Enhancing Biological Control to Stabilize Western Orchard IPM Systems

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Introduction

This paper 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 specialists 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 azinphos-methyl 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.
3) Characterize the phenology of key natural enemies so that spray impacts on natural enemies can be minimized.
4) Evaluate attractants for natural enemies to improve monitoring and help evaluate pesticide impacts on natural enemies.
5) Develop methods to monitor predation of codling moth by generalist natural enemies.
6) Conduct economic analyses to determine the long-term costs associated with IPM programs with and without various levels of biological control.
7) 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.

Objectives

1) Evaluate the sublethal effects of newer pesticides on key natural enemies in apple, pear, and walnut orchards.
2) Evaluate the compatibility of natural enemies with the new IPM programs.
3) Develop qualitative 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 depictd at the right, and then used to determine periods where pesticides will have minimal impact.
4) Develop educational programs for the industry to help adoption of newly developed IPM programs.
5) Develop a decision aid tool to help growers make decisions about the appropriate timing of pest control applications.

Matching Fund Sources:

We thank the Washington Tree Fruit Research Commission, California Walnut Board, Washington State University Agricultural Research Center, Oregon State University, University of California at Berkeley, Washington State Commission on Pesticide Registration, and Washington State Horticultural Association for their grants that provide matching fund support for this project.

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  | Role  |
--  | --  | --  | --  |
CA  | Mike Devencianni  | Ag Consultants  | Consultant  |
CA  | Carolyn Pickel  | UC IPM Extension  | Extension  |
CA  | Ted Nelson  | private PCA  | Extension  |
CA  | Dr. Marshall Johnson  | UC Riverside  | Extension  |
OR  | Rich Garvin  | Cascade Crop Care  | Consultant  |
OR  | Bruce Decker  | Wilbur-Ellis  | Consultant  |
OR  | Phil Van Buskirk  | OSU Extension  | Consultant  |
WA  | Nick Stephens  | Columbia IPM  | Consultant  |
WA  | Dan Hink  | Wilbur-Ellis  | Consultant  |
WA  | Karen Lewis  | WSU Extension  | Consultant  |
WA  | Dr. Doug Walsh  | Entomology  | Consultant  |

Sublethal Effects of Pesticides on Natural Enemies

Assays with newly registered pesticides will be used to assess their compatibility with the need to conserve natural enemies. In the orchards. It is planned 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).

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 will be critical in assisting our partners in 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 improvements 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.

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 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 been 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 prove timing or spray selection to reduce unintended impacts.

For More Information:

http://enhancdb.cfrrec.wsu.edu/