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House Fly Virus Stops

Christopher J. Geden
USDA-ARS, Chris.geden@ars.usda.gov

Sandra Avant
ARS

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STEPHEN AUSMUS (D1058-1)

Common house fly, *Musca domestica*.

The house fly is often considered merely a nuisance. But these flies are capable of transmitting animal and human pathogens that can lead to foodborne diseases, including *Escherichia coli, Salmonella,* and *Shigella* bacteria.

Insecticides are important for control, but house flies are particularly good at developing resistance, and their larvae tend to stay deep enough within their gooey food to avoid exposure to sprays.

Scientists at the Agricultural Research Service's Center for Medical, Agricultural, and Veterinary Entomology (CMAVE) in Gainesville, Florida, are looking at new methods that target adult flies. A promising biological control agent—salivary gland hypertrophy virus (SGHV)—was recently discovered. Once infected with the virus, female flies do not produce eggs, and male flies do not mate.

Entomologist Chris Geden in the Mosquito and Fly Research Unit at CMAVE partnered with scientists at the University of Florida (UF) and Aarhus University in Denmark to study the distribution and host range of the virus as well as the effectiveness of different application methods.

A Virus That Works

SGHV is one of three viruses of a newly discovered family called "Hytrosaviridae." The other two viruses are one that infects tsetse flies in Africa and one that infects a pest of flower bulbs in Europe. These viruses are all very host specific, that is, they only occur in the insects they infect, Geden says.

As SGHV replicates in the salivary gland in female flies, something also happens within the reproductive system.

"The salivary glands become huge, ovaries remain small, and the fly can never lay any eggs," Geden says. "The virus hijacks the fly's protein-manufacturing control system. All the protein that would normally go into the ovaries to develop a fly's eggs is diverted to produce virus particles."

The virus may serve as a potential insect-sterilization agent by reducing the fertility of flies, says Drion Boucias, an entomology professor with UF's Institute of Food and Agricultural Sciences.

"More importantly, studies on this unique virus may provide clues as to how to reduce the yolk protein, providing a template for the development of novel insect birth-control chemistries," Boucias says.

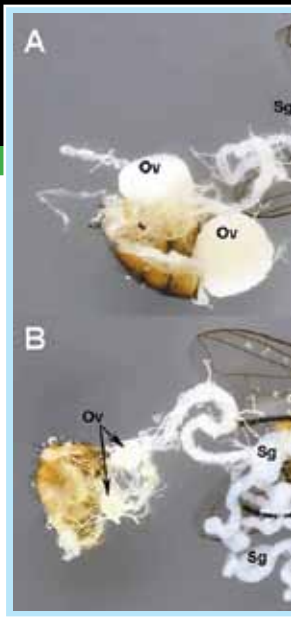
Flies are believed to acquire SGHV when they feed. Infected flies carry disease-causing pathogens on their feet and in their intestines. Each time they feed, infected flies regurgitate massive numbers of virus particles on food. Healthy flies then feed on the contaminated food and pick up virus particles.

The team of researchers wanted to find out if they could infect female flies and stop egg development.

"It's a way of managing the fly population at the adult level by limiting its ability to reproduce," Geden says.

The Right Approach

Generally, the virus's infection rate is very low—around 0.5 to 1 percent of the fly population, Geden says. But sometimes a "hot spot"—an area of significant SGHV activity—can be found. For example, one of the biggest hot spots was found at a large dairy farm in Gilchrist County, Florida, where the virus infection rate was about 37 percent.



"We thought the best approach to increase the infection rate was to develop baits that contain the virus, but we were never able to get high infection levels using baits," Geden says.

The most effective method of infecting flies was direct application of a crude homogenate—a mixture of infected flies and water.

Entomologist Chris Geden and student assistant Rachel Di
virus to determine its effects on fly mortality and reproducti

Flies from Reproducing

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Comparison of a healthy fly (A) and a fly infected with SGHV (B). The fly with SGHV shows underdeveloped ovaries (ov) and overdeveloped salivary glands (sg).

"If we dip the flies in the homogenate or allow them to walk on a surface treated with it, then bingo, we achieve high infection rates; 56 percent of the Danish flies and 50 percent of the Florida flies became infected," Geden says.

In laboratory tests, scientists used SGHV-infected house flies collected from livestock farms in Denmark and a strain of Florida house fly—"Orlando normal"—reared at CMAVE. Virus obtained from one of the infected Danish house flies was injected into the Florida flies, which were found to be highly susceptible to it.

STEPHEN AUSMUS (D2618-1)

illard sort stable flies before injecting them with SGHV on.

None of the other four fly species injected with the virus showed any symptoms.

The study also showed that the Danish and Florida SGHV strains had a similar ability to produce infection. Experiments using Danish and Florida strains of virus as food baits produced infection rates in house flies of 22 percent and 26 percent, respectively. Spraying flies directly with the virus resulted in 18 percent and 22 percent of the flies becoming infected.

Stopping Stable Flies

Two other species—the black dump fly and the stable fly—were also severely affected by SGHV. Stable flies are an important economic pest that affects cattle, pigs, horses, and other large animals. They can also be a problem in recreational areas.

"When we injected stable flies, not only did they become infected, but they also died very quickly, and of those that didn't die, hardly any had developed ovaries," Geden says.

"We found that infected stable flies produced 50 percent to 75 percent less feces, suggesting that they aren't feeding on blood as often or as well as healthy flies. Flies that had the virus not only didn't lay eggs, but also didn't bite as much."

Researchers also found that the virus was developing and replicating in the salivary gland, ovaries, body fat, and other tissues in stable flies. Virus-infected flies had a much shorter lifespan than uninfected flies.

Enhancing Management Techniques

Developing an effective method to infect flies with SGHV in the field could have a significant impact on reducing fly abundance and biting rate, scientists agree.

"I think these novel management strategies of filth fly populations will play an increasingly important role as the human population continues to increase and boundaries between the suburbs and animal-production facilities are reduced," Boucias says.

While SGHV shows great promise in controlling fly populations, it's not a quick fix, Geden says.

"This is not an insecticide. It's not something you would put out when people are complaining about flies at picnics and expect to get a fast reduction," he says. "This would be part of an integrated management program in which you would go out early in the year when natural fly populations are just beginning to increase, hit them with the virus to knock down their reproductive ability, and come back 2 to 3 weeks later and do it again."—By **Sandra Avant,** ARS.

This research is part of Veterinary, Medical, and Urban Entomology (#104) and Animal Health (#103), two ARS national programs described at www.nps.ars.usda.gov.

Chris Geden is in the USDA-ARS Mosquito and Fly Research Unit, Center for Medical, Agricultural, and Veterinary Entomology, 1600-1700 S.W. 23rd Dr., Gainesville, FL 32608; (352) 374-5919, chris.geden@ars.usda.gov.

Stable fly, *Stomoxys calcitrans*.

STEPHEN AUSMUS (D2620-17)