

# 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](mailto: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:** 9/30/11

**Reporting Period:** 9/2009 - 8/2011

**Report Type (please check one):**

Progress Report     Final Report

## B. Grant Data

- Grant Agreement #: 07-001492-UA3
- Title: Crop Pest Losses and Impact Assessment Work Group
- Grant Type: IWG
- Lead investigator:
  - Name: Al Fournier
  - Title: IPM Program Manager
  - Institution: University of Arizona
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- Team members (name, title, institution): Dr. Peter C. Ellsworth, Entomologist & IPM Specialist, University of Arizona; Dr. John Palumbo, Entomologist & Extension Specialist, University of Arizona; Dr. Mary Olsen, Extension Plant Pathologist, University of Arizona; Dr. Bill McCloskey, Extension Weed Scientist, University of Arizona; Dr. Mike Matheron, Extension Plant Pathologist, University of Arizona; Eric Natwick, Imperial County Extension Director and Entomology Advisor, University of California Riverside
- State(s) involved: Arizona, California

**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)

Through this project, focused in the low deserts of Arizona and Imperial Valley California, we develop accurate “real world” data on crop pest losses, control costs, target pests and pesticide use, through face-to-face workshops in an interactive survey process that encourages (and rewards) stakeholder input. Growers, pest control advisors (PCAs), Extension personnel and industry professionals attend workshops to complete the survey, and are offered incentives to offset the costs of participation. This face-to-face approach results in improved response rates, a more representative and better quality set of data, education of all those involved, and collaborative partnership with key stakeholder groups. As necessary, we conduct follow-up mail surveys with key PCAs to ensure good representation of region-wide acres in the final datasets. We currently collect data for cotton, cantaloupes, watermelons and head lettuce. The data generated are useful for responding to pesticide information requests generated by EPA & USDA, and can provide a basis for regulatory processes such as Section 18 or 24c requests, as well as for evaluating the impact of our extension programs on risk reduction to growers.

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

1. We will engage agricultural stakeholders in Arizona and California to develop Crop Pest Losses (CPL) data for key desert crops, including the most relevant pest groups for each crop.

This objective was achieved. We held five meetings in the 2009-10 season and five in the 2010-11 season, discussing and developing crop pest losses data for cotton, head lettuce, watermelons, cantaloupes and interacting with about 132 stakeholders from Arizona and California. We also collected survey data by mail and email. Workshops serve as a focal point for discussion about shifting pest management needs and IPM program emphases. For example, in 2011, John Palumbo collected important information from PCAs about bagrada bug infestation levels and insecticides used to control it in cole crops. The bagrada bug is a new invasive pest of Arizona cole crops.

2. We will serve as a clearinghouse for information and metrics on crop pest losses and impact assessments.

This objective was achieved. Through the Arid Southwest IPM Network, we have continued to coordinate responses to federal pesticide information requests for Arizona and neighboring states in the arid southwest. As appropriate, we have incorporated CPL data into our responses to federal pesticide information requests and posted our responses online. CPL data have also served local and regional needs (detailed in previous reports), including a recent economic analysis for Arizona Cotton Growers Association of the value of Bt Cotton in our markets (Ellsworth 2010).

Since the last report, we have updated the Cotton Pest Losses website which now features detailed Cotton Pest Losses data and analysis from 1979 through 2008 (<http://ag.arizona.edu/crops/cotton/insects/cil/cil.html>) (2009 data were previously posted, but have been removed to revise and reanalyze some data. 2010 data have been compiled and analysis is in process. These data will be finalized once final cotton prices for the year are available.) In 2010, we created a working group page on the Arizona Pest Management Center website (<http://cals.arizona.edu/apmc/croplosswg.html>). This page states the purpose of the working group, provides access to all grant reports, a link to the Western IPM Center website, and direct links to the Vegetable and Cotton Pest Losses sites. New publications were added to the Vegetable Pest Losses website (<http://ag.arizona.edu/crops/vegetables/insects/vegloss.html>).

3. We will conduct outreach, presenting data and information about the data collection process to agricultural stakeholders and colleagues, locally, regionally, and nationally.

