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7. Title Spatially Explicit Approaches for Measuring and Implementing Higher Level, Multi-Crop, Multi-Pest IPM			
12. Investigator Name(s) (Last Name and Initials) Ellsworth, P. C.; Fournier, A.; Carriere, Y.; Palumbo, J. C.			
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Outputs: *Established key partnerships with Arizona Department of Agriculture (ADA), the Arizona office of USDA-ARS, National Agricultural Statistics Service (AZ-NASS) and the Arizona Cotton Research & Protection Council (ACRPC) to secure access to "1080" pesticide use reporting (PUR) data and GIS agricultural field maps for the state. *Developed a 5-year (2001-2005) database of Pesticide Use Reporting data (over 365,000 records), including a significant time investment in "truthing" and correction of the raw data. Because the cross-commodity guidelines were published in 2003, this data represents pesticide use behaviors before and after dissemination of the guidelines through a major outreach effort. *Integrated GIS map data provided by the ACRPC with 1080 database to facilitate spatial analysis of "group adoption" of cross-commodity IPM recommendations. Initial merging of these datasets revealed additional errors in 1080 data entry and user identification of spray locations, as well as section identifications that did not conform to standard values (i.e., 1-36). Data were painstakingly evaluated and corrected prior to spatial analysis. *Conducted spatial analysis of data. *Conducted, transcribed and analyzed 12 one-hour interviews with PCAs using standardized interview guide approach. Analysis provided rich qualitative data on PCA knowledge and awareness of guidelines; pest management behaviors and decision-making; factors affecting adoption (or non-adoption) of guidelines; tests of the guidelines built-in assumptions; PCA recommendations for future modification of the guidelines. (Results presented below.) *Developed and disseminated revised whitefly management guidelines for Arizona cotton (IPM Series no. 18, AZ1404), incorporating new management tools into the existing management plan for cotton. While specific to cotton, these guidelines are harmonized with the pre-existing cross-commodity IPM guidelines that we are evaluating in this project. Distributed at meetings and posted to the Arizona Crop Information Site. *Held a series of statewide whitefly management workshops in 2005 attended by over 200 PCAs, growers and chemical industry representatives from the desert Southwest, the meetings included training on WF management guidelines, and open discussion where we solicited stakeholder input on the cross-commodity guidelines and their adoption. *Held 2 formal sessions (May 8 2008, Casa Grande and June 18, Yuma) where results of this research project were presented and stakeholder input on potential improvements to the cross-commodity guidelines was sought to inform future guidelines improvement. *An outline of this project and preliminary data analysis was presented by Peter Ellsworth at the Fourth International Bemisia Workshop, December 6, 2006, Duck Key, Florida and by John Palumbo at the Insecticide Resistance Action Committee meeting, December 10, 2006, Indianapolis, Indiana. *Presented the most complete analysis of guidelines adoption to date to IPM colleagues at the WERA-069 Western IPM Coordinators Meeting, Chena Hot Springs, Alaska, May 20, 2008. *Established a stakeholder advisory committee to inform development of future data.			
Outcomes/Impacts: *1080 analysis revealed reduced use of neonicotinoids in multi-crop (MC) communities versus cotton-intensive (CI) communities (10% of sprays versus 45% of sprays) by Yuma cotton growers in 2005. This indicates partial adoption of the guidelines. (Full adoption would result in zero neonicotinoid use in multi-crop communities.) Also, differential trends in uses of pyriproxifen and buprofezin (2 IGRs) in Yuma between cotton growers in CI versus MC communities are generally consistent with guideline recommendations. *1080 analysis of grower behaviors in Pinal County showed no significant differences in neonicotinoid use by cotton growers in the two community types (CI versus MC) following our education program, indicating a general lack of adoption of the guidelines. One reason for this, as revealed through PCA interviews, was that central Arizona growers generally failed to recognize the existence of MC communities in their area, which is largely dominated by cotton-intensive communities. *1080 analysis of grower behaviors in Maricopa County showed a dramatic difference before (2003) and after (2004-05) our education programs, with a 2.3-fold reduction in use of neonicotinoids in MC communities. However, in 2005, 15% of sprays in MC communities included a neonicotinoid, indicating less than full adoption of the guidelines. *1080 data analysis revealed the existence of cotton-vegetable communities, that is, a combination of these 2 crop types within a 2-mile radius. This combination was not considered in the original guideline recommendations. *Qualitative analysis of PCA interviews: More than half of PCAs indicated that their pest management decisions were influenced by the guidelines. PCA responses challenged guideline assumptions about PCA knowledge of crop communities and applications made by neighboring growers. Factors that negatively affected adoption of the guidelines included: influence of the grower on PCA product choice; lower cost of neonicotinoid products versus IGRs; situational factors that influenced product choice; availability of generic neonicotinoids; and prevalence of imidacloprid-treated cotton seed in some areas. Some PCAs indicated that a desire to comply with the guideline could not override immediate needs to control whiteflies. Interestingly, some PCAs with little awareness of the guidelines were in compliance with them, but made decisions based on other criteria. Factors positively affecting guidelines adoption were UA Cooperative Extension outreach; participation in guidelines generation; low whitefly populations; availability of many product choices; and registration of new effective aphicides in lettuce. Most PCAs felt the guidelines should be updated and some indicated incorporation of non-neonicotinoid products would be helpful. *A more complete presentation of results, including charts and graphs, is available at http://ag.arizona.edu/crops/presentations/SpatialX-commodityFlo.pdf . *In Sept 2008, hired Database Specialist (temporary) to develop a complete historical 1080 database. *Established dialog with partner organizations that improved data entry to reduce errors and increase data resolution.			
Publications: Ellsworth, P.C. & S.E. Naranjo. 2008. Action Thresholds and Selective Insecticides for Management of Lygus in Arizona Cotton. Abstract in Goodell P.B. and Ellsworth P.C. 2008. Second International Lygus Symposium. Journal of Insect Science 8:49 http://www.insectscience.org/8.49/ref/abstract20.html			

