

Western IPM Center Project Report Form

How to submit: Please submit your completed report 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:** Reports should follow the outline 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: Sept. 2009

Reporting Period: 15 Sept 2004 to 31 Aug 2007

Report Type (please check one):

Progress Report Final Report

B. Grant Data

- Grant Agreement #: 2003-51120-02098
- Title: Identification of a sex pheromone of *Prionus californicus*, and its potential use in management of hop
- Grant Type:
- Lead investigator:
 - Name: James D. Barbour
 - Title: Assoc. Prof.
 - Institution: University of Idaho
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- Team members (name, title, institution):
- Lawrence M. Hanks, University of Illinois, Urbana-Champaign.
- Jocelyn G. Millar, Univeristy of California, Riverside
- State(s) involved: ID, CA, IL

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)

Prionus californicus is a serious root feeding pest of hop in the Pacific Northwest. The only currently recommended method for P. californicus management is for growers to remove all hop rootstock from infested fields. Only one broad spectrum, soil applied insecticide is currently registered for P. californicus management. No effective host-plant resistance, or biological control alternatives exist. Our recent research has confirmed the existence of a female-produced mating pheromone in P. californicus. The objectives of this proposal were to isolate and identify active pheromone components and to test their effectiveness at disrupting communication between male and female beetles, and the potential for use of pheromone components for managing P. californicus in hop. We conducted experiments demonstrating that male beetles were strongly attracted to live females under laboratory and field conditions, and also to freeze-killed females and their excised ovipositors in the laboratory. Males were not attracted to excised heads abdomens, or thoraces of females indicating that the ovipositor was the volatile pheromone source. Solid phase micro extraction of ovipositors followed by analysis of the extract by gas chromatography-mass spectrometry indicate that the basic structure of the volatile pheromone is 3,5-dimethyldodecanoic acid. This compound strongly attracts male P. californicus in laboratory and field studies and has good potential for use in management of this beetle in hops.

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

Objective I. Isolate and identify active components of P. californicus head space volatiles.

1. Collect head space volatiles from male and female P. californicus
2. Use gas chromatography (GC) to isolate and identify potentially active head space volatile fractions
3. Test attraction of male beetles to potentially active volatile components using an olfactometer

All sub objectives under objective I were successfully completed. We were not able to collect head space volatiles for GC analysis (objective I.2.) and bioassay I.3), but were able to collect these volatiles using solid phase micro extraction (SPME). Subsequent testing of SPME extracts yielded potentially active volatile fractions, that strongly attracted male P. californicus in laboratory olfactometer tests. The basic structure of the active component was identified as 3,5-dimethyldodecanoic acid using funding from this grant and from other sources.

Objective II. Examine the potential use of pheromones for management of P. californicus.

1. Determine the attraction of male beetles to active components in field situations
2. Determine the spacing of pheromone-treated lures that disrupt communication between female and male beetles
3. Examine the effect of communication disruption on mating of beetles

Sub objectives under Objective II, were partially fulfilled using funding from this grant. 3,5-dimethyl dodecanoic acid strongly attracts male P. californicus in the field and has excellent potential for use in management of this pest in hop. Work under objectives II.1. and II.3 is the subject of ongoing research using funding from a variety of sources.

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

This project led to the identification of the first female produced volatile sex pheromone for the beetle family Cerambycidae and the first documentation of the use of contact pheromones for mate recognition in the cerambycid subfamily Prioninae. This project has contributed to the publication of four peer reviewed journal articles or book chapters and one peer reviewed extension bulletin. Aspects of this project have been presented to peers at ten invited and six submitted presentations at regional, national or international venues and to hop industry clientele at six regional hop industry meetings.

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.

These findings demonstrate that female *P. californicus* produce a volatile pheromone from the ovipositor that attracts males over a distance. This is the first documented female produced pheromone in the beetle family Cerambycidae. This research also provides the first evidence that contact pheromones play an important role in mate recognition the Cerambycid subfamily Prioninae generally, and *P. californicus*, specifically.

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.

The volatile pheromone has excellent potential to be developed into a pest management tool for monitoring and/or managing *P. californicus* in hop, and other crops (e.g. cherry) of which it is a pest. Several companies are investigating the potential for commercialization of the pheromone for use in hop pest management. The pheromone also has potential for managing closely related beetles in the same genus that attack pecans in the U.S. southeast. Cross reaction of this pheromone with other prionine beetles could render the pheromone useful for ecological studies examining the biology and geographic ranges of cross-reacting species, and perhaps as a tool for monitoring to prevent introduction/establishment of these beetles into areas outside of their native ranges.

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:

Prionus spp. males capture in a 24 hour period at a trap baited with 2,3-dimethyldodecanoic acid

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

Lawrance M. Hanks. Univeristy of Illinois, Urbana-Champaign

Photo #2 description:

Pitfall trap, with pheromone bated lure, used to capture *P. californicus* in Idaho hop yards.

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

Jim Barbour, University of Idaho, SW Idaho Res. & Ext. Center, Parma, ID

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:

See below.

Document #2 description:

See below.

Document #3 description:

See below.

H. Additional Information

Publications:

Book Chapter:

Millar, J. G., L. M. Hanks, J. A. Moreira, J. D. Barbour, and Lacey Barbour, J.D and E. S. Lacey. Pheromone chemistry of Cerambycid beetles. In; (K. Nakamura, ed.). 2008. Chemical Ecology of Forest Insects. Forestry and Forest Products Research Institute and Asia-Pacific Association of Chemical Ecologist September 10,2007 13:30-17:00 International Congress Center, EPOCHAL TSUKUBA. 98 pp.

Peer Reviewed Journals:

1) Barbour, J. D., E. S. Lacey, J. G. Millar and L. M. Hanks. 2007. Cuticular hydrocarbons mediate mating in the Prionine Cerambycid *Prionus californicus* Mots. *Annals of the Entomological Society of America* 100(2): 333-338.

2) Barbour, J. D., D. E. Cervantes, E. S. Lacey and L. M. Hanks. 2006. Calling behavior in the primitive longhorned beetle *Prionus californicus* Motts. *Journal of Insect Behavior*. (online: <http://www.springerlink.com/link.asp?id=p12214434w5h3313>).

3) Cervantes, D. E., L. M. Hanks, E. S. Lacey, and J. D. Barbour. 2006. First documentation of a volatile sex pheromone in longhorned beetles (Coleoptera:Cerambycidae) of the primitive subfamily Prioninae. *Ann. Entomol. Soc. of Amer.* 99: 718-722.

Peer reviewed extension publication:

Alston, D. G., J. D. Barbour, and S. A. Steffan. 2007. California prionus fact sheet. Orchard Pest Management On-Line <http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn=643>. Washington State University.

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?