This objective was achieved. Data generated by the working group is frequently presented to educate growers, pest control advisors and others about desert pest management, and the impact of key insect pests, weeds and diseases and their control strategies on yield and profit. In particular, annual Cotton Pest Losses data, which is available for the longest span, is used to show dramatic impacts of evolving IPM strategies on pesticide use, grower profits and the environment.

4. We will develop an impact assessment analysis and report based on 6 to 30 years of crop pest losses data (depending on the crop) and other data sources.

This objective is in progress. We have developed and analyzed crop pest losses data and developed graphics used in presentations and publications to educate stakeholders about crop pest losses and the impact of IPM programs and pest management technologies. For example, John Palumbo developed an assessment of insect losses and insecticide use data on Arizona head lettuce using CPL data from 2004-2010.

Another data source to illuminate grower pest management practices is the Arizona Pest Management Center pesticide use database, which contains 20 years of state pesticide use records as well other useful data. In April 2011, we hired a dedicated Assistant in Extension, Wayne Dixon, who is now helping us to mine these data, and has also started integrating crop pest losses data into a separate database. Though more work remains to be done, many of the components of the report have been developed.

**E. Outputs.** List your project's outputs, which might include publications, information, data, meetings

held, attendance at meetings held, etc.

- Held 10 face-to-face interactive stakeholder crop pest workshops in Arizona and California, attended by 132 stakeholders, including pest control advisors, growers, Extension personnel and agro-industry representatives. Many participants completed crop losses questionnaires and engaged in dialog to help us improve the process.
- In 2011, John Palumbo collected important survey information from pest control advisors (PCAs) about bagrada bug, a new invasive pest of Arizona cole crops. He is examining the extent and changes in infestation levels, and insecticides used to control it. The CPL workshops provide an important ongoing opportunity for face-to-face feedback from PCAs about important emerging pest issues.
- The Cotton Pest Losses survey was either emailed or physically mailed to 35 potential respondents (mostly PCAs) in 2009 and to 25 in 2010. In 2011, for the first time, Melon Pest Losses surveys were mailed out to PCAs, but the response rate was disappointing. Data from mailed surveys helps supplement face to face data and provide a more complete picture of pest losses.
- In addition to insect information, Crop pest losses surveys now collect detailed data on weed losses and management (all crops) and disease losses and management (lettuce and melons). Our collaboration with additional scientists to develop this aspect of the data has been successful and we plan to continue.
- Collected, analyzed, and presented data on pest losses, including information on the yield impact of key insect pests, diseases and weeds of cotton, lettuce and melons. Many of these presentations are available online, and are cited in the references below.
- Published 8 articles and reports that included CPL data, including 3 peer reviewed journal articles for Pest Management Science and Southwestern Entomologist, 4 reports and one trade press article. Two additional UA research reports have been submitted.
- A conservative tally of Extension presentations making use of these data over this two-year grant is 35, which includes 10 new presentations added to the bibliography at the end of this report. In addition, through presentations at national (e.g., Entomological Society of America) and international (e.g., International Bemisia Conference) conferences we have shared data with scientific colleagues.
- Incorporated CPL data into federal pesticide information requests related to oxamyl, spirotetramat, thiodicarb. Our replies to information requests are available by clicking "Information Requests" on our website at [http://ag.arizona.edu/apmc/Arid\\_SW\\_IPM.html](http://ag.arizona.edu/apmc/Arid_SW_IPM.html).
- We used CPL data in a recent economic analysis done for the Arizona Cotton Growers Association on the value of Bt Cotton in our markets (Ellsworth 2010).
- Updated both Crop Pest Losses websites with new data and publications.  
<http://ag.arizona.edu/crops/cotton/insects/cil/cil.html>  
<http://ag.arizona.edu/crops/vegetables/insects/vegiloss.html>
- Created a working group page on the Arizona Pest Management Center website (<http://cals.arizona.edu/apmc/croplosswg.html>) with statement of purpose, links to grant reports, a link to the Western IPM Center website, and direct links to the Vegetable and Cotton Pest Losses sites.
- Published an assessment of insect losses and insecticide use data on Arizona head lettuce using CPL data from 2004-2010, as part of a Vegetable IPM Update on the ACIS website. This was sent as smart phone update to over 300 stakeholders and was picked up by Western Farm Press and further distributed to thousands throughout the west. <http://ag.arizona.edu/crops/vegetables/advisories/more/insect31.html>

