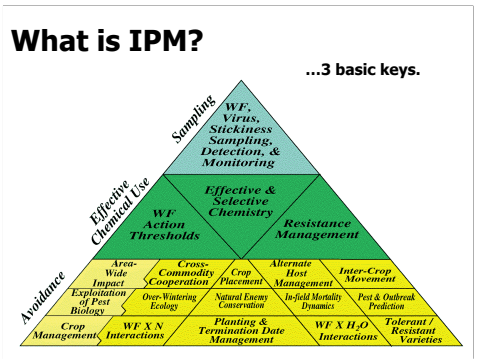
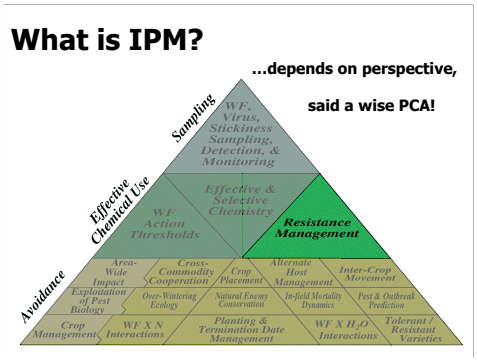
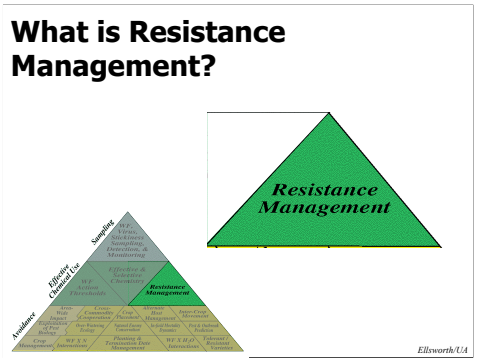
I would like to explore the diversity of chemistry we rely on in cotton insect management and provide a rationale for you as to why Cotton IPM depends so heavily on the wise professional choices made by our pest management industry.



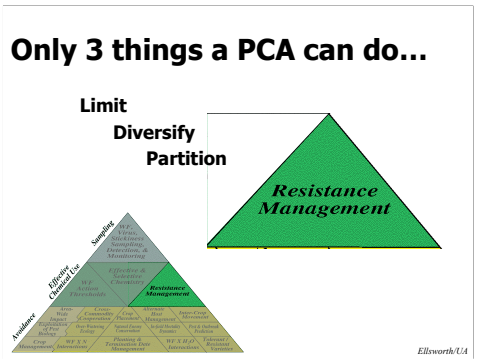
After seeing me present this model for IPM many times before, it may seem odd for me to pose the question "What is IPM?" But I think perspective is important when addressing this question. To me, it can be represented this way, shown as a stable structure rooted in avoidance and prevention practices but very much dependent on effective remedial actions being taken using our chemistry wisely and always guide by eyes on the field and formal sampling programs.



But recently I heard something on this question that stopped and made me think, and conclude that it really is a matter of perspective. And in this perspective, one of a well-respected and experienced Pest Control Advisor (PCA), IPM <u>is</u> "resistance management".



In my model for IPM, "resistance management" is but one building block in the Effective Chemical Use layer of management. Important, to be sure, but still a building block of IPM.



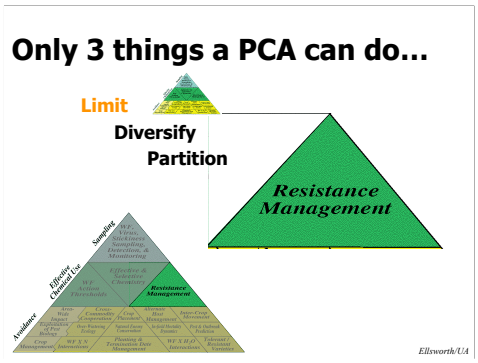
Short of new technology bailing us all out in the nick of time, a practitioner, a PCA, can only manage resistance in one or more of three ways:

Limit his/her use of the chemistry to the lowest practical level,

Diversify the modes of action used, and

Partition chemistry through space or time so as to provide relief from resistance selection in certain crops or at certain times.

