Proposal for Nursery Research Grant Program 2025 Request

Title: Development of the pheromone-based control of thrips for nursery crops

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Project Background: Thrips have hundreds of host plants, including many ornamental and nursery crops. One of the most economically significant pests is the western flower thrips (WFT), *Frankliniella occidentalis* which is tiny body size (< 3mm). Its significant damage to greenhouse, horticultural, and nursery crops makes it a significant concern for growers. Not only direct damage from feeding on flowers and fruits, they also transmit tomato spotted wilt virus (TSWV) that is economically the most important. In 2019, horticultural products were sold for a total of $13.8 billion in the United States. In Oregon, nursery products were the state's most valuable commodity, valued at $1.2 billion, and employed 15,000 across the state. Current control for thrips primarily relies on chemical insecticides despite causing potential negative effects to human health and environmental degradation as well as development of insecticide resistance. Therefore, there is a strong need to develop environmentally friendly alternatives for thrips control.

Plant volatiles and pheromones are known as green chemicals: 1) highly species-specific; 2) no effect on non-targets, including beneficial insects; 3) no effect on human health and the environment; 4) no development of potential insecticide resistance. Thrips pheromones can be easily used to control and monitoring thrips populations in the greenhouse and field. However, since the two aggregation pheromone components, lavandulyl acetate (LA) and (Z)-neryl (S)-2-methylbutanoate (NMB), have been identified, the attraction with the two pheromones for thrips is not significant for attracting thrips. They are not used practically for thrips control.

Results from Previous Research: We identified **1)** eight volatile compounds, including the two known aggregation pheromones (LA and NMB), from WFT male adults. The six components had not been previously reported and were not detected from WFT female adults (**Figure**). The preliminary results showed the additional components for thrips attraction. We hypothesized that these components are missing for the thrips pheromone and must be included for the thrips pheromone. In addition, we first identified the pheromone biosynthetic pathway for the two pheromones in WFT, which is essential for the pheromone research in thrips (2023, *https://doi.org/10.1038/s41598-023-32833-9*).

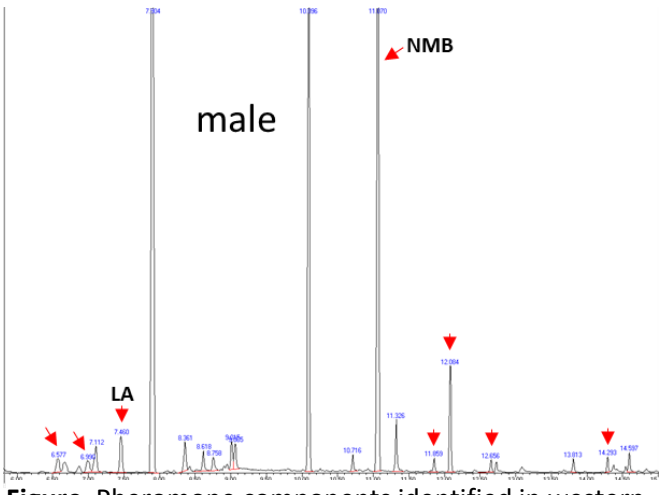

Figure. Pheromone components identified in western flower thrips males and females. Red arrows indicate newly identified pheromone components (data not released until IP protected).

2) the recently obtained results were submitted for a new invention disclosure for the USDA patent application (USDA Docket No. 0069.24), and the USDA-ARS technology committee recommended a patent application. The results, which include new pheromone components and novel analytical method to identify the pheromones in other thrips species. Dr. Choi also submitted a proposal to

the USDA 2025 Innovation Fund program to develop a practical application.

Projective Objectives and Outcomes: Since the two thrips pheromones, LA and NMB, are not available for practical use, the current WFT attractants are synthetic chemicals that are not derived from the thrips and are not WFT-specific pheromones. Therefore, we need to identify the complete pheromone components and their compositions for the thrips. Based on the previous results, in this project, we are focusing on the compositions of the new pheromone components, which is the pheromone formulation for the thrips. To achieve this goal, the following specific objectives need to be continued in this project:

1. Pheromonal activity of each component on thrips.

2. Determine optimal pheromone compositions for thrips in the greenhouse.

Pheromones offer significant potential for addressing modern challenges in pest management strategies. They are clearly safe for human and environmental health, and highly specific. The use of pheromones represents a potential approach for thrips control tools such as mass trapping, bait-based, and population monitoring in the field. Therefore, successful results from this study will add a biologically based green chemicals for thrips control and would be significant for thousands of growers and stakeholders in the nursery and horticulture industry.

Methods and Timeline

1. Pheromonal activity of each component on thrips (0.5 yr): The choice test will be conducted using a Y-tube olfactometer or an apparatus of a similar design. The transparent Y-tube glass will consist of a 100 mm stem with two 80 mm arms separated by a 45° angle. The inner diameter of the Y-tube is 10 mm. The two arms will be supplied with humidified air filtered through activated carbon. All behavioral tests are conducted in a dark room under infrared light (1000 lx illumination) at 25 ± 1°C and 65% relative humidity. In each run, 50 adults will be placed at the bottom of the stem tube. Test insects or compounds will be placed on one side of the arm tube. The duration of each run is 10 minutes. Positive insects are defined as those that pass more than 60 mm from the bifurcation. Each treatment will consist of four replicates, with the installation position of the test insects changed between two arms in each replicate.

2. Determine optimal pheromone compositions for thrips in the greenhouse (0.5 yr): To the greenhouse experiment, we will use two results that the ratios (w/w) of pheromone components identified in WFT adults and the results from the laboratory test. Different pheromone mixtures with different compositions of pheromone components will be dissolved in hexane and added to be absorbed in rubber septa. The rubber septa will be attached to a sticky trap and will be placed at 3m intervals from each trap in the nursery greenhouse. PI Dr. Choi has over 30 years of experience in insect pheromone research, which includes identification of a variety of sex pheromones in moths, aphids, and fire ants, and determination of pheromone biosynthesis mechanism and field application. Currently, Choi is working on the pheromone and field application for the winter armyworm.

Budget Summary:

Salary & Benefit[1]	Travel[2]	Materials & Supplies[3]	Total
$20,000	$1,000	$5,000	$26,000

[1]Salary & benefit (0.25 FTE = $15,000 + $5,000 = $20,000) for graduate research associate. [2]Support the postdoc travel for commission and/or entomological meetings ($1,000); [3]Synthetic pheromones and GC-MS supplies: synthetic pheromone components ($2,000), GC columns, vials, helium and hydrogen gases, Air ($1,000), Y-tubes ($1,000), traps and rubber septa ($1,000). The USDA base fund and other grants (submitted) will support this project.