**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 data and this Work Group serve to address any Federal, regional, state, and local requests for information on the impact of insects or insecticides on our key crops. During this project term, we responded to 10 information requests, and used Crop Pest Losses data in about one third of our responses. Formal responses are posted on the Arid Southwest IPM Network website at [http://ag.arizona.edu/apmc/Arid\\_SWPMC\\_Info\\_Requests.html](http://ag.arizona.edu/apmc/Arid_SWPMC_Info_Requests.html).

What makes these data unique with respect to pesticide (and IPM) policy is that we are directly measuring the “intent” of each insecticide input. That is, stakeholders are asked to identify the specific intent or intended target or targets of their management decisions and inputs. So in addition to rich quantitative data, we also have unique qualitative insights into the decision-making experience of the pest manager. These insights help guide our existing and new programs of IPM research, implementation and outreach.

These data are useful in evaluating changes in grower practices and implementation of our IPM programs over time, and facilitating quick responses to the ever-changing needs of grower communities.

Our ongoing dialog with stakeholders through annual Crop Pest Losses workshops helps us quickly evaluate and respond to emerging pest management issues. For example, in 2011 we were able to quickly evaluate the impact of a new invasive insect pest, bagrada bug, on broccoli yields, quality and insecticide use. This information forms the basis of developing a response plan this new pest.

Through this data source have we been able to document:

- 2006 and 2007 are the two years with the lowest foliar insecticide use in cotton on record in Arizona (records begin in 1979).
- In 2007, we recorded the lowest grower costs for foliar insecticides in cotton.
- 2008 was the first year since 1965 that cotton growers have not deployed insecticides to control pink bollworm statewide.
- Statewide averages for cotton insecticide use patterns in Arizona from 1979 through 2010 show that insecticide use on cotton for all insects combined—including whiteflies, pink bollworm, Lygus bug and others reached a 32-year low over the last 5 years, while also reducing costs to all-time lows. The estimated cumulative savings in control costs and yield (from reduced losses to insects) from 1996 through 2010 was more than \$223 million.
- The last 5 years have shown the lowest insecticide use in cotton on record (32 years), at just 1.5 sprays season-long, reducing insecticide loads on the environment by more than 1.6 million pounds of active ingredient annually and saving growers over \$10 million annually in combined control costs and yield savings.
- The percentage of cotton acres never sprayed for insects in 2010 was 29.3 percent, the highest level ever measured. Overall, cotton acreage in Arizona is expanding, from 150,000 acres in 2009, to 201,000 in 2010, and close to 250,000 acres in 2011 (projected), indicating a health in the industry that can be attributed at least in part to higher yields and lower pest control costs.
- Results from 6 years of Lettuce Pest Losses surveys show that 1) costs associated with spray applications and management fees have increased steadily, 2) western flower thrips has become an important economic pest in both fall and spring lettuce, and 3) the use of older, broadly toxic insecticides has dropped significantly, whereas use of the newer, softer reduced-risk chemistries continues to increase.

**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.

An understanding of the impact of key insect pests, weeds and diseases on crop yield, expense of control, and pesticide use provides a basis for evaluating research and education priorities. These data help us to evaluate adoption and impact of our IPM programs and focus our attention on the major issues that impact growers.

**G. Leveraged Funds.** List *additional funding* you have acquired because of the data and results yielded in this WIPMC-funded project.

**Additional Funding Award #1:**

Date of Award: 10/1/2010  
Dollar Amount: \$142,426  
Grant Period Duration: 3 years

Name of Granting Entity: Arizona Dept. of Agriculture  
Name of Grant Program: Specialty Crop Block Grant

**Additional Funding Award #2:**

Date of Award: 10/1/2010  
Dollar Amount: \$37,125  
Grant Period Duration: 1 year

Name of Granting Entity: Arizona Dept. of Agriculture  
Name of Grant Program: Specialty Crop Block Grant

**Additional Funding Award #3:**

Date of Award: 10/1/2011  
Dollar Amount: \$87,709  
Grant Period Duration: 2 years

Name of Granting Entity: Arizona Dept. of Agriculture  
Name of Grant Program: Specialty Crop Block Grant

## H. 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 "I. Additional Information," below.)

Photo #1 description:

Cotton Pest Losses Workshop in Yuma, Arizona.

