



RESEARCH PROGRAM - FINAL PERFORMANCE REPORT  
 PLEASE COMPLETE AND EMAIL REPORT TO:  
 MDARD-CRAFTBEV@MICHIGAN.GOV

The completed Final Performance Report will be posted to the AMS website.

## FINAL PROJECT REPORT TEMPLATE

Final Performance Reports must illustrate the completion of the project within the grant agreement.

### PROJECT INFORMATION

<b>Project Title</b>	Advancing Sterile Insect Technique in Codling Moth by Investigating Release and Capture Methods			
<b>Recipient Organization Name:</b>	Michigan State University			
<b>Period of Performance:</b>	<b>Start Date:</b>	5/1/2021	<b>End Date:</b>	12/31/2021
<b>Recipient's Project Contact</b>				
<b>Name:</b>	Matthew J Grieshop			
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## PERFORMANCE NARRATIVE

### PROJECT BACKGROUND

*Provide enough information for the reader to understand the importance or context of the project. This section may draw from the background and justification contained in the approved project proposal.*

Hard cider production is a rapidly growing sector of the MI Craft Brewing industry that relies on MI apple production. Codling moth is the number one insect pest of apples worldwide with pest management traditionally accomplished with broad spectrum neurotoxic insecticides. Alternative management strategies are important because of regulatory changes to available chemistries, insecticide resistance and consumer desire for products with low to no insecticide residues. Sterile Insect Technique (SIT) for codling moth is a pest management tactic that can reduce the need for insecticide applications and has been successfully applied in the Pacific Northwest (PNW). However, monitoring SIT moth activity in Michigan orchards has proven difficult and little information is available on best SIT moth release practices. For Michigan apple growers to adopt this sustainable tactic these knowledge gaps must be filled. Our project met the MCBA priority of improving control of insects and diseases.



Our project represents one part of a much larger research effort. The project team has received funding from the Michigan Tree Fruit Commission to evaluate SIT in Michigan orchards in the 2020 and 2021 field seasons. Funding from the MTFC was used to conduct large scale evaluations of SIT efficacy in Michigan Orchards located in the fruit ridge, the Northwest and Eastern lower peninsula apple producing regions. The project team also has active collaborations with researchers located in Washington state who are also evaluating how release strategies affect the success of SIT codling moth.

Our project addressed two important aspects of SIT. The first was evaluating lures for monitoring both male and female SIT moths in Michigan. This will allow growers to evaluate whether moths are active and “doing their job” and 2 determining optimal release methods for MI orchards of varying scales.

## ACTIVITIES PERFORMED

*Address the below sections as they relate to the entire project’s period of performance.*

## OBJECTIVES

*Provide the approved project’s objectives from your approved proposal/grant agreement.*

#	Objective	Completed?	
		Yes	No*
1	Determine optimal lure/s for monitoring SIT codling moth in mating disrupted and non-mating disrupted Michigan apple orchards.	XX	
2	Determine optimal release strategies for SIT codling moth for multiple scales of Michigan apple orchards. Hypothesis: Recapture of SIT codling moths will be highest and distribution most even for self-released moths, intermediate for moths scattered in trees and lowest for moths scattered on the ground.	XX	
3			
4			

*\*If no is selected for any of the listed objectives, you must expand upon this in the challenges and lessons learned sections.*

## ACCOMPLISHMENTS

*List your accomplishments for the project’s period of performance, including the impact they had on the project’s beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project’s objective(s), outcome(s), and/or indicator(s).*



#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
1	<p>Completed a replicated field experiment evaluating the response of wild and sterile codling moth to 6 lures on cooperating farms. We evaluated lures based solely on codling moth sex pheromone (codlemone) as well as lures that combined sex pheromones with other semiochemicals (pear ester, acetic acid, dimethyl nonatriene, and pyranoid linalool oxide.). The experiment was replicated at three sites and run over 5 weeks. Moths were released weekly in a block containing traps baited with six different lures.</p>	<p>Our study showed that none of the lures caught females at an appreciable level (&lt;0.2 females/trap/week) and that the pheromone only lures performed most consistently over time. Lures containing only pheromone or pheromone with just pear ester ester performed numerically better than lures composed of pheromone plus multiple plant semiochemicals. Lures combining pheromones with plant semiochemicals showed an improved capture of males early in lure lifespan.</p> <p>Our data provide further evidence that wild codling moth in MI do not respond to semiochemical blend lures in a manner like those in the pacific Northwest. This is meaningful for the question at hand: evaluating the fitness of SIR releases but also important because growers often purchase semiochemical blend lures in the hopes of capturing females as well as males. Based on our study we would suggest that growers in non-mating disrupted orchards continue with pheromone only lures but growers in disrupted orchards should continue using pheromone + pear ester lures.</p>
2	<p>Completed a replicated field experiment evaluating how release technique of sterile codling moth on cooperating farms. We evaluated moths released on the ground (the standard method), “sprinkled” into the canopy, or allowed to self-release from paper “lunch” bags that were hung in the lower free canopy. The experiment was replicated at three collaborating grower sites and run over 4 weeks.</p>	<p>Our study showed that there were no clear differences in recapture of SIT moths whether self-released, released in trees, or released on the ground. Moths released in trees were recaptured at a numerically higher rate than moths released on the ground or self-released. Thus, growers choosing to hand release moths could use whichever strategy that best fits their needs and limitations.</p> <p>This finding is especially meaningful to growers attempting SIR over smaller extents (i.e. &lt;50 acres) or in individual blocks. Growers applying SIR to large blocks may still want to use UAV-based applications due to labor constraints.</p>



