2009 Entomology Academic Program Review

Extension Integrated Pest Management Programs

Extension Core Faculty:
Paul Baker, Peter Ellsworth, Dawn Gouge, John Palumbo

David Byrne, Bruce Tabashnik

Other: Al Fournier, Carl Olson

Arizona Pest Management Center / Department of Entomology

ARIZONA PEST MANAGEMENT CENTER

ARIZONA COOPERATIVE EXTENSION

Ellsworth/UA

Cooperative Extension Programs in entomology are effectively "Integrated Pest Management" programs, because IPM is the world-wide standard for arthropod and other pest control.

Four core faculty carry majority Extension appointments, split with Research or Res. & Teaching. Two others have minority splits in Extension, and two others are major Extension resources for our programs.

There are other faculty in the dept. who also impact our Extension IPM programs, but do not carry formal appointments in Extension.

Cooperative Extension Programs

- Our Organization strengthens us
  - Transparency & communication
  - Stakeholder engagement
  - Evaluation
- Integration of our Research & Outreach functions
- Advance IPM to higher levels of implementation
- IPM Assessment as a critical tool of evaluation

Our re-organization of IPM resources in this state have led to major improvements in transparency & communication, stakeholder engagement, and evaluation, something we need to do more and more of.

Extension in AZ is a fully integrated program of research & outreach where Specialists have full responsibility for discovering and designing solutions through applied research as well as effectively disseminating and deploying IPM programs. We seek to broaden adoption of IPM to new audiences while elevating existing users to higher levels of integration.

Assessment, largely through Al Fournier as a key central asset, has become critical to our success.

Photo by Tim Knight © http://homepage.mac.com/wildlifeweb/).

IPM? Risk Reduction

- Least possible risk to:
  - People
  - Property
  - Resources
  - Environment
- From pests & pest management practices

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I will not define fully IPM except to say what the expected outcomes are.

The federal definition of IPM identifies it as a risk reduction strategy that will limit risks to people, property, resources (economic and otherwise), and the environment, from the pests as well as the full complement of pest management practices that might be deployed against that pest.

Chronology

- 5/03, Concept proposed to EC
- 1/04, 1st funding for APMC approved
- 4/04, IPM CC convened; IPM Coordinator appointed
- 5/05, Dr. Al Fournier hired as IPM Prog. Mgr.
- 6/06, 1st APMC Summit convened (120 attend)
- 9/08, Hired Database Specialist, Richard Farmer

ARIZONA PEST MANAGEMENT CENTER

The concept for the Arizona Pest Management Center was conceived by John Palumbo, Paul Baker, and myself in response to various changes in the federal climate, new opportunities that resulted, and a need to develop transparency with respect to our federal 3(d) obligation in IPM. Our first formal funding through the Western IPM Center was approved shortly thereafter. Our IPM Coordinating Committee first convened later that year and Peter Ellsworth was appointed IPM Coordinator, a federal designation, with responsibility to respond and report to our federal partner. Al was hired a year later, and multidisciplinary stakeholder Summit was held in 2006. Just last fall, with 1-time, 1-year funds, we hired a database specialist to handle nearly 20 years of state pesticide use records we depend on for program assessment.

Chronology

- 5/03, Concept proposed to EC
- 1/04 APM
- 4/04 IPM appo
- 5/05, as IPM Prog. Mgr.
- 6/06, 1st APMC Summit convened (120 attend)
- 9/08, Hired Database Specialist, Richard Farmer

10/08, IPM 3(d) Formula Funds go competitive 2/09: 80% increase

Then with very little warning, the 35-yr old, formula system (IPM 3(d)) that delivered our annual federal moneys changed over to a competitive process.

As this was one of the driving reasons we gave to the EC 5.5 years earlier for the re-org., we were prepared for this transition.

Just last week, we rec'd preliminary notice that we will be awarded a new grant 80% higher than before.

