Measuring Adoption of Cross-commodity IPM Guidelines for Whitefly Control

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I'm Al Fournier with University of Arizona and the Arizona Pest Management Center. Today, I will present results from a Western Regional IPM Grant to evaluate adoption of cross-commodity guidelines for whitefly management in Arizona cotton, melons and vegetables. I'd like to acknowledge my co-authors, Peter Ellsworth (lead PI) and John Palumbo, who contributed to the analysis and many of the slides, and Yves Carriere, who was involved in the spatial analysis of these data.

Do Growers Follow Our IPM Guidelines?

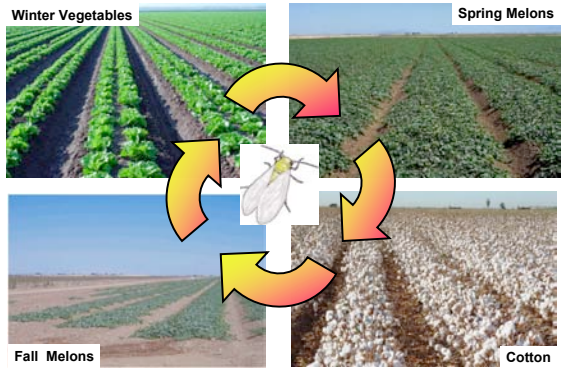
- **Assessed adoption of cross-commodity IPM guidelines (pesticide use records)**
- **Examined user practices and perspectives (interviews)**

To determine if growers follow our IPM guidelines, we examined grower pest management behaviors using state pesticide use reports and by conducting interviews with a dozen Pest Control Advisors (PCAs).

Part 1:
Whitefly Management in Arizona

First, I will provide some background on Whitefly management in Arizona.

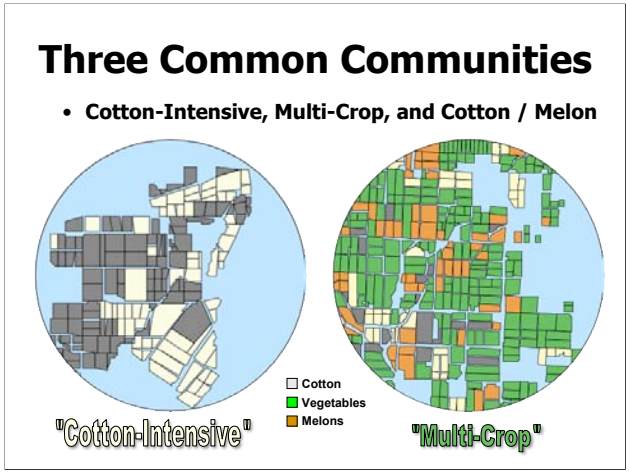
Intercrop Interactions



Photos: John Palumbo

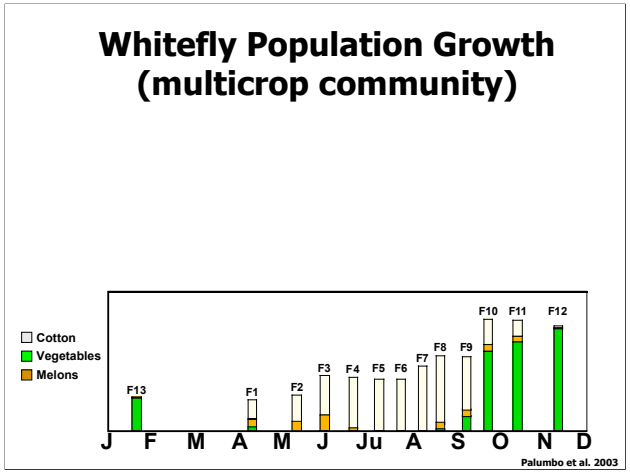
AZ's year round growing season provides for a sequence of crop plants: winter vegetables (e.g., broccoli, lettuce), spring melons (esp. cantaloupes), summer cotton, and fall melons. These crop "Islands" provide perfect habitat for whiteflies. WFs move from crop to crop as the season progresses, with the potential to do economic damage to any crop. This potential for intercrop interactions demands a high level of integration of our IPM programs for various crops.

