Genetically Engineered Mosquitoes: Panacea or Pandora's Box

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Mosquitoes are a very important vector in transmitting certain diseases to humans. According to Hoddle, mosquitoes are capable of spreading the human diseases yellow fever, dengue fever, and malaria. Today, many scientists are focusing on the prevention of malaria and yellow fever. They believe the solution to possibly ridding the world of these diseases to be genetically engineered mosquitoes. The creation of genetically engineered mosquitoes, however, can be proven to bring about more problems and possibly turn into the biologist's Pandora's box instead of being a panacea.

The research that has given scientists hope was conducted by Marcelo Jacobs-Lorena and his co-workers at Case Western Reserve University, Ohio. Jacobs-Lorena and his team had succeeded in the prevention of the transmission of malaria amongst mice (Milius 324). Their research consisted of finding an amino acid that would stay affixed to the mosquito's gut lining and salivary gland wall to decrease the number of parasites that cause malaria. This process has yet to be tested, however, on the human parasites of malaria transmitted by mosquitoes and causes this research to be misleading to the community.

There are actually a myriad of concerns from the scientific community towards transgenic mosquitoes. Some scientists believe that the transgene inserted into the mosquitoes may enlarge "the ability of mosquitoes to transmit other pathogens, such as viruses" (GM 7). Another concern of scientists is that the transgene may be passed on to other insects and possibly harm their populations. It has also been said that the parasites that cause the disease may build a resistance to the transgene block (7).

A meeting of scientists in the Netherlands devoted time to discussing the prospect of genetically engineered mosquitoes and their positive and negative points. Many controversial topics were brought up at the meeting. One of the topics discussed was if the transgenic mosquitoes would be capable of finding mates in their natural habitats (Enserink). The ecologists there also questioned the amount of time it would take for the resistance gene to transfer among the mosquitoes and if it will be entirely effective with each transgenic mosquito (Enserink). According to Bo'te and Koella, the transgenic mosquitoes would not make a noticeable difference in the transmission of malaria if the resistance gene was not fully effective with each transgenic mosquito (Enserink).

Some of the other participants of this scientific gathering had other topics that they thought were important too. One of these was concern as to whether the species in an area with multiple vectors for the malaria disease would need to all be converted to transgenic mosquitoes or not (Enserink). Another topic brought up was what to do if the parasites started to develop resistance to the genes and if the use of multiple antiparasite genes could be used to prevent the resistance development (Enserink).

To research and find the answers to all of these questions, extensive field research would be needed. The process of doing so is complicated though because to do such research, scientists would need an isolated area where the mosquitoes could not escape (Enserink). Field research to discover the answer to the aforementioned questions would have many safety standards to meet because the tests could end up affecting people who did not agree to take part in the research (Enserink).

Outside of this conference, the fitness of a genetically engineered mosquito is another topic discussed among scientists. A genetically engineered mosquito's fitness can

be affected by the:

> type of transgene inserted, placement of the novel material within DNA and associated mutations of interruption of functional gene sequences, and founder effects resulting from inbreeding between small numbers of transformants when establishing newly transformed lines. (Hoddle)

An example of decreased fitness is shown in a study of the *Anopheles stephensi,* a vector of human malaria. During this study, there were genetically engineered mosquitoes caged to encourage breeding with non-transgenic mosquitoes. The results showed that the frequency of the transgenic alleles either decreased in amount or disappeared entirely (Hoddle).

Another study that displays a decrease in fitness among transgenic mosquitoes was carried out with the *Aedes aegypti,* a known vector of yellow fever. The fitness of transgenic *Ae. aegypti* was compared to the fitness of non-transgenic *Ae. aegypti* for this study. The transgenic *Ae. aegypti* was found to have a considerably lower fitness than the non-transgenic *Ae. aegypti* by researchers at the University of California Riverside (Hoddle). An example of this decrease in fitness is a lowering of the fertility rate of the transgenic mosquitoes. When comparing the survival rates of the mosquitoes, the non-transgenic *Ae. aegypti* had a chance of survival from egg to adulthood ranging from 17 to 64 percent of the time and the percent range for the transgenic *Ae. aegypti* was from 0 to 23 percent (Lovekin). The genetically engineered line of *Ae. aegypti* were noticeably out competed by the non-transgenic line of *Ae. aegypti* when comparing the rates at which their populations reached their carrying capacities (Hoddle).

Consequently, molecular biologists are now trying to develop a transgenic

mosquito that can perform better in nature than the non-transgenic mosquitoes (Hoddle). This “super” mosquito may have its positive aspects, but it also has negative aspects. For example, if the transgenic “super” mosquito is superior to the non-transgenic mosquito than it could possibly produce faster. The increase in mosquitoes with a higher fitness could definitely pose a problem for the world. The populations could possibly grow to a point where they could no longer be properly impeded by the mosquito control centers.

If for some reason the genetically engineered mosquitoes happened to run amok, there would have to be a mass uprising against them. Even though the transgenic mosquitoes would not be able to transmit the diseases malaria and yellow fever, they would still be a rather large nuisance to the world. The mosquito control centers would have to put up a large force to decrease the population of the genetically engineered “super” mosquitoes. Therefore, if the mosquitoes were not monitored properly, it would take a long time to make a dent in the size of the populations of the genetically engineered mosquitoes.

The thought of mosquitoes genetically engineered to not transmit the human diseases yellow fever and malaria is a comforting one, but still has a lot of problems to address. In order to solve the many problems mentioned throughout, a lot of dedication, time, and funding will be needed from the scientific world. Many questions will need to be answered before transgenic mosquitoes are thought of differently and fully supported. Genetically engineered mosquitoes are not a panacea then but in actuality, the biological world’s Pandora’s box waiting to be opened.

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