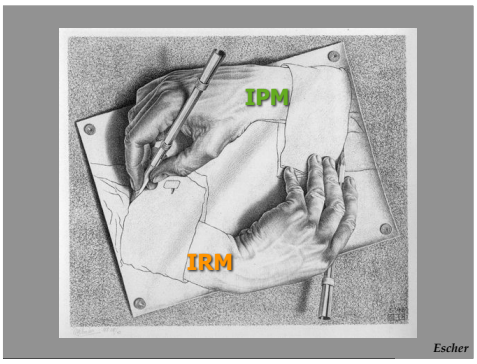
That's it. Practically speaking, these are the only tactics of resistance management available.



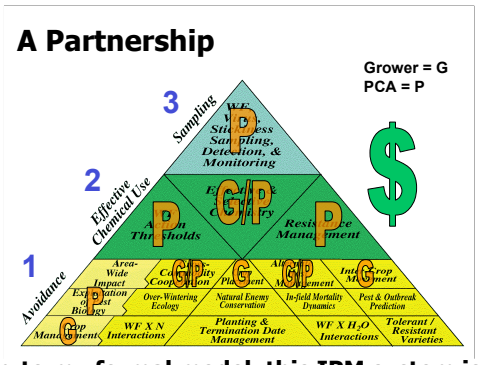
So let's focus on the first one, Limit chemistry. How does one do that? I would say you do that by practicing good IPM! If you are, you are already employing a suite of avoidance and prevention tactics and observing action thresholds that help limit the number of sprays made.

Thus, it is quite clear, when considering this perspective, why a PCA might see that IPM = Resistance Management.

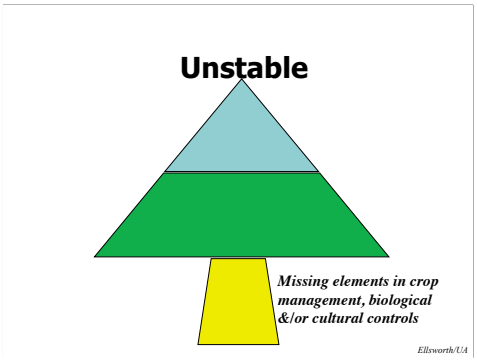
I would suggest that we are saying the same thing here.



Borrowing from a famous Escher drawing, we can ask "Which hand is making the drawing?" Much like the IPM / IRM conundrum, the two are inextricably linked and each could be considered nested within the other. Both perspectives are right!

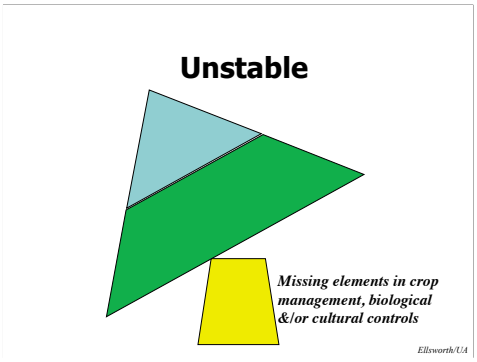


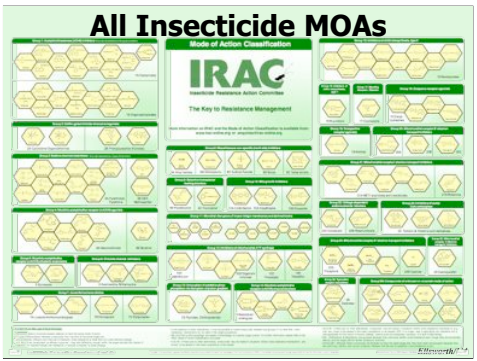
Returning to my formal model, this IPM system is an explicit partnership between grower and PCA. Some elements are clearly under the control of the PCA, while others the grower, and still others may be shared responsibilities of the PCA and grower. The difficulty therefore is making sure both parties have a clear understanding of their role in the efficient management of this pest. Sampling, timing, choice, and management of chemistry tend to be activities the PCA is engage in. Growers, on the other hand, make strategic decisions about crop placement, variety, and on a wide array of crop management inputs. Furthermore, and in the end, growers control the purse strings and can veto virtually any other decision made by the PCA or others in this system. So it is important that the grower wield this power carefully as he/she can undermine the system if they are not prepared to make the investments that need to be made in management.



We should also acknowledge the structure of this management system. It is based in crop management, biological and cultural control as well as other prevention practices.

