A sterile line of Aedes aegypti is developed to fight off arbovirosis

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Margareth Capurro, Professor at the University of São Paulo's Biomedical Science Institute (ICB-USP). Credit: Agência FAPESP

Transgenic males of Aedes aegypti with defective sperm have been created at the University of São Paulo's Biomedical Science Institute (ICB-USP) in Brazil and may be produced on a pilot scale next year. Alongside the development of vaccines, the production of genetically modified mosquitoes could become one of the most effective means of

combating epidemics of dengue, chikungunya, Zika and yellow fever.

"These GM males mate with wild females wherever they can, including places that aren't accessible to human action. Owing to the defect introduced into their sperm, the eggs that result from their mating are nonviable, and this helps reduce the population of A. aegypti," said Margareth Capurro, a professor at ICB-USP and principal investigator for the project based on the use of transgenic mosquito lines.

The development of the GM mosquito was funded by the São Paulo Research Foundation—FAPESP and the International Atomic Energy Agency (IAEA, the United Nations' nuclear watchdog).

"So instead of being appropriated by some private-sector company with a profit motive, it should be distributed free of charge by the U.N. to the 44 countries involved in mosquito control. I've also argued that it shouldn't be patented. The technology should be donated to any country that wants to use it."

Capurro stressed that this should not be the only strategy deployed to combat the diseases in question. It should be one of a battery of coordinated control measures ranging from education of the public to the development of vaccines, the use of larvicides and insecticides, and the adequate treatment of breeding grounds such as garbage dumps, tires and other water containers.

According to the FAPESP-supported researcher, Phase 1 of the project was completed with production of the mosquito in ICB-USP's laboratories.

"Next summer, we embark on Phase 2, consisting of field cage tests. The mosquitoes will be confined in large cages with an area of 3 square meters immersed in a natural environment. The aim is to find out

whether they can survive and mate in the presence of wind and rain. This is an important test, as genetic modification can induce undesirable traits as well as the traits of interest," said Capurro, who leads the research project.

Phase 2 will be conducted at Moscamed Brasil's biofactory in Juazeiro, Bahia State. This partner institution is a nonprofit established under the aegis of the IAEA's program to develop sterile strains of the Mediterranean fruit fly. The program has already inspired the creation of several biofactories to produce transgenic insects around the world.

Pilot-scale production

The mosquito's life cycle lasts 30 days. Phase 2 will involve the breeding of several generations and the evaluation of each one, so it will take six to eight months, approximately from September 2018 to March or April 2019. If all goes well, Phase 3 should begin in late 2019 or early 2020, seeing pilot-scale production of some 500,000 GM mosquitoes per week.

In this phase, a number of adjustments may be made to the product. The next step will be large-scale implementation of the strategy. To this end, the Juazeiro biofactory already has the installed capacity to produce 14 million GM mosquitoes per week.

"But production at Juazeiro or elsewhere depends on several logistical conditions, such as production cost, transportation cost, hiring and training qualified personnel, and so on," said Capurro. "I intend to deliver the technology ready for use to the Health Ministry and other ministries. They can set up a program to implement it if they see fit. The product will also be delivered to the U.N., so even if Brazil decides not to implement a program, other countries can do so."

Provided by FAPESP