Medical Xpress

Researchers revolutionizing control of vector-borne diseases

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Anopheles gambiae mosquito, feeding on blood. Credit: James Gathany, Centers for Disease Control and Prevention

Purdue University entomology professor Catherine Hill is researching a way to respond to new and reemerging vector borne diseases,

specifically without wiping out the mosquito population.

Arthropod vectors include insects such as mosquitoes, sandflies, blackflies and ticks. These insects transmit diseases through biting a host; and many of these diseases are on the rise due to human population growth, climate change, and habitat destruction, Hill says.

Increased human population leads to large groups of people relocating to find more resources. These people bring diseases to which the people in new regions are not immune. Local mosquitoes that feed on infected people are then able to spread diseases to others.

Higher global temperatures mean that insects can survive in different geographical regions that were previously off limits for their biology. According to Climate Nexus, an environmental advocacy agency, mosquitoes can move farther away from the equator, as well as survive in higher altitudes.

Deforestation also plays a role in the movement of vector-borne diseases by changing the dynamics of an ecosystem; this eliminates mosquito habitat and the natural vertebrate hosts used by mosquitoes. These changes then reshape existing ecosystem boundaries, which are typically sites of contact between humans and infected vectors. Therefore, humans living near fragmented forests have a higher risk of being infected and then spreading this infection says Hill.

Hill's team is looking to develop new control technologies to combat the growing problem of these diseases, with research specific to the viruses that cause West Nile, dengue, Zika and yellow fever. These viruses are from a class of viruses called flaviviruses. She wants to develop non-toxic, non-lethal pesticides that will suppress pathogen transmission of these diseases.

"The global societal goal that we're trying to address is to control infectious diseases transmitted by mosquitoes in a way that's safe for humans and the environment and that also preserves biodiversity, so without killing the insect…that's a bit of a radical idea," Hill says.

Within five to 10 years, Hill wants to partner with a company to develop an insecticide. Specifically, she is looking for a chemical compound that will make it impossible for a mosquito to transmit diseases. Mosquitoes are showing high levels of resistance to traditional insecticides, and with diseases on the rise, something needs to be done to control these insects.

"You can see we're kind of on this collision course, this perfect storm, and it's essential that we develop an arsenal of new weapons to control mosquitoes within the next 5-10 years," she says.

Hill's desire to avoid eradicating mosquitoes makes her research groundbreaking. Up until this point, the main approach is to use insecticides that are rapidly toxic and quickly cause the death or paralysis of the insect. Hill points out that this can have devastating effects on many other insect populations, as well as being dangerous to humans.

Therefore, Hill and her team look for changes in mosquito behavior, biology or morphology rather than the death of the insect when screening chemicals that could be used for an insecticide. Hill and her team "recognize mosquitoes are playing a fundamental ecological role and we don't want to disrupt that delicate web," she says

While finding novel and non-toxic chemistries to control mosquitoes is vital to Hill's research, political scientists, communications specialists and environmental health experts play pivotal roles in changing the way the public views mosquitoes.

"There could be a lot of skepticism from the public, and [not killing mosquitoes] could be a tough thing to accept," she says. Therefore, Hill's team is composed of many different scientists with expertise in different areas to not only create a chemical but also to address social concerns and change public policy regarding mosquito and disease control.

For instance, Hill's team includes political scientist Leigh Raymond, medicinal chemists and molecular pharmacologists Val Watts and Daniel Flaherty, entomologist Michael Scharf and communication specialist Linda Pfeiffer.

The team is based in Discovery Park, a research park dedicated to using interdisciplinary teams to solve global problems. Hill's research was one of the winners of Discovery Park's Big Idea Challenge, a program that provides resources to interdisciplinary teams with innovative research.

Hill is eager to produce these new chemicals and get them on the market, but her team will take whatever time needed in order to extensively research a product and ensure that there is enough data to show effective disease control, human safety and low environmental impact.

"I don't want this to languish in the lab. Everything we do in the lab is about application. The mindset has always been to move it out of the lab as quickly as possible, so it's a rapid trajectory," she says.

Provided by Purdue University

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