Enhancing Biological Control to Stabilize Western Orchard IPM Systems

Vincent Jones, Jay Brunner, David Horton[1], Thomas Unruh[1], Elizabeth Beers, Karina Gallardo, Jessica Goldberger[2], Nick Mills[3], Peter Shearer[4], and Steve Castagnoli[4]

Washington State University Tree Fruit Research and Extension Center, Wenatchee, WA
[1]USDA-ARS Wapato, WA
[2]Washington State University, Department of Community and Rural Sociology
[3]University of California at Berkeley, Department of Environmental Policy Management
[4]Oregon State University Mid-Columbia Agricultural Research and Extension Center, Hood River, OR

Introduction

This poster gives an overview of our recently funded five year, $2.24 M CSREES Specialty Crops Research Initiative (SCRI) project. The project is a collaboration between specialitists from entomology, economics, and sociology. We also have an advisory panel to help guide the research and ensure that our outreach component is clear, comprehensive, and targeted to our stakeholders appropriately.

The Problem

Western orchard systems (apple, pear, walnut) all share the codling moth as their most serious pest. With the changes in codling moth management dictated by the restrictions on azinphosmethyl and its eventual elimination in 2013, new pesticide choices and mating disruption are changing the IPM landscape. Newer management programs can provide good direct control of codling moth, but secondary pest outbreaks are becoming more common. These outbreaks result from pesticide-induced disruption of natural enemies that help stabilize IPM programs.

The Goals

1) Improve the long-term sustainability of the apple, pear and walnut industries in the western US by enhancing biological control of pest insects and mites.

2) Synthesize the information developed in this project along with existing information to provide the outreach tools needed to bring about change in grower practices.

Objectives

1) Evaluate the sublethal effects of newer pesticides on key natural enemies in apple, pear, and walnut orchards

2) Characterize the phenology of key natural enemies so that spray impacts on natural enemies can be minimized

3) Evaluate attractants for natural enemies to improve monitoring and help evaluate pesticide impacts on natural enemies

4) Develop methods to monitor predation of codling moth by generalist natural enemies

5) Conduct economic analyses to determine the long-term costs associated with IPM programs with and without various levels of biological control

6) Survey clientele to identify optimal ways for presenting information that will lead to quicker adoption of new technologies and synthesize existing and new information to provide real-time support for pest control decisions

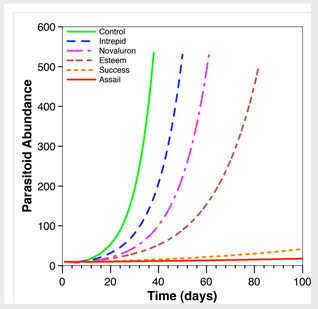
Advisory Panel

The advisory panel members are a key part of our team. Each member has agreed to help keep us focused on both high quality research and high quality outreach needed for stakeholder adoption.

State	Name	Affiliation	Rationale for Role
CA	**Mike Devencenzi**	Agricultural Consultants	Mike is a PCA heavily involved with walnut growers in the San Joaquin production area
CA	**Carolyn Pickel**	UC IPM Extension	Carolyn is Associate Director for Agricultural IPM and IPM advisor in the Sacramento Valley
CA	**Jed Walton**	private PCA	Jed is a private PCA working with walnut and prune growers in the Sacramento Valley
CA	**Dr. Marshall Johnson**	UC Riverside	Marshall is an expert in biological control and is responsible for tree crop extension in the San Joaquin Valley **(outside scientist)**
OR	**Rich Garvin**	Cascade Crop Care	Rich is a PCA with an interest in pear and apple IPM in the Hood River area.
OR	**Bruce Decker**	Wilbur-Ellis	Bruce is an IPM consultant who has been an active participant in outreach to growers.
OR	**Phil Van Buskirk**	OSU Extension	Phil is responsible for outreach to pear growers in the Medford area for pear IPM
WA	**Nick Stephens**	Columbia IPM	Nick is a PCA with apple, pear, and cherry clients and involved with industry education programs. He is on the pest management panel from the WTFRC
WA	**Dan Flick**	Wilbur-Ellis	Dan has been a PCA for 33 years. He is currently a commissioner on the WTFRC and head of the pest management research panel.
WA	**Karen Lewis**	WSU – Extension	Karen works with the tree fruit industry in a range of applications and is currently the head of the WSU Fruit Extension Team
WA	**Dr. Doug Walsh**	WSU Entomology	Doug is IPM coordinator for WSU **(outside scientist)**

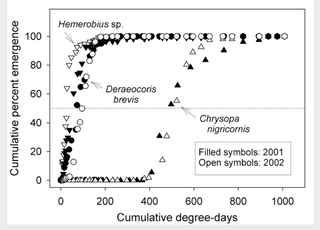
Sublethal Effects of Pesticides on Natural Enemies

Assays with newly registered pesticides will be used to assess their compatibility with the need to conserving natural enemies in orchards. The information is to be included in the economic analyses of competing IPM programs (Obj. 5) and will be incorporated into our web-based decision aid system (Obj. 6). When combined with phenology data, the information will allow us to design IPM programs that enhance biological control by minimizing disruption of the natural enemy community in orchards. Work in the Area-Wide II project provided some data and we will expand that work to newer materials and different natural enemies. The figure to the right shows the effect of five different pesticides on the growth rate of *Mastrus ridibundus*, a parasitoid of codling moth – data similar to what will be generated from this project and extended to stakeholders.