#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
3		
4		

### CHALLENGES AND DEVELOPMENTS

*Provide any challenges to the completion of your project or any positive developments outside of the project's original intent that you experienced during this project. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objectives, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column.*

#	Challenge or Development	Corrective Action or Project Change
1	Loss of one of the project co-PIs. Dr. Larry Gut passed away in early September.	Dr. Matt Grieshop replaced Dr. Gut's role in the project.
2	Dr. Matt Grieshop is resigning from MSU in January 2022	Final project report prepared in advance of resignation.
3		
4		

### LESSONS LEARNED

*Provide recommendations or advice that others may use to improve their performance in implementing similar projects.*

Researchers evaluating SIR should be sure to break processes down when evaluating this technique. The experiments for both projects succeeded to a large extent because they asked simple questions with immediately observable outcomes. In this case these outcomes were whether we recaptured moths released at a known density and time. While these questions don't immediately answer "does SIR work?", they do answer smaller questions which allow us to make inferences on how SIR functions and how best to monitor it.

In contrast, the research team had several other SIR projects (independent from the MCBC work) that attempted to evaluate the "success" of SIR that were largely inconclusive. These projects required large plots (10 acres +) with a lot of inherent heterogeneity. In addition, we experienced massive crop losses at many of our research sites which made it impossible to evaluate the impact of SIR releases on codling moth management success. The lesson we learned from comparing these two projects is: Ask simple questions with definite answers in a manner that allows adequate replication. The simpler the question the less replication is needed!

### CONTINUATION AND DISSEMINATION OF RESULTS (IF APPLICABLE)

*Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results.*

This project is complementary to projects funded by MSU project GREEN, the Washington Free Fruit Commission and the Michigan Tree Fruit Committee. We have presented project outcomes at the Great Lakes Fruit and Vegetable Expo with additional presentations to be made at the Orchard Pest and Disease Conference in Portland Oregon and the 10<sup>th</sup> Annual



Integrated Pest Management Symposium in January-March 2022. These data will also be incorporated into the project MS student (Meagan Andrews) thesis and developed into scholarly publications.

With the untimely loss of Dr. Larry Gut and Dr. Matt Grieshop's resignation from MSU it is not clear if the project will continue beyond May of 2022, when the project graduate student graduates.

However, project outcomes are being shared widely and will contribute to SIT research efforts in the Pacific Northwest. MSU is in the process of hiring a new tree fruit entomologist and they may also continue research in this area.

**BENEFICIARIES**

**Number of project beneficiaries:**.....775 Michigan Apple Orchards

**ADDITIONAL INFORMATION**

*Provide additional information available (i.e., publications, websites, photographs) that is not applicable to any of the prior sections.*

**PLANNED AND COMPLETED PRESENTATIONS:**

Andrews, M. Gut, L., Grieshop, M. 2021. Performance of pheromone and combination lures for monitoring codling moth in MI and WA. 2021 Great Lakes Fruit and Vegetable Expo. Grand Rapids, MI. December 7-9, 2021.

Andrews, M. Gut, L., Grieshop, M. 2022. Do sterile females contribute to population suppression? *Lessons from codling moth sterile insect release*. 2022 Orchard Pest and Disease Conference. Portland, Oregon. January 11-13, 2022.

Andrews, M. Gut, L., Grieshop, M. 2022. Comparing codling moth lures in WA and MI using sterile insects. 10<sup>th</sup> Annual IPM Symposium. Denver Colorado, February 28<sup>th</sup> to March 3<sup>rd</sup>, 2022.



*Figure 1: Self release device for SIT codling moth*



*Figure 2: Codling moth marked with flourescent powder (R) and unmarked (L)*

The Authorized Individual must sign this statement after the applicable report form is completed.

I certify that the statements and information contained in these documents are true, accurate, and complete.



Signature of Responsible Official:

Date:

A handwritten signature in black ink, consisting of several fluid, connected strokes.

01/10/2022