As such, if we are missing key elements in crop management, biological and/or cultural control, the system is inherently unstable and unsustainable.

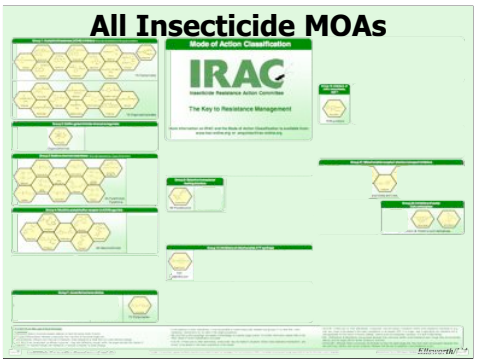




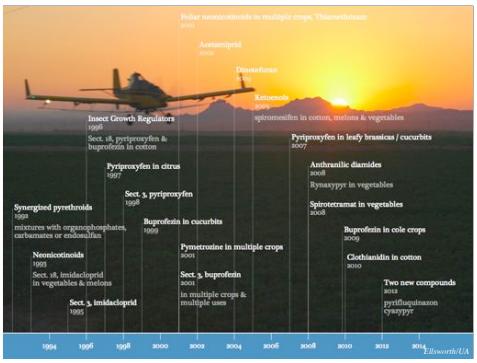
Furthermore, no matter how replete our chemical aresenal is, efficient management of our target pest can be threatened by resistance.

Worldwide, here are all known Modes of Action for insecticides. Each box contains a different mode of action and insecticidal structures within. While we may have hundreds of products, there are just 26 or so different modes of action to combat all insects worldwide.

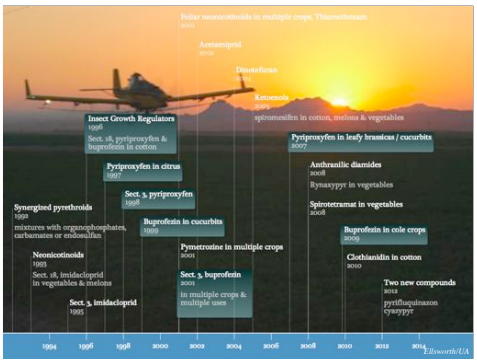
This may seem to be a rich diversity, but bear in mind this includes some rather old MOAs like O.P.'s and pyrethroids for example, plus…



…if we were to limit this just to whiteflies, the list gets much shorter, perhaps just 10 MOA, and not all of these are equally effective or useful. One is not registered in the U.S. and never will be (difenthiuron) and another will be lost in the next few years (endosulfan). That leaves 8 MOAs. O.P.'s and carbamates, as well as pyrethroids, are no longer effective against whiteflies when used alone. They need to be mixed. So that reduces this to a single MOA, for a total of just 7 MOAs. And we're lucky to have them! 20 years ago, we had just the one!

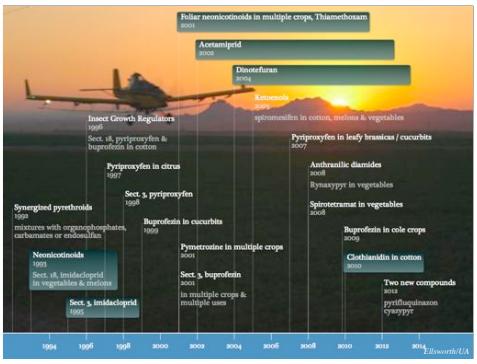


We started with just synergized pyrethroids. That is mixtures of O.P.'s, carbamates or endosulfan with pyrethroids.



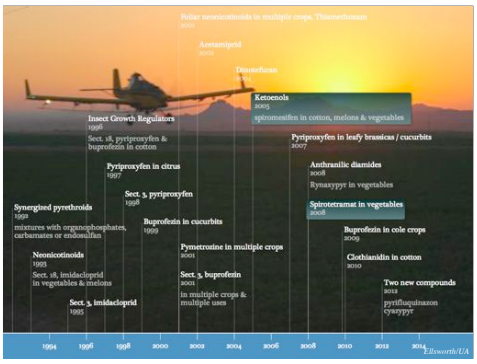
IGRs

In 1996, we brought on two more MOAs to cotton with the two IGRs, Knack and Applaud (now Courier).