Natural Enemy Phenology

We will develop quantitative descriptions of natural enemy phenology in orchards, with specific objectives to determine the timing of appearance and reproduction in orchards. This information will be used to reduce pesticide-induced disruptions of natural enemy populations. We will use traditional monitoring methods (beating tray sampling, tree banding) and commercially available and experimental natural enemy attractants. Abundance data will be combined with temperature data to develop natural enemy phenology models similar to those depicted at the right, and then used to determine periods where pesticides will have minimal impact.

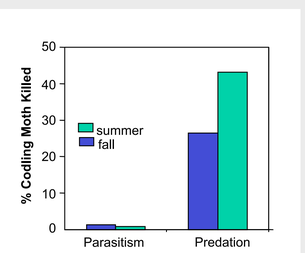


Natural Enemy Monitoring

Evaluating natural enemy population densities, diversity, and phenology are key components to designing IPM programs that conserve natural enemies. In effect, we will be using trap catch from attractant traps as as an indicator of the "health" of a given orchard and to determine the timings for insecticide applications that minimize natural enemy disruption. This year, we have begun the work and evaluated nine different compounds for natural enemy attraction and evaluated four different lure formulations for longevity under orchard conditions. One of our attractants has proven to be extraordinarily effective attractant for *Chrysopa nigricornis*, a major predator of pear psylla, aphids, and soft-bodied insects in apple and pear.

Monitoring CM Predation

Predators of codling moth are poorly known. Dr. Tom Unruh has data that suggests predation has a much larger role in codling moth mortality than parasitoids (figure right), but we are unsure of the natural enemy responsible. Work on this objective will take two directions: (1) the use of infra-red video monitoring of sentinel codling moth larvae to directly observe natural enemy activity, and (2) the development of molecular techniques to quantify predation frequency of candidate natural enemies. Knowing which natural enemies cause the most mortality will allow us to focus on which are important and improve timing or spray selection to reduce unintended impacts.



Economic Analysis

We will develop a model that will evaluate and compare the expected profits of using particular management systems developed in Objectives 1 and 6. This portion of the study attempts to address concerns that farmers have when contemplating the adoption of an alternative pest control strategy: (1) To what extent does biological control affect production costs and revenues? and, (2) Will the indirect advantages or disadvantages associated with competing programs influence farmers' willingness to adopt IPM?

Information Transfer

There are three sub-objectives to this area:

1) Survey clientele to identify optimal ways for presenting information, allowing quicker adoption of new technologies and improvement in rates of technology transfer to growers

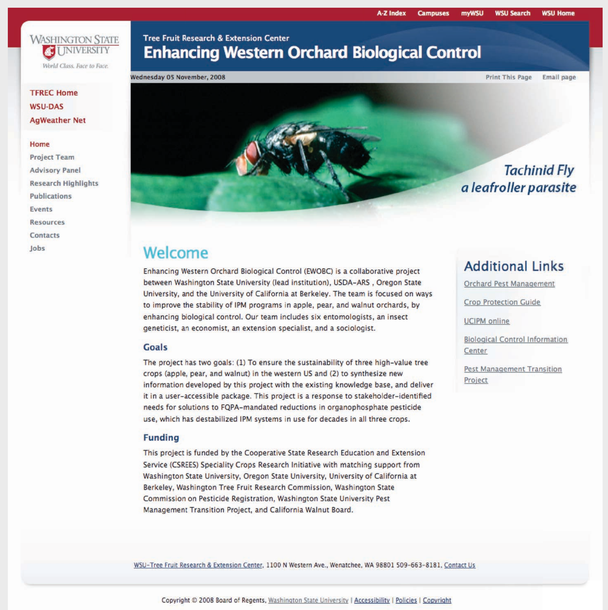
2) To synthesize existing information and information developed in this project into new IPM programs that will lead to enhanced biological control.

3) Develop an educational program for the industry to help adoption of newly developed IPM programs

After we determine optimal ways of presenting the information and synthesize the existing and new information developed in this project, we will develop the education program for the industry. It is likely that the information will be provided in multiple forms, depending on the industry (apple, pear, or walnut) and the state resources that are already in place. For example, in Washington, all the natural enemy phenology and pesticide effects information will be incorporated into the WSU-Decision Aid System (see other poster). We also expect that short courses in pest management, a Pest Management Leadership Training course, presentations at industry events, and field days will be used to extend information.

For More Information:

http://enhancedbc.tfrec.wsu.edu/



Matching Fund Sources:

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