Western IPM Center

Project Report Form

How to submit: Please submit this completed form electronically, as an attached Microsoft Word file, to Jane Thomas at jmthomas@tricity.wsu.edu. If you have questions, contact Linda Herbst, (530) 752-7010. **Content:** Complete each section below, and include responses to as many of the questions listed in Attachment A as are relevant to your project. *These are guidelines.* Provide your readers with enough detail that someone who is not familiar with your project can understand what you were trying to achieve, how you went about it, and what you accomplished, but please keep it concise.

A. Report Data

Date: 9-25-09
Reporting Period: 7-1-06 to 6-31-09
Report Type (please check one):
☐ Progress Report ☒ Final Report

B. Grant Data

- Grant Agreement #: ORE00258
- Title: Effect of Primary Tillage Sequence, Insecticides, and Weed Seed Placement on
- Seed Predator Conservation, Efficacy, and Weed Emergence
- Grant Type: Research
- Lead investigator:
  - Name: Ed Peachey
  - Title: Asst Prof, Sen Res
  - Institution: Oregon State University
  - Address: Hort Dept, ALS 4017,Corvallis, OR 97331
  - Phone: 541-740-6712
  - Fax: 541-737-3479
  - Email: peacheye@hort.oregonstate.edu
- Team members (name, title, institution): Dan McGrath, Staff Chair, Linn County OSU Extension Office; Carol Mallory-Smith, Weed Science, Crop and Soils, OSU; Rick Boydston, USDA-ARS, Prosser, WA
- State(s) involved: OR, WA

C. Nontechnical Summary. An overview of the project, briefly outlining the problem(s), how your project addresses them, and your results, *written to a lay audience.* (500 words)

Weed seed predation by carabid beetles may be a significant cause of weed seed mortality in some agricultural fields. The potential to enhance carabid abundance and weed seed predation potential with tillage rotational systems and other cultural practices is poorly understood. Tillage kills both larval and adult carabid beetles, destroys their habitat, and buries weed seeds so that carabid beetles cannot find them. The objective of this project was measure the number of carabid beetles and the weed seeds they eat in farmers fields, and to develop and test conservation tillage sequence strategies that increase weed seed mortality by enhancing in-field habitat for ground beetles that eat weed seeds. The tillage-sequence treatments were designed to preserve habitat at critical life-stages for carabid populations, and synchronize weed seed availability with periods of high ground beetle activity.

The number of Carabid beetles found in fields varied greatly among farms and geographic regions over the 3 years of the study. Pterostichus melanarius was the most common beetle trapped, followed by Harpalus spp. Weed seed removal rates from seed stations attributed to carabid beetles ranged from 0 to 4 seeds/day in on-farm assessments. Carabid beetle activity and weed seed predation in conventional fields was similar to rates measured in organic fields. Some insecticides reduced carabid activity and weed seed loss from seed stations. Fields that were conservation-tilled (strip-tilled) typically had greater activity density and seed loss than fields that were conventionally tilled in the spring.

Results from an experiment at the Oregon State University Research Farm found that both spring tillage and insecticide use had a significant effect on carabid beetle activity. A vegetable row-crop rotation without spring tillage and soil applied insecticide had the greatest carabid activity. In another study where carabid beetles were confined by fences placed around the plots, survival of a common grass weed seed (wild-proso millet) was directly related to the number Pterostichus melanarius beetles present.

D. Objectives and Progress. List your objectives and describe your progress for each objective.

1. Survey the species diversity and estimate the activity-density and seed predation potential of adult ground beetle and seed bug populations in vegetable crop rotations (conventional and organic) in western Oregon and eastern Washington.
Experiments evaluated weed seed predation potential associated with carabid beetles at 18 farm sites in W. Oregon and the Columbia River Basin of Oregon and Washington. Carabid activity-density and species composition varied greatly among farms and geographic regions over the 3 years of the study. Two additional crop and tillage rotation pulse-chase randomized experiments at research farms were designed to establish a direct link between carabid beetle activity-density, practices that degrade carabid beetle habitat such as tillage and insecticide use, and weed seed predation by carabid beetles. Controlled environment experiments measured weed seed and food preferences of carabid beetles. Pterostichus melanarius was the most common beetle trapped, followed by Harpalus spp. Weed seed removal rates from seed stations attributed to carabid beetles ranged from 0 to 4 seeds/day in on-farm assessments. Activity-density of carabids and seed predation in conventional fields was similar to rates measured in organic fields. Insecticides ethoprop and chlorpyrifos reduced carabid activity-density and weed seed loss from seed stations. Fields that were conservation-tilled (strip-tilled) typically had greater activity density and seed loss than fields that were conventionally tilled in the spring.