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

Al Fournier, University of Arizona.

Photo #2 description:

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

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:

Ellsworth, P.C. 2011. Cotton IPM: A Quiet Revolution Reduces Costs, Losses and Risks for Arizona's Cotton Growers. University of Arizona College of Agriculture and Life Sciences Impact Report. This report highlights some major impacts of our cotton IPM program as documented via Crop Pest Losses data and APMC pesticide use database.

Document #2 description:

Arizona Pest Management Center Impacts. 2011. Arizona Pest Management Center of the University of Arizona. This report highlights some major impacts of our cotton IPM program as documented via Crop Pest Losses data and APMC pesticide use database.

Document #3 description:

Crop Pest Losses Bibliography. 2011. This bibliography documents the most significant websites, publications and presentations that have been outputs of this working group.

## I. Additional Information

*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?

## Crop Pest Losses and Impact Assessment Working Group

### Appendix: Publications, Presentations and Websites

#### *Websites:*

The Crop Pest Losses and Impact Assessment Working Group webpage highlights the purpose of the group and includes links to previous grant proposals and reports, Crop Pest Losses information pages, and the Western IPM Center, at <http://cals.arizona.edu/apmc/croplosswg.html>.

Cotton Insect Losses data, survey instruments, and links to national cotton insect losses data, is available on the Arizona Crop Information Site (ACIS) at <http://ag.arizona.edu/crops/cotton/insects/cil/cil.html>.

Lettuce and Melon Insect Losses data, survey instruments, presentations and publications are available on ACIS) at <http://ag.arizona.edu/crops/vegetables/insects/vegiloss.html>.

#### *Publications:*

Blake, C. 2011. (Fournier, A., contributor). IPM Delivers Monumental Gains in Arizona Agriculture. Western Farm Press. <http://westernfarmpress.com/cotton/ipm-delivers-monumental-gains-arizona-agriculture>. July 21, 2011.

Ellsworth, P.C. 2010. Pink Bollworm Control Costs & Value of Bt Technologies to AZ Cotton Growers. Report to AZ Cotton Growers Association & reprinted in ACGA newsletter, and submitted to Monsanto Company, 4 pp.

Ellsworth, P.C. 2011. Cotton IPM: A Quiet Revolution Reduces Costs, Losses and Risks for Arizona's Cotton Growers. University of Arizona College of Agriculture and Life Sciences Impact Report. [http://ag.arizona.edu/apmc/docs/CottonIPM2011\\_Impacts.pdf](http://ag.arizona.edu/apmc/docs/CottonIPM2011_Impacts.pdf).

Ellsworth, P.C., A. Fournier and T.D. Smith. 2007 (revised 02/10). Based on Ellsworth, P.C. and J.S. Jones. 2000. Arizona Cotton Insect Losses. Publ. No. AZ1183. University of Arizona, College of Agriculture and Life Sciences, Cooperative Extension, Tucson, Arizona. URL: <http://cals.arizona.edu/crops/cotton/insects/cil/cil.html>.

Ellsworth, P.C. and J.S. Jones. 2001. Cotton IPM in Arizona: A Decade of Research, Implementation & Education. In J.C. Silvertooth [ed.], cotton, A college of Agriculture Report. AZ1224. University of Arizona, College of Agriculture, Tucson, AZ pp. 199-215. <http://cals.arizona.edu/pubs/crops/az1224/az12247a.pdf>

Fournier, A., P. Ellsworth, V. Barkley. 2007. Economic Impact of Lygus in Arizona Cotton: A Comparative Approach. 2007 Cotton Report. College of Agriculture & Life Sciences, University of Arizona. <http://cals.arizona.edu/pubs/crops/az1437/az14374a.pdf>.

