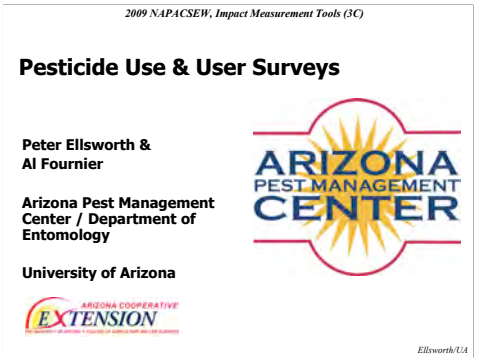
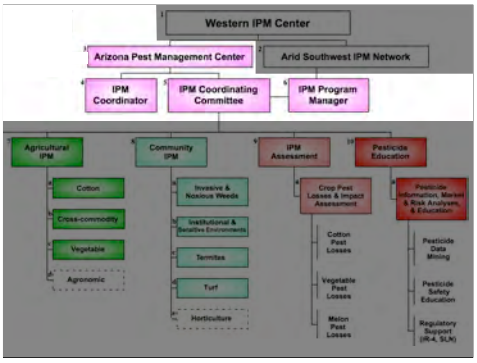


With my co-author, Al Fournier, I wish to present to you how we use pesticide use and other user surveys to assess programs in Arizona.

I am only recently part of the PSEP program, serving as Pesticide Coordinator only for a few months. But as IPM Coordinator, I have lead our re-organization over the last 6 years and formation of the Arizona Pest Management Center. The APMC maintains active programs of assessment with Dr. Al Fournier's expertise in this general area of program planning.

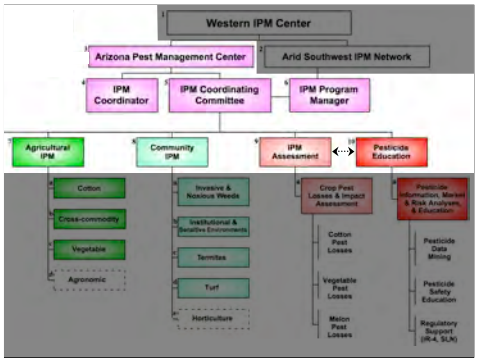
One thing we have learned is that our users are our best source of information when it comes to program assessment. However, we don't always have to "survey" them in order to get at what we need. I will be highlighting two examples, one through direct contact and surveying, and the other where we make use of 3rd party data that users already provide. This helps us reduced "survey fatigue", and also shows users how there information can be re-purposed for all sorts of positive outcomes.



Before I do, I thought it appropriate to review the structure of the APMC, since I am new to this group and to show you how we have re-organized our Pesticide Education focal area.

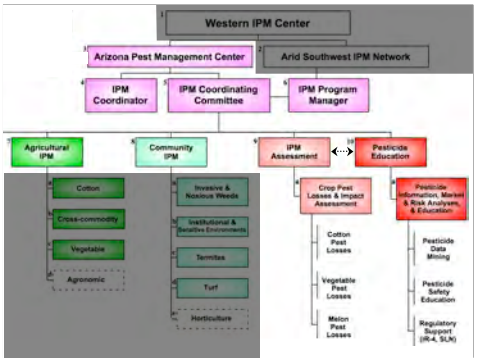
The APMC is managed by myself as State IPM Coordinator and IPM Program Manager (Al Fournier), as directed by a 20-member IPM Coordinating Committee*. Together, we oversee our federal obligation in IPM and Pesticide Safety Education as well as help represent our many diverse IPM programs that make up the APMC.

*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.

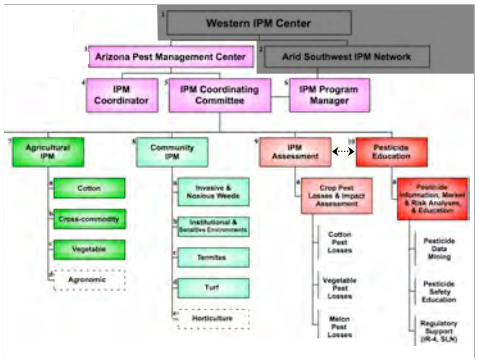
Today's talk shows the explicit interaction between these two focal areas, Pesticide Education and IPM Assessment.



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.]