2. Determine the effect of tillage system and sequence, insecticide use, and weed seed position in the soil on weed seed predation, subsequent weed seedling recruitment or emergence, and weed seed mortality and dormancy.
A vegetable row-crop rotation without spring tillage and soil applied insecticide had the greatest carabid activity-density and the lowest recruitment of wild proso millet the following year in a pulse-chase experiment. In confined field experiments, Pterostichus melanarius density was directly correlated to wild proso millet seed loss.

3.Evaluate the seed predation potential of the Julid millipedes (Julida: Julidae spp.), seed bugs (Heteroptera: Lygaeidae spp.), and other potentially key maritime Northwest seed predators in the laboratory.
Of the species evaluated, only Nebria spp., a recent introduction to the PNW, damaged weeds seeds. This carabid beetle is apparently expanding its range and were trapped at several sites in western Oregon.

.

E. Outputs. List your project's outputs, which might include publications, information, data, meetings held, attendance at meetings held, etc.

FIELD DAYS and PROJECT PLANNING

Field day, July 2007, commercial processed and vegetable growers, vegetable research farm Corvallis. 35 attending.

Field day, August 2008. Commercial processed and fresh market vegetable Growers, Hendricks farm, Stayton OR; 25 attending

Project reporting and planning: Feb 2009. Cooperators and Collaborators.

PRESENTATIONS

Oregon Horticulture Society, Vegetable Section, 2007-09 (450 over 3 years);

Winegrape Growers Annual Meeting, Sustainable Ag Section(200);

North Willamette Hort Society Mtgs. 07-09 (200).

PARTICIPANTS

Individuals: Ed Peachey, PI, OSU; Alysia Greco, Hort, OSU, RA; Jess Green, Hort, OSU, Grad Student; Nicole Marshall, Hort, OSU, RA. Laurel Moulton, Hort, OSU, Grad student; Andy Moldenke, Zoology, OSU; Dan McGrath, Linn County Ext. Carol Mallory Smith, OSU Crop Science, CO-PI.

Cooperators and Collaborators: Rod Chambers, Grower, Dever Conner; Skip Gray, Grower, Albany; Kenny Hendricks, Stayton; Mike Christensen, Lebanon; Peter Kenagy, Grower, Albany; Steve Koch, Grower, Canby; Ron Pearmine, grower, Gervais; Jon Umble, Fall Creek Nursery; Rick Boydston, CO-PI USDA-ARS, Prosser, WA; Alec McErlich, Small Planet Foods, WA; Guy Madison, Hermiston, Watts Brothers Farms; Partner organizations: Oregon Processed Vegetable Commission.

TARGET AUDIENCES: Processed and fresh market vegetable growers; Ag professionals and field representatives of processing and market entities.

PAPERS AND ABSTRACTS

Peachey, E., A. Greco, J. Green, and R. Boydston, USDA-ARS, Prosser, WA. 2008. Activity density and weed seed predation potential of ground beetles in annual row crops of the Pacific Northwest. Poster presented at the Western Society of Weed Science Proceedings. 61:45

Peachey, E., A. Greco, J. Green, and R. Boydston. 2008. Primary tillage sequence and weed seed placement strategies to conserve carabid seed predators and enhance predator efficacy. Ecol. Soc. of Amer. Ann. Mtg., Milwaukee, WI.

Green, Jessica M., R. E. Peachey, A. Greco, N. Marshall. 2007. Beneficial Beetles: Examining weed seed predation potential and population densities of common Carabidae in the Pacific Northwest. Abstract: Entomological Soc. of America Annual Mtg, Dec. 10, San Diego, CA.

F. Impacts and Potential Impacts. The "impacts" and "potential impacts" sections of your report will help the Western IPM Center highlight the value of IPM research and education by detailing the real-world impacts of Center-funded projects. We will use the information in news articles, reports, and informational brochures to showcase the impacts of projects that our program supports. *See Attachment A at end of form for questions to assist you in describing the impacts of your project.*

1. Impacts. Describe any impacts of your work. ***Impacts*** are specific changes in condition for those affected by your work. Impacts include adoption of technology, creation of jobs, reduced cost to the consumer, less pesticide exposure to farmers, access to more nutritious food, and a cleaner environment and healthier communities.

Regulation of weed seed banks and weed interference in agroecosystems is typically accomplished by reducing weed seed inputs, or by stimulating weed seed germination with tillage. Strategies to enhance seed mortality are frequently overlooked. Results from field surveys over 3 years indicate that seed predation by invertebrates such as carabid beetles is an important source of weed seed mortality in some cropping systems of the PNW. It is also clear that activity-density varies greatly among sites and regions, indicating the potential to structure cropping systems to enhance seed predation potential by carabid beetles. This was demonstrated in experiments at the OSU experimental farm. Eliminating spring tillage and certain insecticides increased the number of seed-eating carabid beetles. Integrated weed management population models and strategies should incorporate estimates of weed seed predation efficacy.

