Computer Simulation of Genetically Modified Aedes aegypti Release Methods

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It is hypothesized that variable release methods for genetically modified Aedes aegypti will control wild mosquito populations using the least number of modified mosquitoes. Aedes aegypti mosquitoes are largely responsible for the spread of Dengue Fever, Chikungunya, and Zika virus. Genetically modified male Aedes aegypti have been developed which produce non-viable offspring. Field trials have been done in several locations and are planned in the United States. One of the critical issues is determining the best release method which controls the wild mosquito population and minimizes the use of the limited supply of modified mosquitoes. A computer program was written in C++ to simulate an environment containing humans, wild mosquitoes, and genetically modified mosquitoes under varying conditions. The simulation compared favorably with known field data from Juazeiro, Brazil. All the variable release methods tested produced a statistically significant 95% reduction ($p<0.001$) in wild mosquito population. A slower changing release method with a minimum release number allowed for a late increase in the wild mosquito population. A more rapidly adjusting method without a minimum release number produced a rapid decrease but allowed for a large rebound in wild mosquitoes. The rapidly adjusting method with a minimum released controlled the wild mosquito population while using 17% and 19% less genetically modified mosquitoes in dry and wet conditions respectively ($p<0.001$). The hypothesis was supported by this study as one variable release method based on measured data reduced the quantity of genetically modified mosquitoes needed while maintaining suppression of wild Aedes aegypti mosquito populations.

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