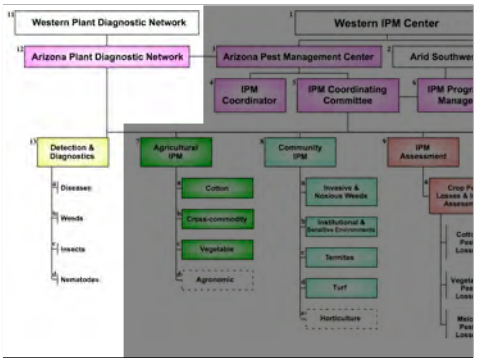
Within Pesticide Education, we mine pesticide data collected by the state, conduct traditional PSEP activities, and provide regulatory support to other programs.

Within IPM Assessment, we have active groups collecting and generating information about pest losses in cotton, leafy vegetables and melons.



Our core structure looks like this, though there are more boxes than there are people in the pest management disciplines (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 and beyond our limits.



There is a 5th area in Detection & Diagnostics, a focus that is shared with a parallel organization, the National Plant Diagnostic Network.

Our crop pest losses working group has as its goal to develop so-called real world data for the AZ and low desert regions of CA, which are typically underrepresented by other CA statewide efforts. Because of the similarity of our climate and agriculture, southern CA (e.g., Imperial County) shares more commonality with AZ than with the central Valley of CA.

Crop Pest Losses and Impact Assessment Working Group

- Who's Involved:
  - Peter Ellsworth (entomology, cotton)
  - John Palumbo (entomology, lettuce, melons)
  - Mike Matheron (plant pathology, lettuce, melons)
  - Bill McCloskey (weeds, cotton)
  - Eric Natwick (UCCE)
  - Al Fournier (coordination)
- County Agricultural Agents
- Pest Control Advisors
- Ag Industry representatives

Ellsworth/UA

This is a multi-disciplinary group made up of pest management Specialists and Farm Advisors, who directly engage County Agents, Pest Control Advisors and ag industry representatives.

Pest Management Industry

- Pest Control Advisors (PCAs)
  - Licensed, professional scouts & pest managers (220)
- Private & Commercial Applicators (820)
  - Ca. 42 aerial applicators (pilots)
- Growers

Ellsworth/UA

The industry is somewhat peculiar to the West where we have licensed professional pest control advisors (PCAs) who drive the pesticide use industry through their recommendations to growers. We have a relatively small applicator industry, with very few ag aviation businesses that cover very large areas and a great deal of spraying.

1979 – 2003

	Insects	Weeds	Pathogens
Cotton	✓		

National Cotton Council Beltwide Survey

Ellsworth/UA

Our approach has its origin in a survey that was developed for the cotton industry starting in 1979 and sponsored by the National Cotton Council. As one of this nation's best organized commodities, the cotton industry found value in collecting this information annually by state for insects.

I became involved with this survey process as statewide coordinator in 1992.

2004 – 2007

	Insects	Weeds	Pathogens
Cotton	✓		
Watermelon	✓		
Cantaloupe	✓		
Head lettuce	✓		

Work Group Funding from Western IPM Center

Ellsworth/UA

Starting in 2004, we decided to initiate a parallel process for watermelons, cantaloupes and head lettuce, under the leadership of Dr. John Palumbo, our Extension Vegetable IPM Specialist, with funding provided by the Western IPM Center.

2007

	Insects	Weeds	Pathogens
Cotton	✓		
Watermelon	✓		
Cantaloupe	✓		
Head lettuce	✓		
Alfalfa	✓	✓	✓

Ellsworth/UA

In 2007, we developed and pilot tested a multi-disciplinary survey for alfalfa.

2008

	Insects	Weeds	Pathogens
Cotton	✓	✓	
Watermelon	✓		✓
Cantaloupe	✓		✓
Head lettuce	✓		✓
Alfalfa	✓	✓	✓

Ellsworth/UA

In 2008, we continued expansion to other pest types for cotton and vegetables.

Crops & Pests

	Insects	Weeds	Pathogens
Cotton	✓	✓	
Watermelon	✓		✓
Cantaloupe	✓		✓
Head lettuce	✓		✓
Alfalfa	✓	✓	✓

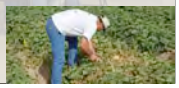
Ellsworth/UA

However, we have since retreated from our ambitious survey of alfalfa losses, due to the overly complex nature of that instrument. Growers and PCAs simply would not engage this survey as it was far too detailed and time-consuming, plus many had difficulty assigning losses in a perennial crop that has dozens of cuttings over the life of the crop. One problem was the challenge of assigning losses and costs of control to each individual weed. While insects are often managed individually and certainly perceived individually, weeds are more usually perceived as a large group or at best as grass, broadleaf, and sedge type weeds.

