Mosquito vs. Mosquito in the Battle Over the Zika Virus

By NINA FEDOROFF and JOHN BLOCK   APRIL 6, 2016

GENETICALLY modified mosquitoes are in the news for good reason: They may be our best hope for controlling the mosquito-borne Zika virus. The Food and Drug Administration has issued a preliminary finding of no significant environmental impact and is seeking public comment on a plan to test them in a field trial in the Florida Keys.

So you might think this will resolve the Zika crisis, which has caught the world’s attention because of an unexpected spike in microcephaly in babies born to women infected during pregnancy and in the incidence of the paralytic Guillain-Barré syndrome in Zika-infected adults.

You’d be wrong. People are apprehensive about the release of these mosquitoes simply because they are genetically modified. And the company that produces them must traverse a time-consuming federal regulatory process before they can be released in the United States.

This is unfortunate, because biological insect control can eradicate pests over large areas. This is what these genetically modified mosquitoes are intended to do to Zika-virus-carrying mosquitoes.
The story of the screwworm, a particularly nasty insect that once caused millions of dollars of losses in the livestock industry, is instructive. Female screwworm flies lay eggs in open wounds of animals and humans. The larvae feed on the living flesh and attract more egg-laying females. If not treated, the animal dies.

Around 1950, Edward Knipling, a Department of Agriculture scientist who had been exploring sterilization as a way to control screwworms, learned of the Nobel laureate H. J. Muller’s pioneering genetic work on the fruit fly Drosophila.

Dr. Muller had discovered that X-rays produced genetic changes in the fruit flies, but that high doses made them sterile. So Dr. Knipling wondered whether irradiated, sterile screwworm flies could still mate. His experiments showed that screwworm pupae could grow into sterile adults that could mate, but not reproduce.

Dr. Knipling believed these sterile insects could suppress the screwworm biologically. The idea was to release lots of them to mate. Since they couldn’t produce offspring, the sterile screwworms flies should gradually eradicate the species.

The first large-scale test was conducted on Sanibel Island in Florida in 1951. It was a success, as was a 1954 trial that eradicated the screwworm from the Antilles island of Curaçao, followed by another successful trial in Florida.

Over the next three decades, the eradication program was carried out first in Florida, then in the Southwest and eventually, in Mexico and beyond. Irradiated screwworm flies raised in Florida, Texas and Mexico were packed in boxes and released from small planes. At the program’s peak, upward of 300 million sterile flies were released weekly.

The impact was decisive. The last cases of screwworm in the United States were reported in 1982. By the end of 1985, most of Mexico was screwworm-free and the eradication program had moved on to Guatemala and Belize, now also free of the pest. This ranks as perhaps the greatest insect-control success story.

Now, the world is focused on the public health menace of the Zika virus. Zika is spread by Aedes aegypti, the same mosquito that transmits dengue, chikungunya
Mosquito-control efforts rely on insecticides and eliminating mosquito breeding places. But despite a relatively successful hemisphere-wide effort beginning in the 1940s, mosquitoes have roared back, becoming difficult to control because of growing resistance to insecticides.

Diseases carried by mosquitoes that were once relatively well controlled are re-emerging along with newer ones, including the West Nile and Zika viruses.

But there is a promising solution. Building on Dr. Muller’s legacy, scientists at a small start-up called Oxitec (now a subsidiary of Intrexon) endowed mosquitoes with a lethal gene that prevents development of their offspring. The pupae are sorted, and only the males are released.

Unlike irradiated mosquitoes, which don’t compete well with wild ones for mates, genetically modified mosquitoes mate just fine, passing on the lethal gene. Small-scale tests conducted in the Cayman Islands, Panama and Brazil since 2009 reduced local mosquito populations by as much as 99 percent.

So why aren’t we quickly gearing up production and beginning large-scale programs to release these mosquitoes?

It’s because the Oxitec mosquitoes are genetically modified organisms and subject to different regulatory oversight in different countries. In Brazil, for example, release of Oxitec mosquitoes has been approved by one government agency but awaits approval from another agency.

Despite its substantial expertise in insect control, the Department of Agriculture has regrettably not taken a role in helping navigate the regulatory complexities for this mosquito. So these insects are being regulated as a “new animal drug” by the F.D.A. The agency is now accepting public comments on Oxitec’s plan and will then evaluate each one before deciding whether to approve the Florida trial.

You get the picture. None of this happens fast.

Then there’s public opinion. More than 160,000 people signed a petition
opposing Oxitec’s trial in the Florida Keys, but most signed before the Zika crisis. In a recent Purdue University survey, 78 percent of respondents supported the use of genetically engineered mosquitoes to control the spread of the Zika virus.

The released male mosquitoes have no effect on people because males don’t bite. While we might wait years for a Zika vaccine, the genetically modified mosquito is tested, scalable and ready to go.

Zika looks more devastating with every new study. Are the stakes finally high enough to expedite an effective, hemisphere-wide mosquito eradication program that makes use of modern genetic modification techniques?

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