The Potential and Problems of Gene Drive Technology

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Introduction

Gene drives are an incredible new tool currently being developed in biotechnology. This technology enables researchers to release organisms into nature that can genetically engineer one another, spreading a desirable trait throughout a population within a couple of generations, completely suppressing an undesirable trait within a population, or destroying an invasive population completely (Noble, 2017). This technology is a revolutionary process that has incredible potential in many areas of our society, including public health, agriculture, and the environment. Gene drive technology has the potential to reduce or eliminate insect-borne diseases, invasive foreign species, and even potentially reverse the development of resistance to insecticides and herbicides (Champer, et. al, 2016). Researchers have already started using this technology in a laboratory setting to create malaria-free mosquito populations, pest-resistant crops, and disease-free rat populations.

Research Question

Is gene drive technology safe to use in the environment? Do the benefits of this technology outweigh the potential costs?

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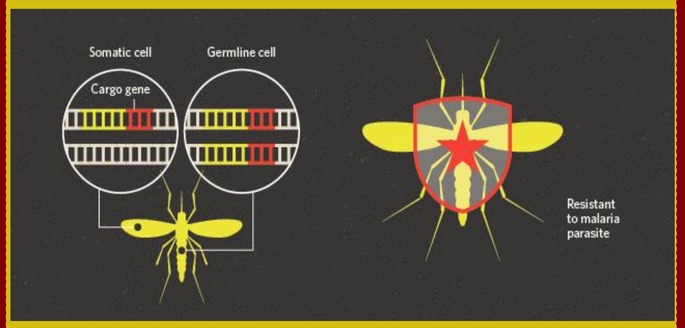
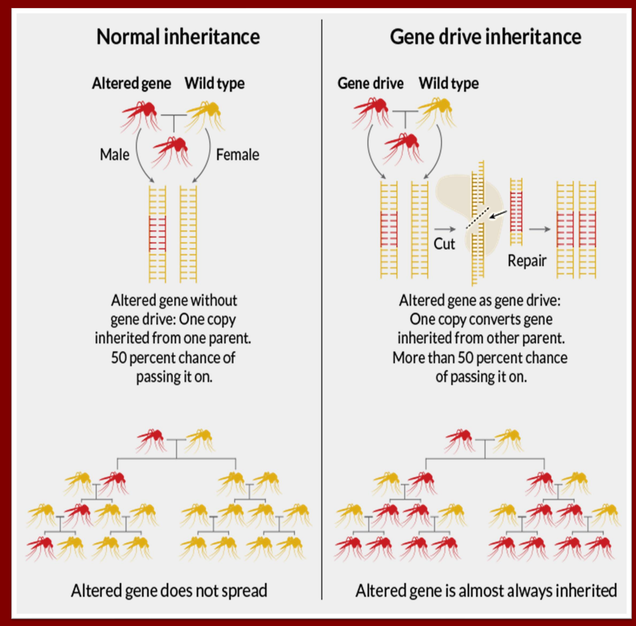
Background and Literature Review

Gene drive technology is based on the concept of selfish genes, which are naturally occurring genes that are increased in heritable frequency with each generation no matter if they hold an evolutionary advantage for the population (Champer, et. al, 2016). Scientists are using this naturally occurring phenomenon to create gene drives along with the gene editing tool CRISPR to alter the genes within an organism that would be more beneficial to spread within a population. Currently, there are multiple methods of gene drives, including homing-based drives, sex-linked meiotic drives, Medea, and underdominance drives. Gene drives have only been used in a laboratory setting with an emphasis on mosquito populations. The research scientists have conducted using these methods showcases the amazing potential of this technology despite its limitations. For example, a study using homing-based drives has been done in A. stephensi which successfully spread an antimalarial antibody within this mosquito population (Noble, 2017). Even though this study did have some complications, it demonstrated the amazing potential of this technology and its potential applications within the environment.



However, despite the immense benefits this technology may provide, there are many who believe this technology is dangerous and should not be used outside of the laboratory. There are many ecological and environmental considerations researchers must examine including the possibility of horizontal gene transfer, in which a modified gene may move to a completely different species, and gene flow, in which a modified gene may move to a different population from the target population (Gene Drives on the Horizon, 2016). This could result in detrimental effects for an ecosystem and may have long-lasting affects within the environment.



Method

- To answer these questions, I will be using a multi-case study design.
- I plan on limiting my research to focus only on experiments using gene drives on mosquito populations.
- I will focus on the data from at least 5-7 different experimental results within peer-reviewed articles. These articles will be collected from the university library database.
- I will examine the data collected from each of these experiments and make conclusions on what this data suggests about the effectiveness and safety of gene drives.

Expected Results

The expected result of this study is that though this technology has incredible potential more research must be done before it can be used on wild populations in order to improve its safety and identify all of the potential issues hidden within this technology. Most experiments using this technology have experienced some success but have also experienced issues with the transfer of genes within the study population and other populations.

Significance

This technology has incredible potential to eliminate insect-borne diseases, reduce pests found within our agriculture, and reduce the spread of invasive species. This topic is important because of all the potential it has to benefit our society. The main goal of this study is to bring awareness to this amazing technology and promote more research being done so that one day this technology can be used within our environment to potentially eradicate mosquito-borne diseases.

References

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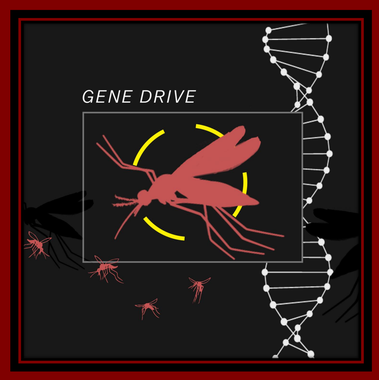

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