

## **Virginia Tech Graduate Student Fights Tropical Diseases with Genetic Engineering**

Mosquitoes have been causing a lot of buzz about tropical diseases recently, and researchers at Virginia Tech are working to zap the problem.

Mosquitoes are one of the world's deadliest animals, and are a key contributor to the spread of life-threatening diseases such as Zika, Dengue, and Chikungunya.

Researchers at Virginia Tech have been working to edit the genes of mosquitoes and combat the spread of these tropical diseases. Justin Overcash, an entomology Ph.D. student in the College of Agriculture and Life Sciences, is one of these researchers.

Justin has been working under Zach Adelman, an associate professor of entomology and member of the Fralin Life Sciences Institute, since his undergraduate years at Virginia Tech.

"I've always been fascinated with genetics and molecular biology," Justin said.

But it wasn't until he started working in Dr. Adelman's lab that he realized he wanted to work in the branch of biology that deals with genetics.

"Dr. Adelman was fantastic about giving me a lot of opportunities. I started really getting into all of the aspects of running experiments, working the lab, the whole culture of scientific research," Justin said. "I started getting involved with DNA repair pathways, which led to grad school, and I eventually wrote a review paper."

That review paper ignited the passion that led Justin to his work with the CRISPR/Cas9 system.

CRISPR/Cas9 is a gene editing method that allows researchers to cut and paste DNA. Justin uses it to study the structure of mosquito DNA.

"I've always liked new cutting-edge things, and CRISPR/Cas9 is the new most cutting edge technology in terms of gene editing," Justin said. "The possibilities are endless in terms of what you can do with CRISPR/Cas9."

The new technology took the life-science scene by storm in 2012. Since then research has ramped up—with no end in sight.

Gene editing allows scientists to study an organism by deleting certain genes or adding new ones, and observing how the organism is affected. The new CRISPR/Cas9 technique makes the editing process more efficient and may accelerate efforts to develop mosquito-control or disease-prevention strategies.

Justin and his colleagues hope to design new methods of controlling or preventing mosquito-borne viral disease outbreaks by blocking the mosquito's ability to transmit the viruses. One way to do this would be genetically increasing the number of males that hatch in proportion to females, because only the females transmit the diseases.

Justin specifically uses the CRISPR system to cause breaks in mosquitoes' DNA strands. He then studies how those breaks can be manipulated, why they occur, and what can be changed. Currently, little is known about how mosquitoes defend themselves against foreign DNA elements, also called transgenes. To implement a successful genetic control strategy, it is vital to understand how these breaks occur and how a mosquito reacts to a transgene over time.

A key component of Justin's research and of the Adelman lab is to raise public awareness about the potential benefits and limitations that genetically modified organisms could have on disease control. "Gene editing is a very controversial topic right now in genetics," Justin said, and sometimes the public can be unreceptive to its possibilities. But, he explained, tropical diseases infect millions of people annually, and more than a million people die from mosquito-borne diseases each year.

"It's such an important topic right now," Justin said, and he's passionate about raising awareness.

That's why Justin has traveled across the country promoting his research at various conferences and symposiums. "Any opportunity I get, I'm going to take it," he says, and he has. On top of the conferences and symposiums Justin has attended, he has published review papers, and will be giving a presentation on his lab's research at the American Society for Virology conference this summer.

By raising public awareness and continuing this research, the only buzz concerning tropical diseases will hopefully be telling them to buzz off.