

Mosquito population successfully suppressed through pilot study using nuclear technique in China

Aedes albopictus is the world's most invasive mosquito species. A successful pilot trial for controlling this insect pest recently concluded and the results were published in Nature on 17 July 2019.

(Photo: N. Culbert/IAEA)



For the first time, a combination of the sterile insect technique (SIT) with the incompatible insect technique (IIT) has led to the successful suppression of mosquito populations, a promising step in the control of mosquitoes that carry dengue, Zika virus and many other devastating diseases. The results of the recent pilot trial in Guangzhou, China, carried out with the support of the IAEA in cooperation with the Food and Agriculture Organization of the United Nations (FAO), were published in Nature on 17 July 2019.

SIT is an environmentally friendly insect pest control method involving the mass rearing and sterilization of a target pest using radiation, followed by the systematic area-wide release of sterile males by air over defined areas. The sterile males mate with wild females, resulting in no offspring and a declining pest population over time. IIT involves exposing the mosquitoes to the Wolbachia bacteria. The bacteria partially sterilize the mosquitoes, which means less radiation is needed for complete sterilization. This in turn better preserves the sterilized males' mating competitiveness.

While SIT, as part of area-wide insect management strategies, has been successfully used to control a variety of plant and livestock pests, such as fruit flies and moths, the control of mosquitoes still had to be demonstrated.

The main obstacle in scaling up the use of SIT against various species of mosquitoes has been overcoming several technical challenges related to producing and releasing enough sterile males to overwhelm the wild fertile population. Researchers at Sun Yat-sen University, and its partners, in China, have now successfully addressed these challenges, with the support of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, which is leading and coordinating global research in SIT.

For example, the researchers used racks to rear over 500 000 mosquitoes per week that were constructed based on models developed at the Joint FAO/IAEA Division's laboratories near Vienna, Austria. A specialized irradiator for treating batches of 150 000 mosquito pupae was also developed and validated with close collaboration between the Joint FAO/IAEA Division and the researchers.

The results of this pilot trial, using SIT in combination with IIT, demonstrate the successful near-elimination of field populations of the world's most invasive mosquito species, *Aedes albopictus* (Asian tiger mosquito). The two-year trial (2016–2017) covered a 32.5-hectare area on two relatively isolated islands in the Pearl River in Guangzhou. It involved the release of about 200 million irradiated

mass-reared adult male mosquitoes exposed to Wolbachia bacteria.

The study has also shown the importance of socio-economic aspects for the successful use of the IIT–SIT approach. Social acceptance, for example, increased during the study, as the support of the local community went up following mosquito releases and the resulting decrease in nuisance biting; for the IIT–SIT approach to be successful, the local community needs to be on board and work together to ensure the consistent and integrated use of the approach over the entire area in order to effectively counteract and control the movement of the insects. Another aspect is cost-effectiveness; overall future costs of a fully operational intervention are estimated at between US \$108 and \$163 per hectare per year, which is considered cost-effective in comparison with other control strategies.

Experts in China plan to test the technology in larger urban areas in the near future using sterile male mosquitoes from a mass-rearing facility in Guangzhou, said Zhiyong Xi, Director of the Sun Yat-sen University–Michigan State University Joint Center of Vector Control for Tropical Diseases and Professor at Michigan State University in the United States. The company operating the facility uses advanced mosquito mass-rearing and irradiation equipment that has been developed in collaboration with the Joint FAO/IAEA Division.

Global cooperation on the development of SIT to control mosquitoes intensified following the Zika epidemic in 2015–2016. The incidence of dengue is on the rise, with the number of cases reported to the World Health Organization (WHO) increasing from 2.2 million in 2010 to over 3.3 million in 2016. The actual incidence is much higher, and one estimate, according to WHO, indicates 390 million new infections each year.

— By Miklos Gaspar