Goals

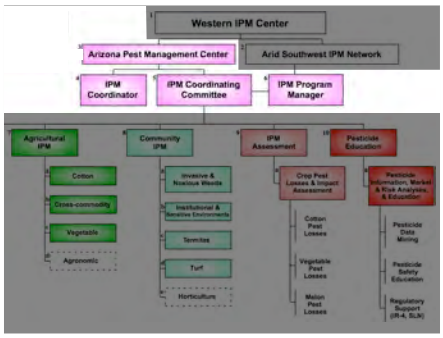
- Establish the University of Arizona's IPM pro... as one of the nation's premier efforts in re... ta...
- De... as the hub for IPM research & outreach resources in the Western U.S. and as a resource for IPM in arid environments around the world

Create a working environment in which the science and implementation of IPM can thrive in Arizona

Ellsworth/UA

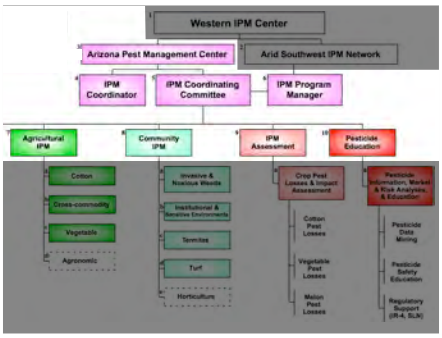
The APMC is becoming well-known and well regarded across our region and country. We wish to foster and energize the very best IPM programs possible, and serve as a hub for resources in the West and beyond.

Internally, our goal is modest: to create a working environment in which the science and implementation of IPM can thrive in Arizona.

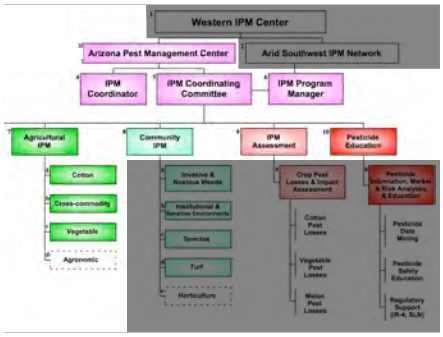


Along with the State IPM Coordinator (Peter Ellsworth) and IPM Program Manager (Al Fournier), the 20-member IPM Coordinating Committee* oversees our federal obligation in IPM as well as helps represent our many and diverse IPM programs that make up the Arizona Pest Management Center.

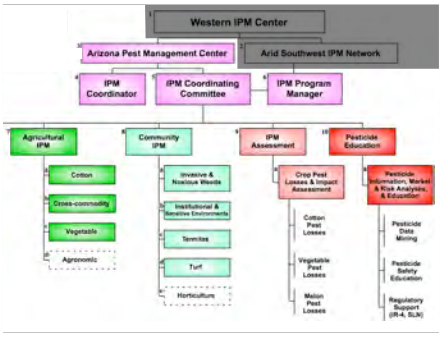
*The IPM CC includes members external to the University as well as internal stakeholders, and is multidisciplinary.



All programs are organized around strategic focal areas: Agricultural IPM, Community IPM, Pesticide Education, and a dedicated focus on IPM Assessment, reflecting our investment in this activity which supports all programs.

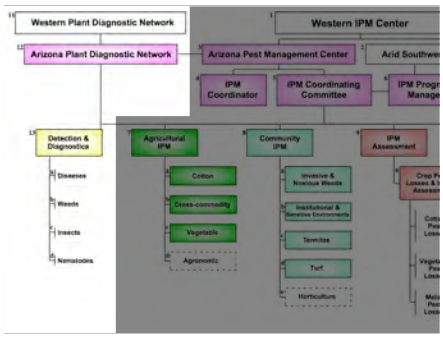


Each focal area houses several teams. These are the functional units of the APMC. These interdisciplinary teams address stakeholder needs in development of research and outreach programs around these themes. Dotted boxes represent relatively newly organized efforts.