We had to abandon this effort but may some day re-work the approach and try again.

The Process

- Face-to-face workshop
- Invite PCAs; organize meetings around clientele schedules; offer CEUs
- Incentives for participation
- 2-way communication
- Follow-up with mail surveys



For years I managed the cotton survey as a traditional mail-in questionnaire. I quickly learned that return rates were terrible and much time had to be spent following up by phone. I also learned that these questions were not simple, and required significant explanation and understanding before the surveys could be completed properly.

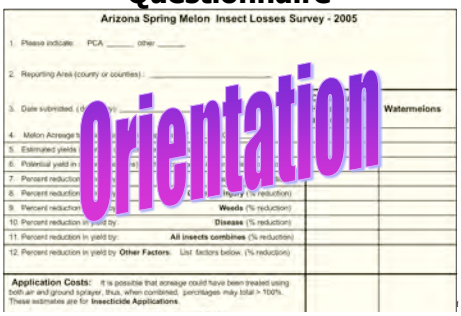
So we went to a face-to-face workshop format where PCAs in particular are invited in to "work" and provide data directly to us. The session is not an "add-on" to the end of another program. It is a dedicated session where they are told they will be providing direct input to our programs. It also has become an excellent vehicle for discussing the past season, what challenges they face, and what we can do to make our programs more relevant to them.

A Team Effort!

- Specialists design questionnaire with input from clientele
- Agents organize & promote meetings, provide data
- Program coordination through APMC
  - Direct contact with clientele
  - Follow-up mail surveys
  - Apply for grants; write reports

This is a team effort, with Specialists designing the questions, agents organizing the workshops, and coordination coming through Al Fournier and the APMC.

Questionnaire

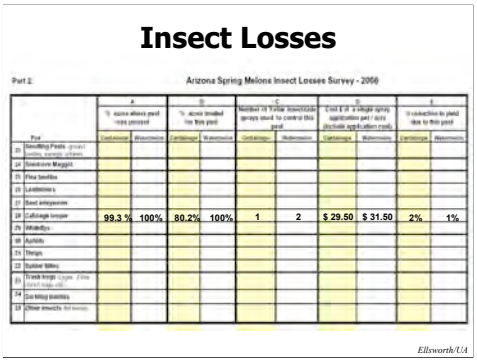


While I will not go over the specific questions asked, I do want to emphasize that any time you are asking stakeholders detailed questions, especially ones requiring analytical or mathematical skill, it is imperative that some orientation be provided to the process and some cross-checking questions be asked. Otherwise, one gets un-interpretable data back.

For example, losses is a complicated topic. Some do the entire survey and their tallies show ≥ 100% loss to insects! Not likely, but with these cross-checking questions, we are able to "divine the chads" and determine the real intent of their responses.

Other things are well ingrained in the industry and are simply factual, I.e., how much does one spray to control pest 'x' cost?

Insect Losses



Respondents are presented with a list of arthropod pests with specific questions about the percentage of acreage infested and sprayed for this pest, the no. of sprays required to control that pest on that acreage, and the cost of one spray targeting that pest.

The last column, % losses to this pest, becomes the most subjective and difficult estimate to create, but in general, with these high value crops, most practitioners have a fairly detailed knowledge of how many lbs or no. of cartons lost to a given pest. This is extremely valuable information, as many times, there is no academic or more authoritative source for such information.

Insecticide Survey

For each compound listed...

Never	Rarely (not every year)	Often (every year)	"Go to" Product	Primary Target Pest(s)	○Industry ◉PCA ○Grower County: Pinal Acreage: 2500	
					Acres (%) treated with this product	Avg. no. of times treated with product
○	◉	○	○	cutworms	2%	1

Several years ago, as an adjunct to this process, we added a short, 1-page, insecticide use survey. This allows us to track the importance of individual products or compounds to a local industry over time. These data have been very useful in responding to federal inquiries about the relative use and importance of key active ingredients.