Furthermore, with registrations of key whitefly chemistries across multiple crops, resistance management becomes a shared responsibility that extends across commodity borders. Cross-commodity cooperation is the key to a sustainable resistance management plan in Arizona, and we have achieved some remarkable agreements among

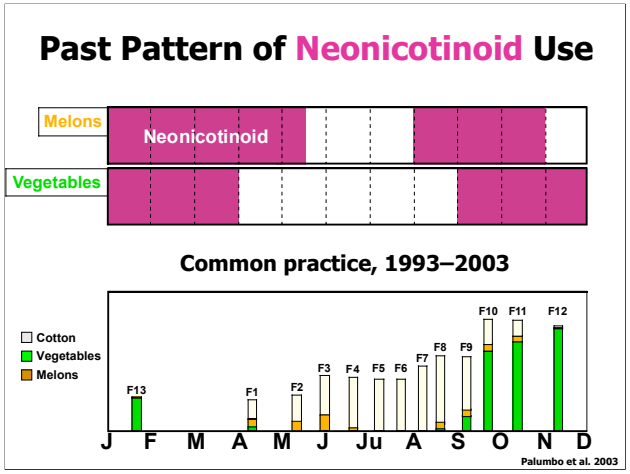


In some agricultural areas of Arizona, these crops are all grown in close proximity, while other areas specialize in intensive cotton production, or cotton-melon production.

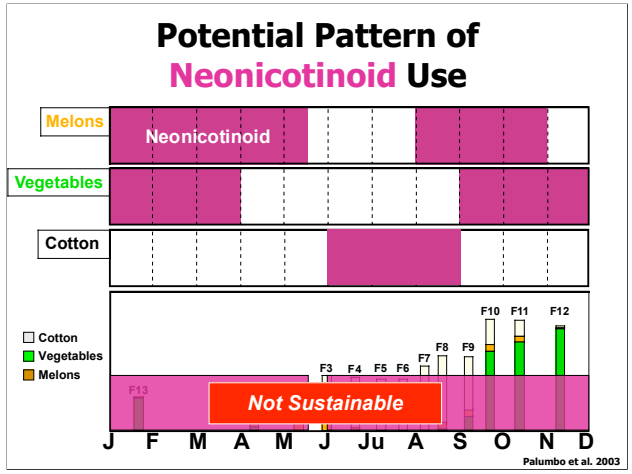
We can identify three distinct cropping "communities": Cotton-Intensive, Multi-Crop, and Cotton/Melon (not pictured). White = cotton; orange = melons; green = vegetables (mostly lettuce); and gray = non-treated and/or non-whitefly hosts.



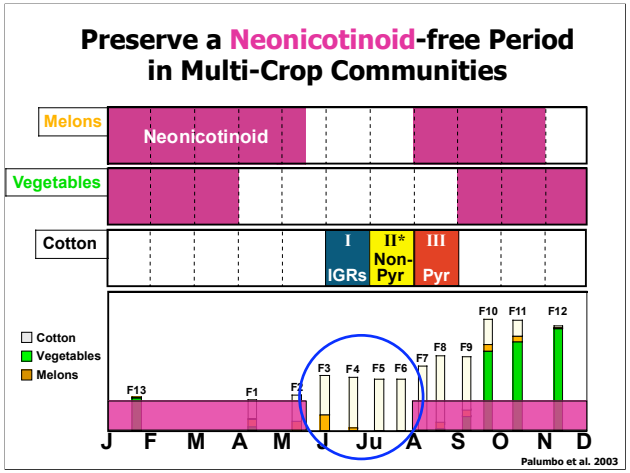
Let's look at how WF populations develop across these crops in a multicrop area. This slide shows the generational production and relative abundance of whiteflies through time on the various crops, where green represents the contributions of vegetables to whitefly abundance, white for cotton and orange for melons.



This slide shows the established pattern of neonicotinoid usage, or really the periods during which residues are present, before the guidelines were developed. This is for vegetable and melon crops produced in Yuma valley. This pattern of usage was the de facto practice for 10 years while essentially only soil-applied imidacloprid was being used, without bioassay detections of resistance.



