Disease-free mosquito bred to disease-carrier can have all disease-free progeny

A decade ago, scientists announced the ability to introduce foreign genes into the mosquito genome. A year ago, scientists announced the successful use of an artificial gene that prevented a virus from replicating within mosquitoes. But how does one apply what can be done with a small number of mosquitoes in a lab to the tens of millions of mosquitoes that spread disease worldwide?

Researchers from Virginia Tech and the University of California Irvine have demonstrated the ability to express a foreign gene exclusively in the female mosquito germline, a necessary prerequisite to future genetic control strategies in mosquitoes where all progeny of lab and wild mosquitoes will have the gene that blocks virus replication – or whatever trait has been introduced into the lab mosquitoes.

Until now, if lab-grown mosquitoes that are unable to support virus replication were to mate with wild, disease-vector mosquitoes, only half of their off-spring would have the anti-virus gene. Researchers have been working on how to skew the outcome so that all off-spring lack the ability to spread disease. However, these experiments have been hampered by the inability to express foreign genes in the mosquito germ cells.

“We needed to gain access to the cells in the reproductive germline to change the way traits are inherited,” said Zach Adelman, assistant professor of entomology and a member of the Vector-Borne Infectious Disease Research Group at Virginia Tech.

Adelman will discuss what the research breakthrough means for the future control of diseases spread by mosquitoes in his talk, “Dengue Viruses and Mosquitoes, Scourge of the Developing World: Can Genetic Control Make a Difference"” to be presented Thursday morning, July 19, at the 2007 Biotechnology Education Conference at the Inn at Virginia Tech, hosted by the Fralin Biotechnology Center at Virginia Tech.

The research appeared in the June 12, 2007, *Proceedings of the National Academy of Sciences*, in the article, "Nanos gene control DNA mediates developmentally-regulated transposition in the yellow fever mosquito Aedes aegypti," by Adelman, assistant professor of entomology at Virginia Tech, and UC Irvine colleagues Nijole Jasinskiene, Sedef Onal, Jennifer Juhn, Aurora Ashikyan, Michael Salampessy, Todd MacCauley, and Anthony A. James.

Working with Aedes aegypti, the mosquito that carries yellow fever and dengue fever viruses, the researchers are working to create a “gene-drive system” by using instructions copied from the nanos (nos) gene, which is essential for germline formation. “Think of the nanos instructions as a key to a room,” Adelman said.

Using the nanos “key,” the researcher team successfully achieved germline-specific expression of Mos1, an enzyme isolated from the housefly that is a transposable element (TE) -- a piece of genetic material that moves around. Mos1 can also move anything attached to it and can duplicate itself and whatever is attached to it, such as a gene that directs the dengue virus to stop replication.

“The research reported in PNAS shows that we can access the female germline and we can perform experiments in the germline,” said Adelman. “The nanos control sequences show promise as a part of a TE-based gene drive system,” he said.

Link: http://www.pnas.org/cgi/content/abstract/104/24/9970

Source: Virginia Tech