Impact of the Data

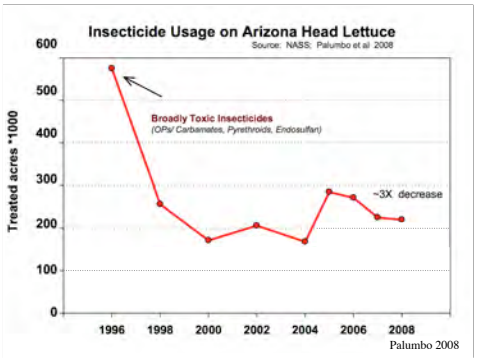
- Direct stakeholder input
  - 50 to 90% of scouted acres represented!
  - Economic impact of pests
  - Insight into control decisions, value of products
  - Identify & support pest management needs
- Respond to Federal information requests
- Evaluating IPM programs
  - Changes in IPM practices, products over time
  - Quantitative data on pesticide use
  - Qualitative input to improve programs

Ellsworth/UA

Higher than any other type of surveying process (including Presidential preferences by voting!), we obtain insights into 50–90% of all acres grown in Arizona for these crops!

Most importantly in this process, we gain a very detailed insight into the "intent" of users control decisions. Irrespective of whether a pest is on a label or not, we get a direct measurement of what they were intending to do when they decided to spray.

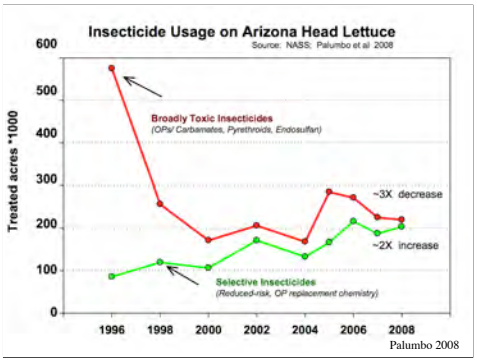
Ultimately we can use this information to improve our programs.



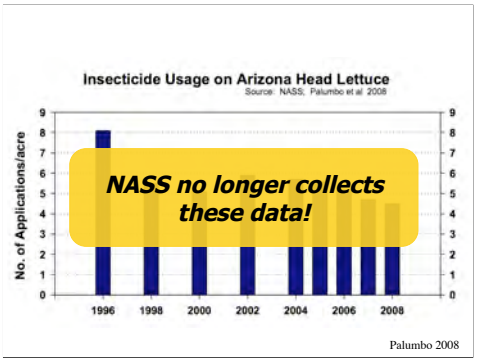
An example from the Head Lettuce survey:

Here John Palumbo has carefully bridged and combined data from NASS surveys and his own lettuce survey to show a rather significant 3-fold decline in the use of broadly toxic insecticides.

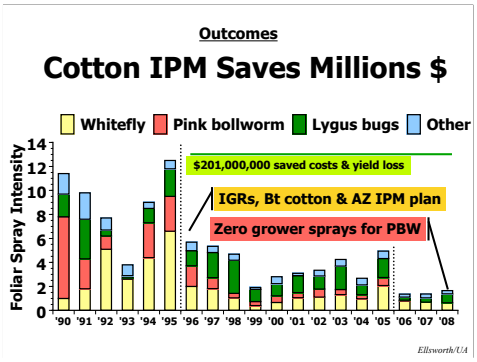
But that is only part of the story…



John is also able to show that over this same time period, the usage of selective insecticides including reduced-risk and OP replacement chemistry has increased 2-fold.

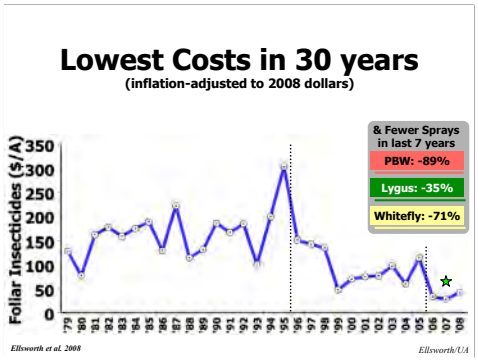


Furthermore, John is able to show progressive reductions in the no. of sprays made. This is more critical to us than ever because NASS has discontinued this service. These historical trends and perspectives are very important to us internally as well as to the industry that wishes to make or track changes and to federal policy-makers.