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Ellsworth, P.C., Palumbo, J.C., Naranjo, S.E., Dennehy, T.J. 2006. Whitefly Management in Arizona Cotton 2006. IPM Series #18. University of Arizona Cooperative Extension publication #AZ1404. <http://cals.arizona.edu/pubs/insects/az1404.pdf>.

Fournier, A., P. Ellsworth & V. Barkley. 2008. Economic Impact of Lygus in Arizona Cotton: A Comparative Approach. Abstract in Goodell P.B. and Ellsworth P.C. 2008. Second International Lygus Symposium. Journal of Insect Science 8:49 <http://www.insectscience.org/8.49/ref/abstract20.html>

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Palumbo, J.C., Ellsworth, P.C, Dennehy, T.J. and Castle, S.C. 2006. Sustained Insecticide Performance Against Whiteflies in Multi-cropping Systems: Past Success and New Challenges. Presented at the Insecticide Resistance Action Committee meeting, Indianapolis, Indiana, December 10, 2006. <http://ag.arizona.edu/crops/presentations/presentations.html>.

Palumbo, J., Ellsworth, P.C, Fournier, A., Dennehy, T.J., Nichols, R.L. 2005. Cross-Commodity Guidelines for Neonicotinoid Insecticides in Arizona. Poster presented at the Entomological Society of America 2005 Annual Meeting, Fort Lauderdale, Florida, Dec 17, 2005. http://ag.arizona.edu/crops/presentations/05ESA_Palumbo_Poster.pdf.

Participants:

Principle Investigators: Peter C. Ellsworth, IPM Specialist & IPM Coordinator, University of Arizona, Department of Entomology, Maricopa Agricultural Center, Maricopa, AZ, USA; Al Fournier, IPM Program Manager, University of Arizona, Maricopa Agricultural Center, Maricopa, AZ, USA; Yves Carriere, Professor, Department of Entomology, University of Arizona, Tucson, AZ, USA; John C. Palumbo, Full Research Scientist, University of Arizona, Department of Entomology, Yuma Agricultural Center, Yuma, AZ, USA Partner Organizations: Arizona Department of Agriculture; Arizona Office of National Agricultural Statistics Service, USDA Agricultural Research Service; Arizona Cotton Research and Protection Council; Arizona Crop Protection Association

Target Audiences:

Professional Pest Control Advisors (PCAs), growers, agricultural industry representatives, Cooperative Extension, pesticide regulatory agencies, entomologists, IPM practitioners, Land Grant colleagues.

Project Modifications:

It is important to note that Arizona does not have 100% use reporting. The ADA requires applicators to report all pesticides that are applied for hire (i.e., custom), applied by air, that are under Section 18 and 24c exemptions, or that are listed on Arizona's Department of Environmental Quality's Groundwater Protection List, as well as all restricted use products and certain odoriferous pesticides. While not complete, we estimate that 1080 data capture a large majority of insecticide applications, particularly in cotton, which was the primary focus of many of the analyses. Spatial analysis of data included some modifications and improvements from the original analysis plan as presented in the proposal. These changes occurred for a variety of reasons, but did not detract from the quality of the results. Data analysis spanned 5 years (not 2, as proposed) and incorporated all available data from key production regions (rather than a random sampling approach). We did not produce "compliance maps" as originally intended, largely because of unanticipated time-consuming error corrections to raw 1080 data and corrections associated with merging 1080 data with GIS maps. A comparative analysis of pesticide use behaviors by community within 3 major production regions proved the most valid approach, in part because it accounted for regional differences in whitefly pressure. Additional data sources, including crop pest losses surveys provided supplemental information on pest management behaviors that enhanced our quantitative understanding of guidelines adoption.

Approved (Signature)	Title	Date

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