- Naranjo, S.E., Ellsworth, P.C. The contribution of conservation biological control to integrated control of *Bemisia tabaci* in cotton. *Biological Control* (2009), doi:10.1016/j.biocontrol.2009.08.006
- Naranjo, S.E. and P. C. Ellsworth. 2010. Fourteen years of Bt cotton advances IPM in Arizona. *Southwest. Entomol.* 35: 437-444.
- Naranjo, S.E. & P.C. Ellsworth. 2009. 50 years of the integrated control concept: moving the model and implementation forward in Arizona. *Pest Management Science*, 65: 1267–1286.
- Naranjo, S. E. & R. G. Luttrell. 2009. Cotton Arthropod IPM. P. 341-353. In *Integrated Pest Management: Concepts, Tactics, Strategies & Case Studies*, E. B. Radcliff & W. D. Hutchison (eds.). Cambridge University Press, Cambridge, UK.
- Naranjo, S. E., J. R. Ruberson, H. C. Sharma, L. Wilson & K.M. Wu. 2008. The Present and Future Role of Insect-Resistant GM Cotton in IPM. P. 159-194. *In* *Integration of Insect-Resistant Genetically Modified Crops within IPM Programs*, J. Romeis, A. M. Shelton & G. G. Kennedy (eds.). Springer, New York.
- Palumbo, J. C. 2011. Assessment of Insect Losses and Insecticide Use on Arizona Head Lettuce, 2004-2010. *University of Arizona Vegetable IPM Update*, Vol 2, No. 8. April 20, 2011. <http://ag.arizona.edu/crops/vegetables/advisories/more/insect31.html>.
- Palumbo, J.C. 2011. Impact of Bagrada Bug on Desert Cole Crops in 2010. *University of Arizona Vegetable IPM Update*, Vol 2, No. 8. June 29, 2011. <http://ag.arizona.edu/crops/vegetables/advisories/more/insect36.html>.
- Palumbo J.C. & Castle S.J. 2009. IPM for fresh-market lettuce production in the desert southwest: the produce paradox. *Pest Management Science* 65: 1311-1320. Available at: <http://www3.interscience.wiley.com/cgi-bin/fulltext/122653066/HTMLSTART>.
- Palumbo, J., A. Fournier, P. Ellsworth, K. Nolte, P. Clay. 2006. Insect Crop Losses and Insecticide Usage for Spring Melons in Southwestern Arizona: 2004 -2006. 2006 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona. [http://cals.arizona.edu/pubs/crops/az1419/1\\_WEB.PDF](http://cals.arizona.edu/pubs/crops/az1419/1_WEB.PDF)
- Palumbo, J., A. Fournier, P. Ellsworth, K. Nolte, P. Clay. 2006. Insect Crop Losses and Insecticide Usage for Cantaloupes and Watermelons in Central Arizona: 2004 -2006. 2006 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona. [http://cals.arizona.edu/pubs/crops/az1419/2\\_WEB.PDF](http://cals.arizona.edu/pubs/crops/az1419/2_WEB.PDF)
- Palumbo, J., A. Fournier, P. Ellsworth, K. Nolte, P. Clay. 2006. Insect Crop Losses and Insecticide Usage for Head Lettuce in Arizona: 2004 -2006. 2006 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona. [http://cals.arizona.edu/pubs/crops/az1419/3\\_WEB.PDF](http://cals.arizona.edu/pubs/crops/az1419/3_WEB.PDF)

Palumbo, J., A. Fournier & P. Ellsworth, E. Taylor, K. Rice. 2007. Insect Crop Losses and Insecticide Usage for Spring Melons in Central Arizona for 2007. 2007 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona.  
<http://cals.arizona.edu/pubs/crops/az1438/az14382d.pdf>.

Palumbo, J., K. Nolte, A. Fournier & P. Ellsworth. 2007. Insect Crop Losses and Insecticide Usage for Spring Melons in Southwestern Arizona for 2007. 2007 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona.  
<http://cals.arizona.edu/pubs/crops/az1438/az14382c.pdf>.