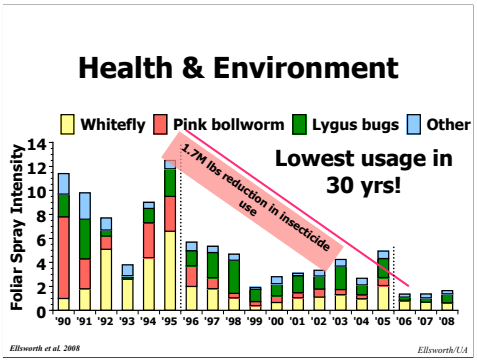
An example from AZ cotton:

Assessments lead to outcomes and impacts, which are critical to documenting success and attracting future funding. 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 our programs take for any part of this is shared with many, many others, but the result has been over $200M saved cumulatively since 1996.

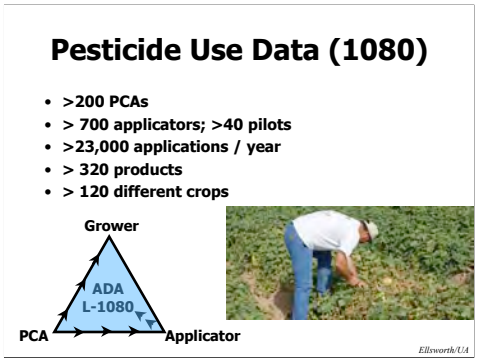


At the same time, we learned that cotton growers spent less on insecticides in 2007 than at any other time on record (30 years). Comparing the last 7 years to the 6 preceding the 1996 introduction of our new IPM plan, growers have sprayed far less than before. The average grower now sprays once or twice, 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., 2008).



These 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!



3rd party data can be just as important. In this case, we have a system of PCAs who, in consultation with their growers, prescribe the usage of pesticides by supplying them with a written 1080 form. This 1080 is also supplied to the applicator who upon completing the spray completes the 1080 and forwards it onto our state lead agency, the Arizona Department of Agriculture.

While we do not have a 100% mandated reporting system, some chemistry is always reported by law and still others are reported as a matter of routine and convenience. Overall, on average, 23,000 applications are reported of over 300 products applied to more than 100 different crops in Arizona.

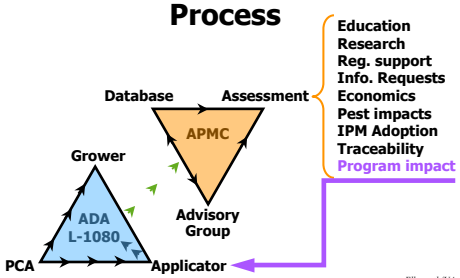
L-1080

- PCA initiated
  - Crop, legals, location
  - Product, a.i., rate
  - Target pest(s)
- Applicator completes
  - Date of application
  - Deviations
  - Signature
- Sent to ADA

Ellsworth/UA

So what is the "1080"? It is a form that contains all the information relevant to pesticide application including the crop, pest target or targets, location (legal descriptions), product, rate, date of application and any deviations. All this is sent to ADA for encoding into their in-house database.

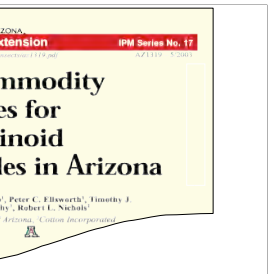
1080 Information Flow Process



Ellsworth/UA

The APMC has an excellent partnership with ADA who does the initial data entry and data checking and of course is responsible for compliance monitoring and enforcement. Maintaining a strict differentiation between regulatory and research/education activities, the data are passed to the APMC where they are post-processed by our database technician and shared with our stakeholder advisory group. This group is critical to guiding the usage of these data and for developing policy on its usage for assessment research and education.

Importantly, however, we close this feedback loop so that rather than information always going in only one direction (i.e., to ADA), we carry back key information to our stakeholders that help us determine program impact and meet other stakeholder needs. They appreciate this.



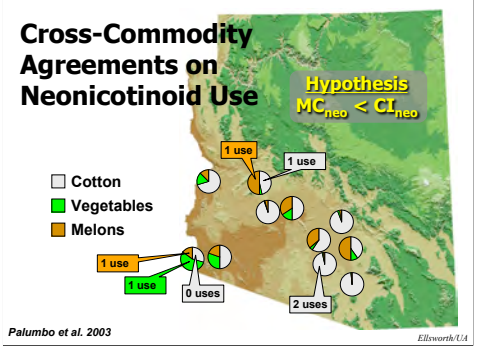
IPM & IRM guidelines emerged from a stakeholder-engaged process; simple yet ecologically-relevant

Ellsworth/UA

An example of 1080 data usage for spatially measuring IPM in multiple crops.