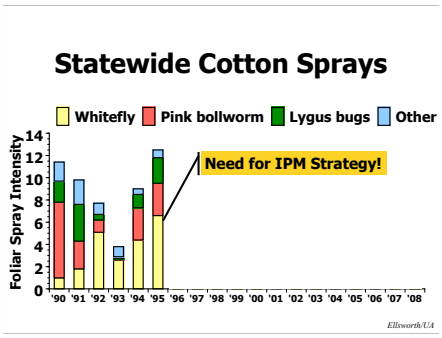


One thing should be evident; there are more boxes than there are people in entomology (in Extension) to fill them. Each of us leads and participates in multiple groups or teams.

We are a very limited resource stretched essentially to our limits.



Panning left, we reveal a 5th area in Detection & Diagnostics, a focus shared with a parallel organization, the National Plant Diagnostic Network. While their activities are very much related to detection of exotics and invasives with regulatory consequence, our interests are in supporting clientele needs for diagnostics in support of IPM. Carl Olson is our main resource here, but Dawn Gouge and many of the rest of us run official labs of the PDN system which is led locally by our adjunct faculty, Dr. Judy Brown.

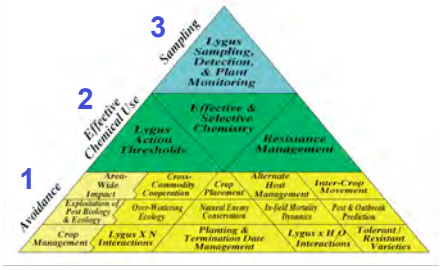


The situation in the past was dire. Cotton growers were spraying 5-15 times to control an array of pests. Whitefly, Pink Bollworm, and Lygus bugs are our 3 key pests of cotton in AZ.

There was a critical need for an IPM strategy, especially after the whitefly outbreak of 1995 precipitated in part by a resistance episode.

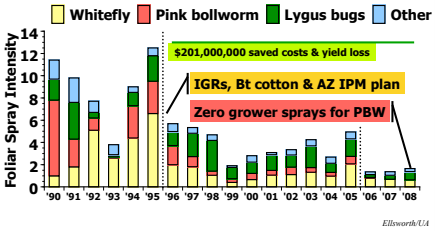
Statewide average cotton foliar insecticide spray intensity by year and insect pest (Ellsworth et al., 2007).

Cotton IPM



In 1996, through previous research efforts on the part of many different research and extension scientists both at the University and at partner organizations (USDA-ARS, state agencies, and industry), we developed and deployed an organized IPM strategy, which we have continued to refine and build upon for the last 13 years.

Cotton IPM Saves Millions $



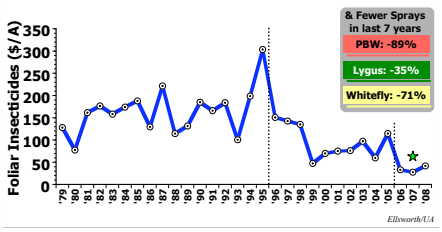
The results have been striking. A watershed of change occurred in 1996 with the introduction of very safe and selective Insect Growth Regulators for whitefly control, and transgenic Bt cotton, along with an IPM plan for whitefly management.

More recently, state agencies began a PBW eradication in 2006. For the first time since the mid-1960's, AZ growers statewide did not spray at all for PBW! Bt cotton is grown on 98.25% of the acreage. And whiteflies have faded from memory as a severe and unmanageable pest.

The credit we take for any part of this is shared with many, many others, but the result has been over $200M saved cumulatively since 1996.

Lowest Costs in 30 years

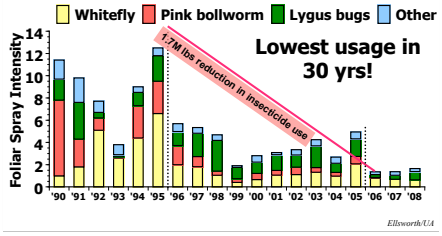
(inflation-adjusted to 2008 dollars)



Growers spent less on insecticides in 2007 than at any other time on record (30 years). Comparing the last 7 years to the 6 preceding the 1996 introduction of our new IPM plan, growers have sprayed far less than before. The average grower now sprays once or twice, with compounds that are relatively safe, far safer than anything used in the past, to control all insect / arthropod pests season-long. Cotton is grown from March to October.

