Scientists discover chemical cues that stimulate egg laying by pregnant mosquitoes

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North Carolina State University scientists have figured out one reason why pregnant yellow fever mosquitoes (*Aedes aegypti*), one of the most important disease transmitters worldwide, choose to lay their eggs in certain outdoor water containers while eschewing others.

In a paper published in *Proceedings of the National Academy of Sciences,* the NC State researchers show that certain chemicals emanating from bacteria in water containers stimulate the female mosquitoes to lay their eggs. The female mosquitoes sense these chemical cues and decide that the water container is a preferable environment for their larvae to develop.

The findings could have implications for devising lures and traps that might help control yellow fever mosquito populations in equatorial locations around the globe, which would go a long way toward preventing important global diseases like dengue fever and yellow fever, say the study's lead authors, Dr. Charles Apperson and Dr. Coby Schal, professors of entomology at NC State. Postdoctoral researchers Dr. Loganathan Ponnusamy and Dr. Ning Xu and senior researcher Dr. Satoshi Nojima also co-authored the paper.

The study shows that yellow fever mosquitoes are particularly motivated to lay eggs in water containers that have just the right amounts of specific fatty acids associated with bacteria involved in the degradation of leaves and other organic matter in water. The chemicals associated with the microbial stew are far more stimulating to discerning female

mosquitoes than plain water, for example, or filtered water in which the bacteria once lived.

The study used a combination of approaches, including one in which the NC State scientists presented female mosquitoes with different types of bacteria and bacterial extracts, and, in Schal's words, figured out "what turned the mosquitoes on" to lay their eggs.

"Some water-filled containers are rejected by the female mosquito," Apperson says. "If we filter the bacteria out, the mosquitoes want no part of the water container. But put the filtered bacteria back in the water container, and the mosquitoes will be stimulated to lay eggs."

Female mosquitoes are choosy when it comes to finding the proper egg-laying habitats. They do not normally lay all their eggs in one location, but instead exhibit a behavior called "skip-oviposition," distributing eggs in multiple water-filled containers.

Once the NC State scientists discerned the specific chemical compounds that stimulated increased egg-laying – a blend of fatty acids and methyl esters – they exposed the mosquitoes to varied concentrations of the chemical brew. High concentrations of the brew gave the mosquitoes pause, causing them to withhold their eggs. Lower concentrations were more convincing to mosquitoes than high concentrations, but still not as convincing as the proper amount – found to be only 10 nanograms in 30 milliliters of water.

Mosquito larvae depend on microbes in their new homes for growth and development, so it is important for mothers to be discerning when it comes to living arrangements for their young, the researchers say.

Now, the NC State scientists hope to use this choosiness against female mosquitoes. Stimulating females to lay eggs in water containers that have

lethal chemicals or insect growth regulators could be another tool in the overall strategy kit to control mosquitoes – and dreaded diseases like dengue fever.

"We want to use the mosquito's egg-laying behavior against itself for control purposes," Apperson says.

Source: North Carolina State University