A few years ago, in a stakeholder process, we developed guidelines for the usage of neonicotinoids, a key class of insecticides used by growers of many different crops. In the old model, our educational effort would end there. Today, however, we are interested in whether these voluntary guidelines, were adopted or not and if not, why not?

Cross-Commodity Agreements on Neonicotinoid Use

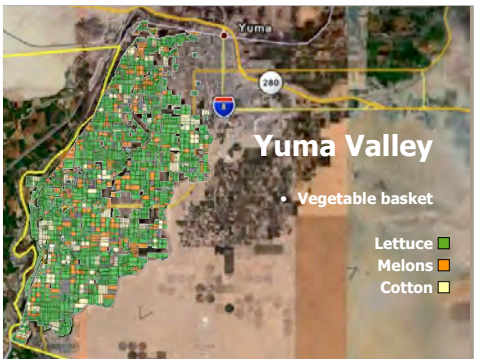


Palumbo et al. 2003

Ellsworth/UA

Without delving into the full set of guidelines, they in essence boil down to resistance management suggestions that restrict usage of the neonicotinoid class based on the cropping complexity of the area a grower is in. For example, growers of cotton in different communities have access to as few as 0 and as many as 2 uses of this class of chemistry.

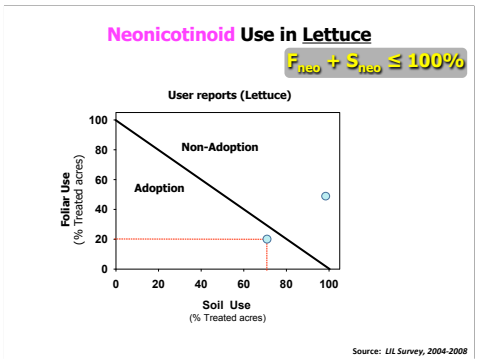
So, cotton growers in Multi-Crop communities should be making less use (if any) of neonicotinoids relative to cotton growers in Cotton-Intensive communities within similar localities (to control for differences in pest pressures).



We also have access to detailed GIS-based crop maps statewide as maintained by a cotton-grower agency, the Arizona Cotton Research & Protection Council. Between these two datasets we are able to identify the cropping make-up of each "community".

So here we have Yuma Valley, adjacent to CA and Mexico, and an area that represents the winter vegetable basket for our nation. It is a very intensively cropped area made up of cotton, leafy vegetables (mainly lettuces) and melons grown year round.

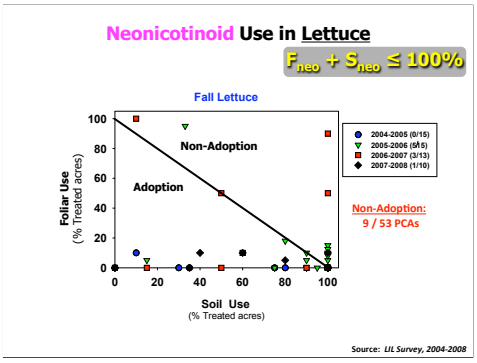
In this sort of community, cotton growers have agreed to forego the usage of the neonicotinoid class because of the inherent risks of year-round usage of this class on all these high value crops.



Switching back to our pest losses dataset, we can examine specific behaviors for this class of chemistry. In this chart we show how lettuce growers make use of the neonicotinoid class of chemistry as reported in user reports of our Vegetable Insect Losses workshops.

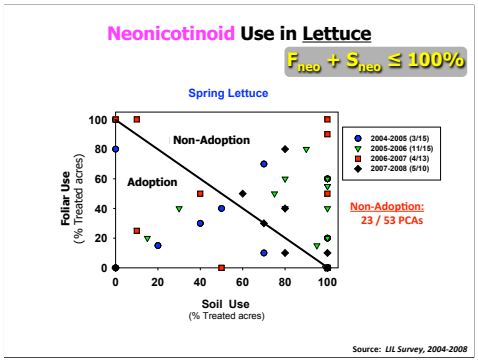
With foliar uses on one axis and soil uses on the other, we can see whether they are observing our guidelines by not using foliar neonicotinoids over the top of crops that have already been subject to a soil neonicotinoid. A user reporting 70% acres of soil use and 20% acres of foliar use of this class (total 90%) indicates likely adoption of the guidelines. However, a user who reports 100% soil use AND 50% foliar use is clearly outside the guidelines.