Statewide average cotton foliar insecticide spray intensity by year and insect pest (Ellsworth et al., 2007).

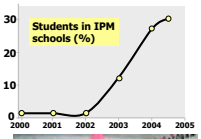
Health & Environment



The benefits extend to health and safety of workers on farm and the greater environment at large. Comparing our 30-year high in 1995 to our lowest usage in 2006, growers used 1.7 million lbs less insecticide!

School IPM Protects Children

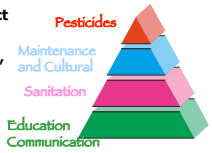
- Reduces pesticide use by 71%
- Reduces pest complaints by 78%
- Reduces costs by 31%
- Measurable improvements in indoor air quality
- 303,600 students benefit from schools practicing IPM



Our successes extend beyond agricultural field borders to other environments as well. Wherever there are arthropod pests, IPM can have impact. Here Dawn Gouge has had tremendous success in the development and deployment of IPM in schools. Over a 5-yr period, schools practicing verifiable IPM reduced their use of pesticides by 71%, their pest-related complaints by 78% and even their costs by 31%. At the same time, there have been measurable improvements in indoor air quality -- note that cockroaches are a major source of allergens in interior environments and can be a major trigger for asthma in children. Over 300,000 students have benefited from IPM in their schools!

Municipalities Reap Benefits

- Phoenix city pilot project reduces pesticides by 99% (Orpheum Theatre, Civic Center, Public Works Bldg.)
- Potential to reach 250 City facilities
- Substantial one-time facilities renovation costs



Ellsworth/UA

Cities and their facilities can benefit, too. Dawn Gouge is working with the city of Phoenix in a pilot project that includes a historic theater, the new civic center, and various public works buildings. In a very short time, they have reduced pesticides by 99%!

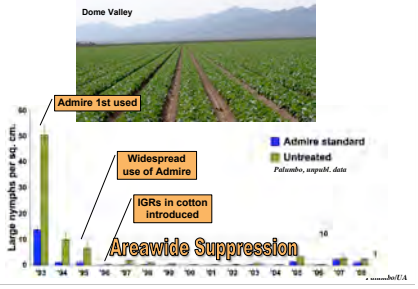
Levels of Integration in IPM
(from Kogan 1998, 2001)

- Level I – "Species / population level integration"
  - The integration of control methods for single species or species complexes
- Level II – "Community level integration"
  - The integration of the impacts of multiple pest categories on the crop and the methods for their control
- Level III – "Ecosystem level integration"
  - The integration of multiple pest impacts and the methods for their control within the context of the whole cropping system

Ellsworth/UA

IPM exists at different levels of integration. I some environments (city of PHX buildings, for example), our goal is just to get users to adopt an IPM strategy. However, in other environments where IPM has been in practice in one form or another for a long time (e.g., cotton in AZ), we wish to raise the level of integration to a point ultimately where the entire ecosystem is considered. Level I integration acts at the species or population scale; Level II at the community scale; and Level III integration operates at the ecosystem scale, the level we wish to advance science and understanding.

Areawide Pressure



A historic example of cross-commodity (or ecosystem level) interactions: John Palumbo established untreated blocks of lettuce within commercially-treated fields with soil-applied imidacloprid. In this chart, we see whitefly levels starting in 1993 when Admire was 1st used. Pressure was extreme as seen in the UTC green bar, but Admire did an excellent job at reducing these numbers. In 1994-1995, we see a period where widespread use of Admire was prevalent throughout the fall vegetable landscape and numbers were reduced in the UTC by nearly an order of magnitude. In 1996 through today, we enter a period where the IGRs were first registered and used in AZ cotton and used on a wide-scale. The result is another magnitude lowering in the overall whitefly density, and what we think of as area-wide suppression of whitefly populations.