2. Potential impacts. Describe your project's potential impacts. ***Potential impacts*** are the ways that your project's outputs could directly lead to changes in condition that will unfold in the future.

Ongoing research is evaluating the conditions essential to the development of robust carabid populations in agronomic settings. Understanding the processes within landscapes or fields that lead to enhanced seed predation potential will allow growers and other agricultural professionals to build cropping systems that constrain populations of target weeds.

G. Appendices

1. With your report, please attach ***at least two (2) photographs*** that illustrate your project. Please describe the photo and indicate the name and institution of the person who took the photo. (If you submit more than two photographs, please include those additional descriptions and photo credits under "H. Additional Information," below.)

Photo #1 description:

Photo 317A. Conservation (strip) tillage treatments applied to the tillage sequence rotation plots at the experimental farm.

Photo #1 credit (photographer's name and institution):

Jess Green, Oregon State University

Photo #2 description:

Hendricks 6-25-09: Graduate students Jess Green (left) and Laurel Moulton install pitfall traps and seed predation stations on a farm near Stayton, Oregon to track potentail movement of carabids between field. In the background are pitfall traps installed in plots within field just planted to snap beans.

Photo #2 credit (photographer's name and institution):

Alysia Greco, Oregon State University

2. Also attach any printed fact sheets or other publications resulting from your work that will enhance our understanding of your project and its impacts. Please provide a description of each attached publication below.

Document #1 description:

1. Final reaserch summary of projects completed during the funding period.

Document #2 description:

2. Brochure: important carabid beetles of the PNW

Document #3 description:

H. Additional Information

I attached one of the many time-lapse photos we took. Not sure if it will be used, but it is interesting.

Credit: *Some of the language about impacts and potential impacts was adapted from a PowerPoint presentation by H. Michael Harrington, Executive Director, Western Association of Agricultural Experiment Station Directors, Colorado State University.*

Attachment A

Questions to Help in Reporting Impacts and Potential Impacts

Below are some questions that will guide you in assessing and then describing the impacts and potential impacts of your project. The relevance of each question may vary depending on whether yours is a research or extension project. Please answer as many as you can to the best of your ability, and feel free to describe any additional types of impacts not mentioned below. Remember to identify any potential impacts.

1. ***Innovations in IPM:***
   Are there new IPM practices that have been (impacts) or could be (potential impacts) adopted as a direct result of your project? What is the total number of acres (or homes, schools, greenhouses, nurseries) on which these practices could realistically be implemented?
2. ***Safeguarding human health and the environment:***
   a. Has the project reduced risk (or could it potentially do so) by changing the use of pesticides on farms, in homes, in schools, etc.? For example, could it result in fewer sprays per season or a switch to lower-risk pesticides? If possible, quantify the changes in condition. (Since there is no unanimous definition of *high* and *low risk,* investigators selecting this indicator are asked to categorize the pesticides they are reporting on as *high* or *low risk* according to the particular situation [e.g., lower risk to natural enemies]).
   b. Are there any other impacts or potential impacts on human health or the environment as a result of your project?
3. ***Economic benefits:***
   a. What is (or could be) the economic benefit (e.g., dollars saved) for clientele who adopt IPM strategies and systems you studied? Do you envision potential commercialization or mass production of these systems?
   b. How many clients are satisfied with IPM results (such as improved yield, improved quality of yield, reduced pest populations, more effective pest control, greater preservation of nonpest species)?
   c. Are there other financial benefits that might be realized (potential impact) as a result of your project?
4. ***Implementation of IPM:***
   a. How many IPM strategies and systems have been validated through this project (e.g., through on-farm trials, large plot tests, or other methods used to confirm efficacy)?
   b. How many educational materials were delivered? To whom? And what are the impacts or potential impacts?
   c. What is the number of growers/personnel trained? And what are the impacts or potential impacts?
   d. For a Web site, what volume of traffic and type of use has the site experienced? (For example, number of visitors per day or month; number of page views; number of unique user sessions; change in volume during growing season; average viewing time.) And what are the impacts or potential impacts?
   e. How many more people adopted IPM practices as a direct result of your project, or how many people adopted new IPM practices?
   f. Are there other ways in which your work will result in improved use or increased implementation of IPM strategies in your region or across the West?
5. Has your project or study increased collaboration among stakeholders interested in the development and implementation of improved IPM strategies and systems?