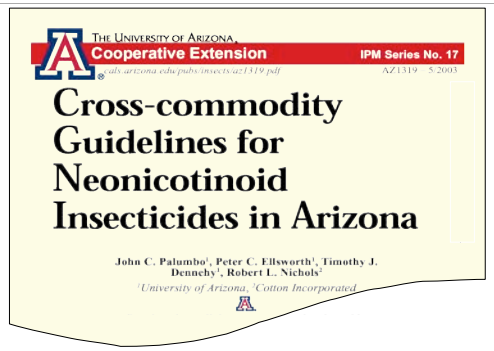
Now consider: If neonicotinoid use was to expand to cotton in these complex communities, these products would be used in the mid-summer window as well. Transposing these potential use patterns over whitefly generations, and the potential problem becomes apparent. This potential overall use pattern for neonicotinoids in this ecosystem is, we believe, not sustainable.



Despite new registrations of neonicotinoids in the early 2000s, we concluded that cotton growers should depend on an earlier whitefly management plan that includes selective IGRs, used first, and non-pyrethroid and pyrethroid insecticides as needed, rather than making use of the newly available foliar neonicotinoids in cotton.

This effectively sustains a neonicotinoid-free period that had been the de facto condition in these complex communities for the previous decade (1993-2003).

Part 2: Cross-Commodity Guidelines



IPM guidelines emerged from dialog with grower communities; simple yet ecologically-relevant

This was the conclusion reached by John Palumbo, Peter Ellsworth, and a diverse group of growers, pest control advisors and industry representatives that studied this issue and developed the Cross-commodity Guidelines for NN use, which were published in 2003.

By engaging clientele directly, we were able to forge a relatively simple and practical set of rules for neonicotinoid usage among different cropping communities in AZ. We attempted to consider practical management issues as well as whitefly biology and movement, to develop spatially and ecologically-relevant guidelines.

Sharing Neonicotinoids

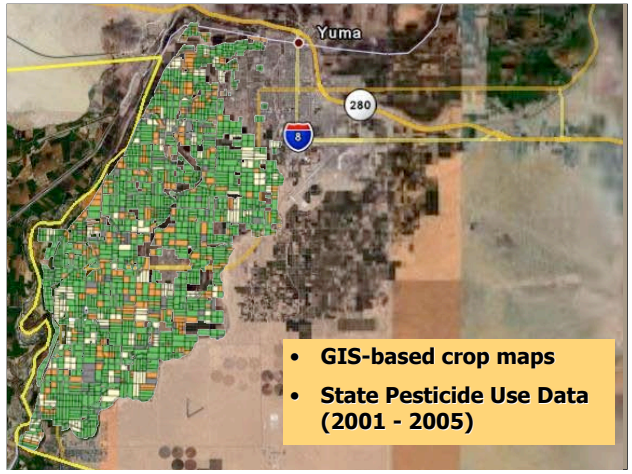
Neonicotinoid Limitations:*
Maximum usage by crop per season

Community	Cotton	Melons	Vegetables
Multi-Crop	0	1	1
Cotton / Melon	1	1	—
Cotton-Intensive	2	—	—

*Seed, Soil, or Foliar

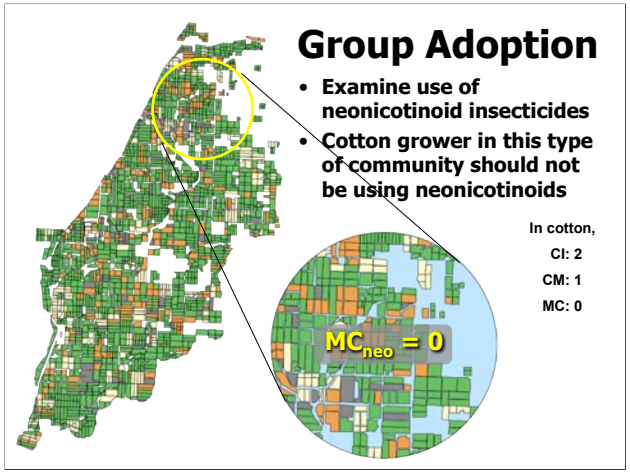
The guidelines essentially restrict neonicotinoids (as a class) to just two uses per cropping community. In a Cotton-Intensive community, growers of cotton can use up to 2 non-consecutive neonicotinoids per season, while in Cotton/Melon communities, those two uses are shared between the cotton and melon grower. Perhaps most controversial, in the Multi-Crop community, the cotton growers there forego any usage of this chemical class, reserving the two uses to melon and vegetable growers there who are so dependent on this class for their whitefly control. Seed, soil or foliar uses all "count" as NN use. In today's talk I will mainly focus on comparing adoption of the guidelines among cotton growers in these different communities.

