M.L. 2016 Project Abstract
For the Period Ending December 31, 2022

PROJECT TITLE: MITPPC Sub-project 9: Genetic Control of Invasive Insect Species: Phase II
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APPROPRIATION AMOUNT: $55,100
AMOUNT SPENT: $55,100
AMOUNT REMAINING: $0

Sound bite of Project Outcomes and Results

Genetic biocontrol provides a non-toxic approach to control invasive pests. The Smanski lab pioneered a version of this technology for relatives of spotted wing drosophila. They demonstrated the feasibility and robustness of the technology in laboratory environments and explored strategies to ensure environmental safety.

Overall Project Outcome and Results

Recent advances in high-precision genome engineering are enabling a new class of pest-control strategies wherein the pest organism itself becomes the basis of control. The idea is to release genetically engineered males of the pest species into the environment, where they would compete with wild males to mate with wild females. The females they mate with would not have any surviving offspring, and the population will crash. This approach, termed Genetic Biocontrol, is the focus of this research project. In this phase of the project, the Smanski lab tested the performance of their technology in relatives of spotted wing drosophila in controlled laboratory environments that were designed to mimic the outside environment.

Overall, all goals described at the start of this project were achieved, but not necessarily via the route we described in the original proposal. Our goal for Activity 1 was to determine the robustness of hybrid lethality (arising from mating of a biocontrol agent and wild type) in diverse environments. Every strain of biocontrol agent that we studied had a temperature-dependent activity that could be readily observed. Our goal for Activity 2 was to confirm the molecular mechanism for hybrid lethality. We confirmed that it is lethal ectopic (wrong tissue) expression of our target developmental genes, or lethal overexpression of our target developmental genes, depending on the specific genetic design. Our goal for Activity 3 was to develop a simulation model to predict how the performance of genetic biocontrol was impacted by the presence of resistance genes in the target population. We developed nuanced strategies to mitigate this effect based on the modeling results. Our results from Activities 2 and 3 have been published in peer-reviewed journals, and our results from Activity 1 will lead to two new manuscripts submitted in the next 6 months.

Project Results Use and Dissemination

We have disseminated our results through the normal channels available to academic labs (regional, national, and international conferences and workshops; peer-reviewed publications; patents; etc.). Publications to emerge from this work include three research papers published in 2022 (one in eLife and two in Frontiers in Insect Science). We anticipate two additional research papers from this phase of the project to be published in 2023. These manuscripts are in advanced draft (one) or draft (one) stage.

These studies significantly advance the development of genetic biocontrol technology. We intend to use the results for a workable management strategy for spotted wing drosophila. Significant work remains to address efficacy and regulatory concerns before flies would ever be released into the wild. However, the findings also have spin off uses for the management of other invasive insects.