Innovative Methods to Control Invasive Mosquitoes

Global warming has facilitated the spread of two invasive mosquito species, *Aedes albopictus* and *Aedes aegypti*, throughout the state. Invasive Aedes mosquitoes are vectors of Zika, dengue, chikungunya, yellow fever, and dog heartworm. These mosquitoes are not native to California, so they don't have a place in our natural ecosystems. Reducing or eliminating their populations will not harm native insect-eating animals.

Aedes mosquitoes exploit small and cryptic water sources and have shown resistance to many commonly used insecticides, limiting the efficacy of traditional control approaches. Invasive *Aedes* continue to spread throughout California, posing a daunting challenge for mosquito and vector control districts and a serious public health threat. Innovative methods of controlling these mosquito populations and limiting their abundance is very important.

STERILE INSECT TECHNIQUE (SIT)

This is an environmentally friendly insect control technique, in which sterile male insects are released to mate with the local population of females of the same species. Once the sterile males mate with local females, the resulting eggs will not hatch. When used for mosquito control, only sterile male mosquitoes are released because male mosquitoes do not bite and cannot transmit diseases to humans. Two forms of SIT involve Wolbachia and irradiation.

Wolbachia is a safe and natural bacteria that is found in up to 60% of insect species including butterflies, dragonflies, moths, and some mosquitoes. However, Wolbachia is not naturally present in the *Aedes aegypti* mosquito. Wolbachia can be used to reduce mosquito populations through SIT. If a female mosquito that does not have Wolbachia mates with a male mosquito that has Wolbachia, her eggs will not develop, and she will not produce any offspring. The release of male *Aedes aegypti* mosquitoes with Wolbachia will increase the likelihood of incompatible matings and thus reduce the local population of *Aedes aegypti* mosquitoes.

SIT was first developed in the U.S. and has been used successfully for more than 60 years by many agencies for a variety of insects including screwworms, moths, fruit flies and other agricultural pests. The Consolidated Mosquito Abatement District in Fresno County, in partnership with Verily and MosquitoMate, recently concluded a successful three-year pilot project called DeBug Fresno involving SIT to reduce populations of Aedes aegypti mosquitoes by 95% in various communities throughout the Central Valley.

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Irradiation involves the mass-rearing and sterilization of male mosquitoes using radiation followed by a wide release of the sterile males over defined areas. The irradiated males will mate with wild females resulting in no offspring and a reduction in mosquito populations.

- The California Department of Food and Agriculture (CDFA) successfully utilized this method to control Mediterranean fruit fly infestations in citrus and other fruit trees.
- The United States Department of Agriculture (USDA) has also had tremendous success using SIT to control screwworms, a devastating cattle pest.

EMERGING RESEARCH

Genetic Modification of Mosquitoes is being led by the British company Oxitec whose Friendly™ mosquitoes carry a self-limiting gene. This means that when Friendly™ mosquito males mate with wild females, their offspring inherit a copy of this gene, which prevents females from surviving to adulthood. Since these females do not mature to reproduce, there is a reduction in the wild pest population. This method can be applied to a variety of pests ranging from mosquitoes that transmit disease to other insects that can damage crops. Genetic methods of mosquito control are being tested in some areas of the U.S. but are not currently being tested in California.

ADDITIONAL RESOURCES

- Sacramento-Yolo Mosquito and Vector Control's Frequently Asked Questions about SIT
- Information about Verily and how DeBug works
- Detailed Wolbachia information from the National Environment Agency
- World Mosquito Program video on Wolbachia
- What is Wolbachia video from the Greater Los Angeles Mosquito & Vector Control District
- Singapore Wolbachia suppression study
- International Atomic Energy Agency (IAEA) on irradiation and sterilization in male mosquitoes
- Oxitec's Friendly™ Technology

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