Part 3:
Measuring Adoption of the Guidelines



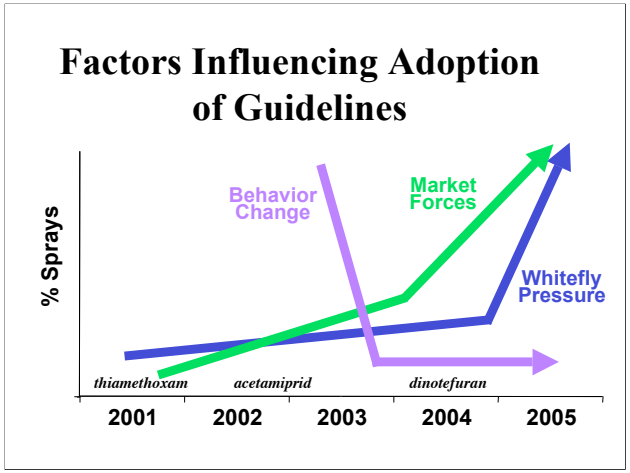
We also have detailed GIS-based crop maps maintained by the Arizona Cotton Research & Protection Council. By merging pesticide use records with the maps, we are able to identify the crops grown in each geographic area.

Our goal is to measure community compliance with our cross-commodity guidelines. Because the unit of interest is a community, individual behaviors are not as important as the adoption by whole groups within each community. I will present a simplified analysis that focuses mainly on cotton-grower use of neonicotinoids. But before I show the data, I would like to briefly explain the approach we are taking.

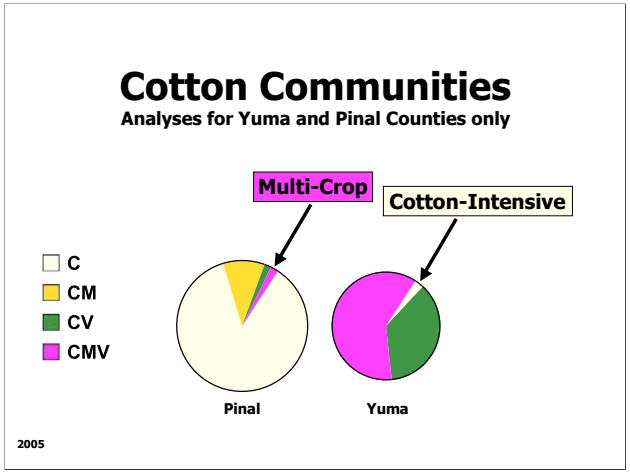


If we look at this example of the Yuma Valley in Southwestern Arizona, neonicotinoid use by cotton growers within these Multi-Crop communities should equal zero.

Using the 1080 data, and an approximation of the spatial definition of a community, we can test this hypothesis.