Palumbo, J., K. Nolte, A. Fournier & P. Ellsworth. 2007. Insect Crop Losses and Insecticide Usage for Head Lettuce in Arizona 2006/2007. 2007 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona.  
<http://cals.arizona.edu/pubs/crops/az1438/az14382f.pdf>.

Palumbo, J., K. Nolte, A. Fournier & P. Ellsworth. 2009. Insect Crop Losses and Insecticide Usage for Head Lettuce in Arizona 2007/2008. 2009 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona. (submitted)

Palumbo, J., K. Nolte, A. Fournier & P. Ellsworth. 2009. Insect Crop Losses and Insecticide Usage for Spring Melons in Southwestern Arizona for 2008. 2009 Vegetable Report. College of Agriculture & Life Sciences, University of Arizona. (submitted)

*Presentations:*

Ellsworth, P.C. 2005. Cotton Insect Losses Working Group. Presented at the Maricopa Agricultural Center, Maricopa, Arizona. November 21, 2005. [Note: This is a typical Cotton Pest Losses Workshop presentation which has been continually updated annually to guide the survey process. [http://ag.arizona.edu/crops/presentations/05\\_CIL\\_Yuma-Blythe-MAC.pdf](http://ag.arizona.edu/crops/presentations/05_CIL_Yuma-Blythe-MAC.pdf)

Ellsworth, P.C. 2007. Cotton Insect Losses: Survey and Survey Process. Presented at the Texas A&M Research and Extension Center, Lubbock, Texas. June 19, 2007.

Ellsworth, P.C. & A. Fournier. 2009. Pesticide Use and User Surveys. North American Pesticide Applicator Certification & Safety Education Workshop, Impact Measurement Tools Seminar, Charleston, SC. August 11, 2009. URL:  
[http://ag.arizona.edu/crops/presentations/09PSEP\\_Charlestonv5Flo.pdf](http://ag.arizona.edu/crops/presentations/09PSEP_Charlestonv5Flo.pdf)

Ellsworth, P.C. & S.E. Naranjo. 2009. IPM in Arizona Cotton: Successful adoption of selective controls for multiple key insect pests. Presented at 6th International IPM Symposium, Portland, OR. March 26, 2009. URL:  
<http://ag.arizona.edu/crops/presentations/09IPMPortlandBiorationalvF7lo.pdf>

Ellsworth, P. & S. Naranjo. 50 Years of the Integrated Control Concept: Moving the Concept and Implementation Forward in Arizona. Presented at the Fifth International Bemisia Workshop, Guangzhou, China. Nov 10, 2009.

[http://ag.arizona.edu/crops/presentations/09China\\_Bemisia\\_50-yrsvF23Flo.pdf](http://ag.arizona.edu/crops/presentations/09China_Bemisia_50-yrsvF23Flo.pdf)

Ellsworth, P.C. 2009 Cotton Insect Management. Presented at the 2010 Desert Agricultural Conference. Casa Grande, AZ. May 13, 2010.

[http://cals.arizona.edu/crops/presentations/10DAC\\_Cotton\\_mgt\\_v3plo.pdf](http://cals.arizona.edu/crops/presentations/10DAC_Cotton_mgt_v3plo.pdf)

Ellsworth, P.C., J. Palumbo, A. Fournier, X. Li, S. Naranjo. Whitefly Management: Multicrop Systems. In Understanding and Capitalizing on Agricultural Biodiversity in IPM/IRM. Presented at the IRAC Symposium, Entomological Society of America 58th Annual Meeting. San Diego, CA. December 14, 2010.

<http://ag.arizona.edu/crops/presentations/11BeltwideTwinlinkvF3lo.pdf>

Ellsworth, P.C. 2011. Cotton Insect Management Update. Arizona Crop Protection Association Desert Ag Conference, Casa Grande, Arizona. May 4, 2011.

<http://ag.arizona.edu/crops/presentations/2011/11MexicaliCarbineFMCFlo.pdf>

Ellsworth, P.C. Lygus Chemical Control. Presented by invitation to cotton entomology technicians of Mexicali Valley. Mexicali, Mexico. June 2, 2011.

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