Data from Palumbo, unpubl.



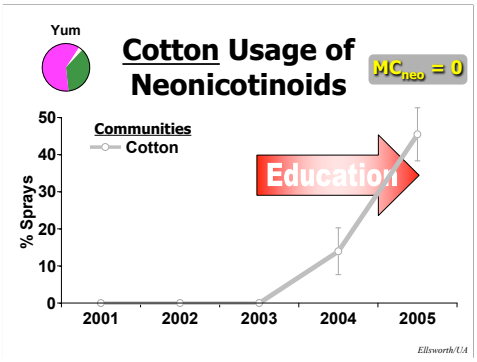
Looking at growers of fall lettuce from 2004-2007, we can see that the majority of pest control advisors (PCAs) are within the adoption zone. There are some examples where non-adoption is occurring, 9/53.

Data from Palumbo, unpubl.



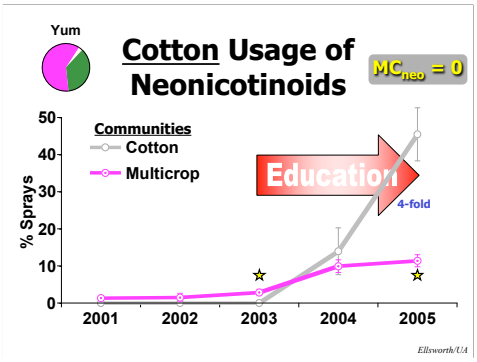
Things looked good in the fall where they are battling whiteflies primarily. However, in spring lettuce, the picture changes and now shows closer to 50% non-adoption. Why is this? As it turns out, many of these neonicotinoid uses are targeting aphids rather than whiteflies, which are less of a concern in the spring crop. So perception of the resistance risk may be quite different between users in the fall vs. users in the spring.

This assessment points to much needed dialog on the spring lettuce crop.



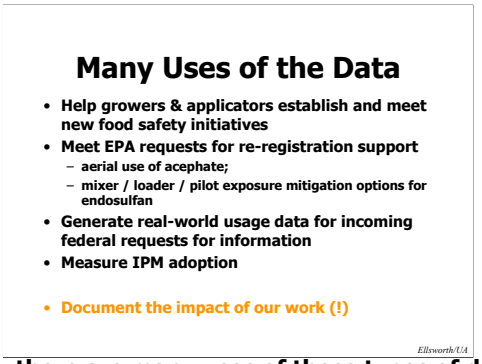
Over this same time period, we can examine the 1080 pesticide use database and measure the percentage of sprays made that contained a neonicotinoid for cotton fields in Cotton-Intensive communities of Yuma Co. These growers should be limited to no more than two non-consecutive neonicotinoid sprays (gray line). Cotton neonicotinoid usage started at 0% in 2001-2003 and increased as acetamiprid use increased, topping out at ca. 45%.

Our guidelines were published in 2003 and our educational efforts were intense to begin with and then re-intensified in 2005 (red arrow).



In contrast, cotton growers in Multi-Crop communities of Yuma Co. had very small usage of this class of chemistry in 2001-2002, and significantly higher usage in 2003. By 2005, the trend was reversed, presumably as a result of our education, showing a 4-fold reduction in neonicotinoid usage in comparison to cotton users in Cotton-Intensive communities.

Of course, the guidelines would have suggested no neonicotinoid usage in Multi-Crop communities. So ca. 10% of the applications made may have been at odds with the guidelines (though exceptions do exist in the guidelines themselves permitting use of neonicotinoids under limited conditions).



In sum, there are many uses of these types of data. Some may not initially be anticipated. For example, new food initiatives are being developed to combat the risk and the perception of risk for food-borne illnesses. Some of these programs can be bolstered through various food traceability efforts including detailed pesticide use records. We also have contributed meaningful and objective data and information to re-registration processes and other federal information requests.

Ultimately, we can measure IPM adoption and potentially adoption of other pesticide use practices related to Pesticide Safety Education Programs. Documenting the impact of our work is an issue of accountability as well as stakeholder interaction, where more and more demands for transparency and two-way flow of information are expected.

For more information, please visit these APMC resources.

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