits the same infection route and behavior as symbiotic microorganisms.
- It was revealed that the discovered pathogenic microorganisms are taken up from the soil into the gut, invade the symbiotic organ using the same “wrapping motility” mode as symbiotic microorganisms, proliferate abnormally, and cause nearly 100% mortality in the host stink bugs within 10 days
- Their application could be a new biological pesticide with high specificity and low environmental impact

Article Information

Publication : *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*

Paper title : A Trojan horse pathogen breaking through partner choice barriers in the insect gut

Authors : Kota Ishigami¹, Seonghan Jang¹², Aoba Yoshioka³, Hiroyuki Morimura³, Aya Yokota⁴, Lionel Moulinh⁴, Antoine-Olivier Lirette¹⁵, Kazutaka Takeshita⁶, Daisuke Nakane³, Peter Mergaert⁴, Yoshitomo Kikuchi¹

¹AIST, ²Korea Research Institute of Bioscience and Biotechnology, ³The University of Electro-Communications,

⁴CNRS, ⁵ Hokkaido University, ⁶ Akita Prefectural University

DOI : 10.1073/pnas.2533244123