Photo credit: JCP

Stakeholder Engagement

- **Pest Management Strategic Plans**
  - Gouge, Fournier: National School IPM PMSP
  - Ellsworth, Fournier: Desert Cotton PMSP
- **National/Regional Working Groups**
  - Gouge, Fournier, Baker: WR-School IPM
  - WERA-069 IPM, WDC-13 Urban IPM
  - Fournier, Gouge: Western IPM Center Advisory Comm.
  - Palumbo: IR-4
  - Ellsworth, Fournier, Palumbo: Crop Pest Losses
  - AZ, NM, NV, CA: Arid Southwest IPM Network
  - Baker: Western Regional Pesticide CE Meeting
- **Industry & Agency Partnerships**

Ellsworth/UA

"Stakeholder Engagement" is central to how we identify stakeholder needs and priorities, and in how we measure changes in behavior and assess impact of our programs, which then leads to further refinement of everything we do. Our Extension scientists have very extensive stakeholder networks that they engage regularly. PMSPs are an EPA-recognized mechanism for developing system-specific priorities. Our faculty are also involved with many national and regional working groups, as well as significant partnerships with industry and government agencies.

These interactions keep our programs focused and relevant.

Publications & Outreach

350 in last 7 years > 50 CEUs / yr

Ellsworth/UA

Our impacts are great and our approaches innovative; however, we also do the traditional activities of any successful Extension program. Our small core of Extension scientists have written over 350 publications over the last 7 years. We also support various credentialing and professional systems where Continuing Education is mandated. We offer over 50 CEUs each year.

I should note here, too, that we contend with unique environments in AZ. So unique that it is not possible to "import" IPM programs from other parts of this country (e.g., to control termites), because of our unusual fauna and climate. Also, we don't have the luxury of working only with insects. E.G., Bats are a key feature of the Sonoran desert and this is a recent bulletin that Dawn Gouge produced.

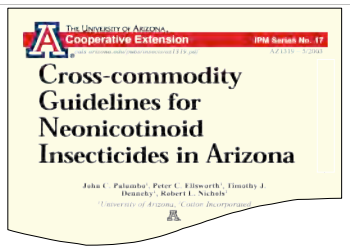
Cooperative Extension Model

- **Identify problem through stakeholder feedback**
  - **Stable whitefly management threatened by overuse of a key class of chemistry**
- **Develop solutions through applied research & education**
  - **Analysis of agroecosystem suggests variable risks; guidelines are generated, published & workshops conducted**
- **Assess & measure impacts and changes in client behavior**
- **Develop feedback & make adjustments in research & education**

Ellsworth/UA

What I have detailed so far today, quickly, is the classic Extension model, where workers identify problems through stakeholder engagement and they develop solutions through applied research and education. These are time-tested standards in Extension. However, a modern program continues with formal assessments that measure impacts and changes in client behavior. With this information, we can benefit from feedback that helps us make needed adjustments in our research & education programs.

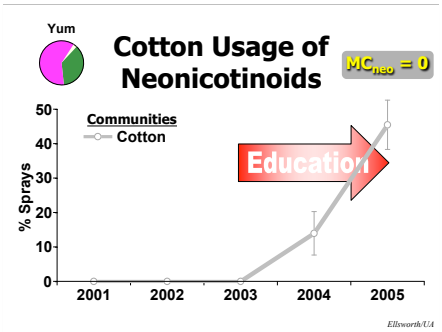
This completion of the Extension programming loop is what has contributed to our great success with extramural, competitive funding. It is no longer enough to "do something" and just say "it worked". This needs to be measured quantitatively.