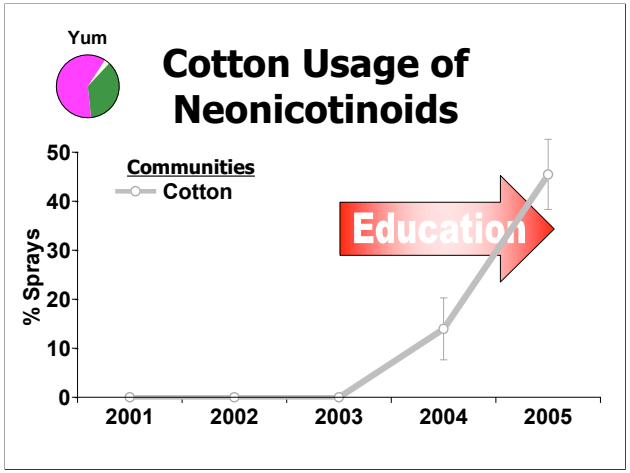


Documenting changes in behavior through time requires a clear understanding of competing forces & inherent change in the system. Market forces (new registrations) push users towards greater usage. In 2001, thiamethoxam was available, but by late 2002, acetamiprid became available as well. Still later (2004), dinotefuran was available to cotton growers. All the while, imidacloprid was available as a foliar spray either alone or in mixture with a pyrethroid. Whitefly pressures also change over time. In our case, pressures were low but increasing 2001-04 until 2005 when whitefly pressures were at a decade high. This pushes usage upward. Our impact on behavior should show some kind of decline in usage as a consequence of deployment of our educational programs for cotton growers in Multi-Crop communities.



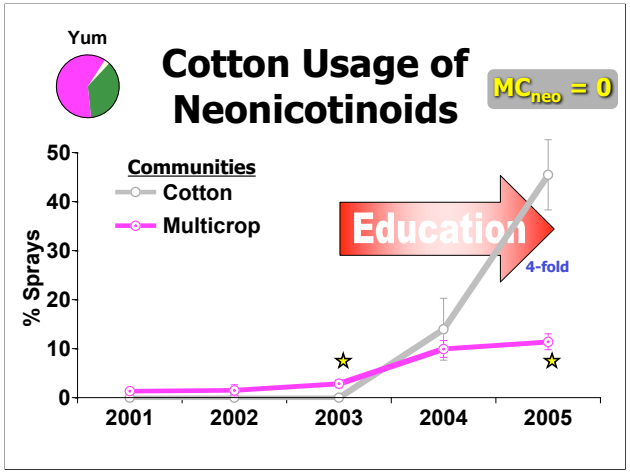
This bubble chart indicates the number and types of communities that grow cotton by county. As expected, there are very few Cotton-Intensive communities in Yuma county, but they do exist there! Conversely, there are very few Multi-Crop communities in Pinal (or Maricopa) counties, but again they do exist there.

Our analyses will focus on these larger agricultural counties where most of the whitefly applications are made each year.



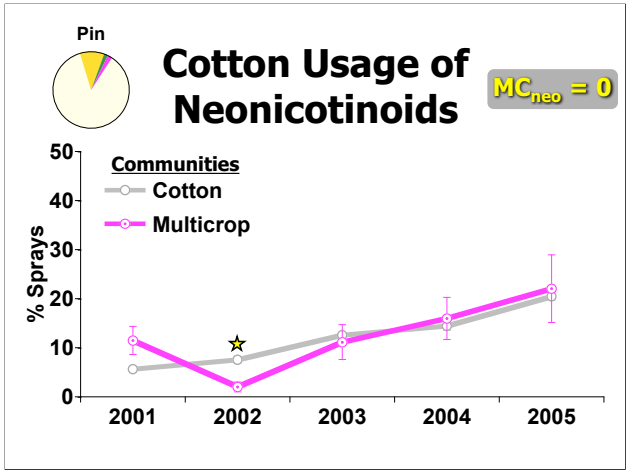
% Sprays that contained a neonicotinoid for cotton fields in Cotton-Intensive communities of Yuma Co. These growers should be limited to no more than two non-consecutive neonicotinoid sprays (gray line). Cotton neonicotinoid usage started at 0% in 2001-2003 and increased as acetamiprid use increased, 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).



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 were at odds with the guidelines.



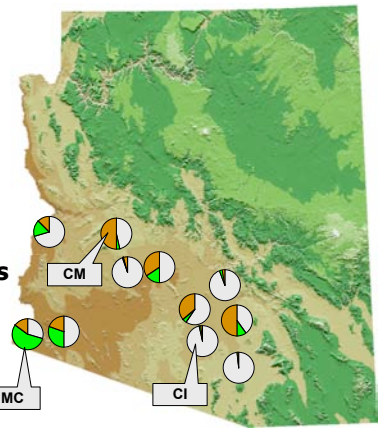
The conclusions are quite different as we move to the central part of the state and examine Pinal Co. usage data. Here it would seem that the clientele do not differentiate their usage of neonicotinoids by community type. The reasons for this are unknown at this time, but qualitative analyses of subject interviews should help us understand if this is a problem with the guidelines, perception of spatial dynamics, or perception of risk, among other potential factors. It could be as simple as growers not recognizing they are operating within a Multi-Crop community, for example.

