

Pre-proposal for Oregon Department of Agriculture for Nursery Research (2020)

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Title: Development of biologically based thrips management for nursery crops

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Project Background and Justification: Several species of pest thrips have hundreds of host plants, including many ornamental and nursery crops, and vegetables in greenhouse and field. One of the most economically important pests is the Western flower thrips (WFT), *Frankliniella occidentalis*, owing to its serious damage on horticultural crops worldwide. Not only direct damage from feeding and oviposition on leaves, flowers and fruits, they also transmit tomato spotted wilt virus (TSWV) that is economically the most important.

Control method for thrips are mainly relied on frequent use of chemical insecticides. This repeat use of pesticides has led to the development of WFT resistance to major insecticide groups, residue problems on marketable crops, toxicity towards beneficial non-target organisms, contamination of the environment, and human health risks. Therefore, it is essential to develop appropriate management strategies which focus on environmentally friendly alternatives.

Advanced genomics/proteomics tools allow us to develop biologically-based molecular approaches, that offer new strategies for pest management. To develop molecular approaches for thrips control, molecular information is critical to identify effective biological targets to be applied for the thrips management. Therefore, we have investigated biological targets involved in RNAi and pheromone communication that can be used to develop biologically-based thrips controls.

Preliminary results: From our previous project we successfully completed the specific objectives: 1) Establish the lab colony of the Western flower thrips, and 2) Identify DNA marker(s) and potential biological targets for thrips. The WFT colony has been successfully established in the lab, and currently being maintained all life stages in USDA ARS facilities, Corvallis, OR. This is a great benefit to provide a stable WFT samples for the molecular work.

We identified an ITS gene in two WFT strains originated from Oregon and Korea, and compared nucleotide sequences. The result confirmed the sequences from two strains were almost same, that indicates the ITS gene can be used as a DNA marker for the molecular identification. In addition, we first identified one of the most important insect neurohormone genes from the thrips, that is Pheromone Biosynthesis Activating Neuropeptide (PBAN). PBAN is a family of neuropeptides to function pheromone production, muscle contraction, and diapause in various insects. In thrips, however, it has not been identified yet. The gene should be identified and characterized for thrips own biological function, that will be a great potential to develop a new strategy of thrips IPM.

Project Objectives: Based on our previous results, in this project we particularly focus on the PBAN and receptors as potential targets in the thrips, *Frankliniella occidentalis*.

Objective 1. Identify and characterize the PBAN gene in the thrips

Objective 2: Cloning and identify the PBAN receptor genes

Methods and Time Lines: PI and cooperator have expertise in specialized areas for insect genomics and proteomics including RNAi and pheromone (Choi), and thrips biology and IPM (Yun). Next generation transcriptome and pheromone analysis for thrips, spotted wing drosophila, slugs and moth species to identify biological targets are currently being conducted in PI's lab. Therefore, we are well-positioned to conduct all experimental procedures for the objectives.

Obj. 1. Identify and characterize the PBAN gene in the thrips (0.4 yr): Characterization of the PBAN gene is the most important to identify unique biological function(s) in the thrips. WFT biological samples will be collected from all life stages - egg, 1st and 2nd nymphs, pupa, adults (male and female separately) in the lab colony. Then, we will isolate mRNA from the biological tissues, and investigate the PBAN gene expressions in the life stages using PCR and/or quantitative real time PCR (qRT-PCR).

Obj. 2. Cloning and identify the PBAN receptor genes (0.6 yr): Another key factor required for the PBAN biological function is identifying the PBAN receptor(s) in the thrips. Over 20 years PI has experienced insect PBANs and receptors in various insect groups, and identified these genes involved in different physiological functions including pheromone production. Total RNA will be isolated from the whole body and central nervous tissues to identify the receptor gene(s). Genomic and RNA sequencing data mining will be also analyzed and used to identify target genes and potential biological targets.

Budget summary:

Salary ¹	Travel ²	Materials & Supplies ³	Total
\$15,300	\$500	\$4,200	\$20,000

¹Salary (0.3 FTE = \$15,300) for research associate level. ²Support the postdoc travel for commission and/or entomological meetings; ³Molecular biology materials & supplies, and thrips rearing materials (\$4,200).

Benefit to Nursery Industry: Oregon has a variety of nursery crops in greenhouse and field. Management of thrips under biological controls is one of top research priorities from nursery growers. Target genes of the WFT proposed in this project will be a great potential to approach molecular and biological tools including RNAi and pheromone application. The impact of developing a biologically-based thrips control, which is a chemical pesticide alternative, would be significant for thousands of growers and stakeholders in the nursery and horticulture industry. Thus, outcomes of this research are expected to address fundamental requirements for the application of biological tools for controlling other thrips.