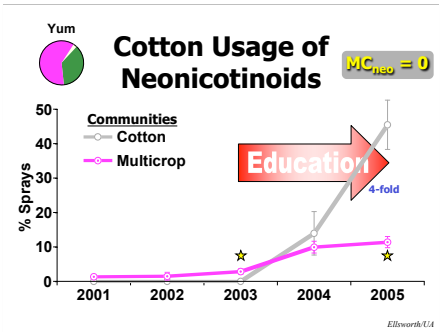
IPM & IRM guidelines emerged from a stakeholder-engaged process; simple yet ecologically-relevant

Ellsworth/UA

The specifics of the stakeholder process and "assessment" are beyond the scope of what I can cover in this presentation. However, I can share with you this one quick example. Guidelines, which were published and disseminated in 2003, were the result of a year-long, stakeholder-engaged process spear-headed and led by Dr. John Palumbo. By engaging clientele directly in the development of these guidelines, we were able to forge a very simple set of rules for neonicotinoid usage that they would be more likely to adopt.



Without going into the specifics, our guidelines were published in 2003 and should have impacted the rate of usage of a certain class of insecticides. We conducted educational workshops to support these published guidelines over a two-year period when these insecticides were being introduced to the market.



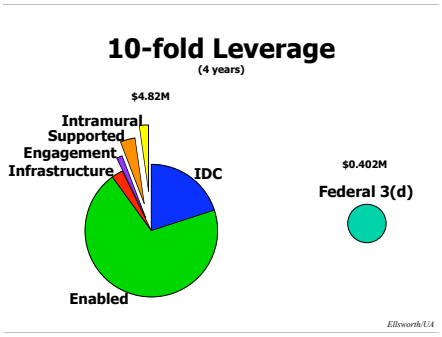
The net result was that we could show a 4-fold change in behavior with respect to the usage of these insecticides, consistent with the recommendations made in our guidelines.

Cooperative Extension Model

- Identify problem through stakeholder feedback
  - Stable whitefly management threatened by overuse of a key class of chemistry
- Develop solutions through applied research & education
  - Analysis of agroecosystem suggests variable risks; guidelines are generated, published & workshops conducted
- Assess & measure impacts and changes in client behavior
  - Cotton growers making insecticide use choices based ostensibly on guidelines
- Develop feedback & make adjustments in research & education
  - New data on imidacloprid performance; new products?

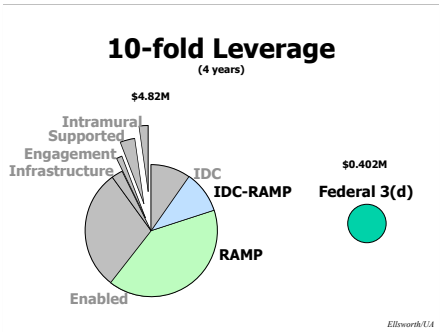
Ellsworth/UA

Growers did in fact alter their insecticide use patterns as a result of our guidelines. However, resistance remains a threat to this and other chemistries. We will have to consider this along with other results in the generation of new research, new guidelines, and education.

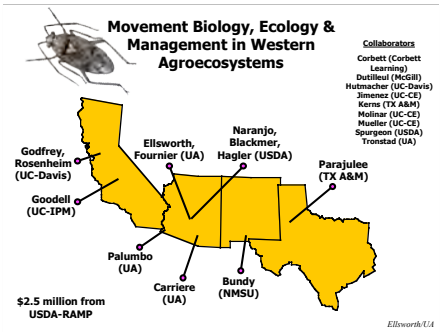


So how do we fund all this activity? Not nearly just with our federal 3(d) allocation. While critical to our infrastructure, this allocation has been leveraged 10-fold by other sources of funding, mostly extramural and mostly competitive grants.

We do have small intramural investments made by Extension. But everything else is extramural. We even write grants to support our stakeholder engagement efforts, and our infrastructure. The APMC also supports others in their pursuit of program grants. However, our largest fraction comes in the form of grants that we believe would not otherwise be possible if not for our organization as the APMC, i.e., "enabled".