Part 4:
Interviews with
Pest Control Advisors

In 2008, I conducted interviews with 12 pest control advisors. These are professional consultants that work for the growers to scout for pest problems and make recommendations on pesticide use. They are often the true decision makers when it comes to pest management. The goal of the interviews was to understand the PCA perspectives on the cross-commodity guidelines and to identify factors that positive or negatively contributed to their adoption.

Methods

- Selective sampling (n=12)
- 3 growing regions
- Multiple crops
- Average experience = 23.2 yrs (8 to 42 yrs)



I used a selective sampling strategy. I identified a number of PCAs that worked in the different growing regions and were responsible for watching mainly cotton, mainly melons, or a mixture of crops. PCAs had an average of 23.2 years worth of experience and were responsible for a high percentage of reported applications in the 3 crops.

Adoption - positive factors

- University of Arizona outreach
  - 83% "aware" of guidelines
  - 67% "influenced" by guidelines
  - Participation in development of guidelines
- Many product choices
- Low whitefly pressure in recent years
- Yuma cotton growers were primarily vegetable producers

The UA outreach program was cited as influencing behavior and pesticide choices. Based on PCA interviews, 83% of those interviewed were aware of the guidelines and 67% indicated that their pest management decisions were influenced or strongly influenced by the principles outlined in the guidelines. Participation in the process of developing the guidelines was positively associated with their adoption. However, even staunch supporters indicated there were situations, rarely, when the guidelines would take second priority to immediate control needs. Other factors that contributed to adoption: Many product choices (including new aphicides in lettuce, e.g., Movento); Low whitefly pressure in recent years; and cotton growers in Yuma were primarily vegetable growers, growing short season cotton in rotation.

Adoption - negative factors

- Influence of grower on product choice
- Influence of price on product choice
- Generic neonicotinoids
- Pinal County cotton growers more focused on cotton yields

Factors that negatively affected adoption of the guidelines included: influence of the grower on PCA product choice, combined with lower prices for neonicotinoid products versus IGRs (importance of this ranged dramatically among PCAs); specific situations, such as early whitefly infestations in cotton in MC communities (too early to apply an IGR and expect control through to defoliation); availability of generic neonicotinoids, which has reduced their cost; and prevalence of imidacloprid-treated cotton seed in parts central AZ, which has reduced compliance in CM communities.

Conclusions

- **Guidelines developed** to address WF resistance concerns
- Our analysis showed **partial but incomplete adoption** of guidelines
- **+ Factors:** UA outreach, alternate product choices, low WF pressure
- **- Factors:** Influence of grower and cost on product choice, generic neonicotinoids

In conclusion, the cross-commodity guidelines developed through a stakeholder dialog to address resistance concerns were partially adopted by growers in Arizona. Cotton growers in multicrop areas of Yuma showed significant adoption. We identified several factors that either positively or negatively influenced guidelines adoption, and identified the need to revise and expand guidelines in the future.

Photo credit: J. Silvertooth

A large group of people are involved in the larger effort to research, develop, and disseminate cross-commodity whitefly management programs [e.g., T.J. Dennehy, Y. Carriére, C. Ellers-Kirk (all UA); S. Naranjo, J. Blackmer, S. Castle (USDA-ARS); P. Dutilleul (McGill U.); R.L. Nichols (Cotton Inc.); AZ Cotton Growers Assoc., Western Growers Assoc., AZ Crop Protection Assoc.]. In addition, we thank the ADA and AZ-NASS for cooperating on the development of a pesticide use database; WRIPM & Cotton Inc. for providing grant support; and the Arizona Cotton Research & Protection Council for providing GIS mapping support.

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, including a PDF version of this presentation for those interested in reviewing its content.