I would like to finish by briefly detailing a very large, and very significant competitive "RAMP" grant we rec'd starting in 2006. USDA-Risk Avoidance and Mitigation Program grants are given to only 1 or 2 projects each year. We rec'd 2.5 million dollars…



… for the purpose of developing information that will help growers more efficiently manage Lygus over the entire western landscape. This is a large collaboration that we at the University of Arizona are leading.

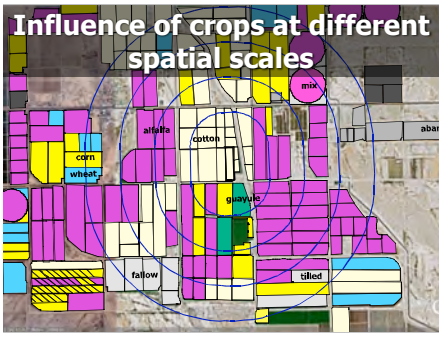
There are many projects in this grant designed to help us understand Lygus management and movement across the landscape. It features a dozen PIs from 4 states. AZ figures prominently with 5 faculty (incl. adjunct) from entomology.

Ellsworth, P., P. Goodell, M. Parajulee, S. Bundy, S. Naranjo, J. Bancroft, J. Blackmer, Y. Carriere, A. Fournier, L. Godfrey, J. Hagler, J. Palumbo & J. Rosenheim. Developing and Implementing Field and Landscape Level Reduced-Risk Management Strategies for Lygus in Western Cropping Systems. $2,500,000. (Sept 2006 - Aug 2010).

We are so large that we've never had everyone in one spot at one time, but this is about half of the overall team (including collaborators). Yves Carriere, Al Fournier (UA, adjunct), Steve Naranjo (USDA, adjunct), and Peter Ellsworth from entomology are shown. As part of our project, we organized an international Lygus symposium.

The project team. Missing PIs: Larry Godfrey (UC-Davis); David Kerns (Texas A&M); Jay Rosenheim (UC-Davis); Scott Bundy (NMSU).

This picture is from the 2nd International Lygus Symposium held at Asilomar Conference Center, Pacific Grove, CA, 15-19 April 2007, and sponsored in part by the APMC and the USDA-RAMP grant.



The RAMP includes over 30 subprojects. However, I'd like to just mention a very large one with sites in CA, AZ and TX. The objective of this project is to map out the agricultural landscape and measure the influence of different crops on Lygus dynamics through the system at various spatial scales.

The goal would be to identify patterns in our ecosystem that can be exploited for pest management. This project is inspired by work that Yves Carriere and colleagues in Canada have been doing in spatial analyses.

This sort of effort is the kind of advance we need to make to reach higher levels of integration in IPM.

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Needs & Future Goals

- Recognition
  - To address changes in federal climate
- Stable support for infrastructure
  - Fournier, just 20% state support
- Investment in CE and IPM curriculum
  - 2 positions Res/Ext, to develop IPM Programs
  - 2 positions Res/Teaching to develop applied curriculum & support IPM research
- New mechanisms for state-based funding

Ellsworth/UA

6 years ago, our commitment to CALS was to seize on an opportunity for extramural funding due to federal reorganization of IPM. We committed to re-organizing resources around the structure shown, focusing our limited resources on programs with achievable goals. Our commitment extends to developing the best and most relevant IPM programs possible. All this was done in an environment of transparency and with the goal of making Arizona's IPM programs as competitive as possible. In return, the APMC needs better institutional recognition and more stable support for our modest infrastructure. To capitalize on these investments and grow both our academic and Extension programs to meet the IPM needs in the state, 4 positions should be created and filled. We also need new mechanisms for state-based funding.

The Arizona Pest Management Center (APMC) as part of its function maintains a website, the Arizona Crop Information Site (ACIS), which houses all crop production and protection information for our low desert crops.

The APMC also maintains an organizational website cals.arizona.edu/apmc that includes a PDF version of this presentation for those interested in reviewing its content.

Photo credit: J. Silvertooth