Neonicotinoids

The neonicotinoid era began in 1993. But we did not get our first effective cotton product until 2002 with Intruder. This has been a rich and effective class of chemistry.

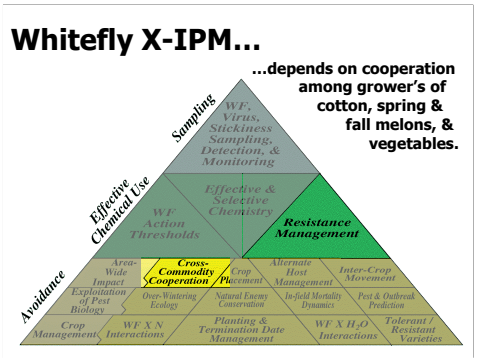


Ketoenols

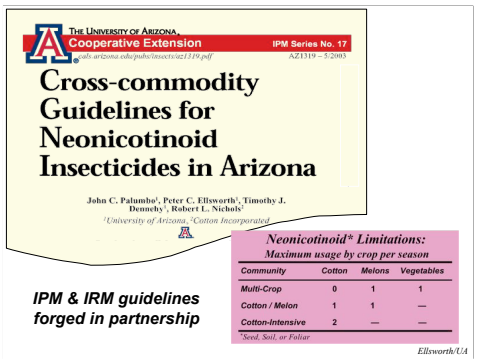
More recently in 2005, we got the ketoenols with Oberon.

So right now, we depend on just 4 MOAs. But there is more to come. We are very fortunate to have an active industry that has developed novel MOA with great safety and selectivity.

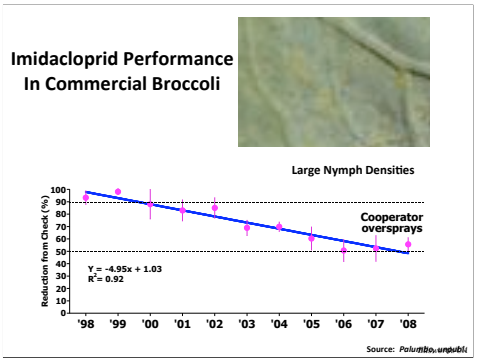
But we also need to recognize that these chemistries are being registered widely with access given to all crops including melons, vegetables and cotton.



Singular attempts to deploy recommendations in one crop especially for a mobile, polyphagous pest seems futile, when registrations of key chemistries are broad across multiple crops. Thus, our cross-commodity effort concentrates on elements where we can integrate our practices across multiple crops. Resistance management is a shared responsibility that extends across commodity borders. Cross-commodity cooperation can be key to the sustainability of a resistance management plan, and in Arizona, we achieved some remarkable agreements among growers of several key whitefly crop hosts, 2000–2005.

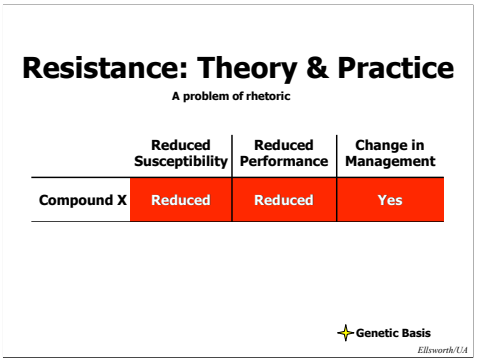


These neonicotinoid guidelines, which were published and disseminated in 2003, were the result of a year-long, stakeholder-engaged process spear-headed and led by Dr. John Palumbo. And while we did not and never do have perfect data or information, by engaging clientele directly in the development of these guidelines, we were able to forge a very simple set of rules for neonicotinoid usage. Yet through understanding of our system spatially, we also have ecologically-relevant guidelines as a result.



Did they work? The answer to this is complicated, but today (2010), neonicotinoids are still used heavily in this state against whiteflies.

However, John Palumbo has been doing systematic examinations of imidacloprid efficacy (soil uses) in broccoli for the past 10 seasons. Charting efficacy relative to a control shows rather marked reductions in efficacy in these studies. While users don't widely report problems with this use pattern and soil uses, especially in fall crops, are still almost universally practiced, this is a warning sign that we must re-consider our management program and decide whether further steps are needed to stabilize the control system. A dialog is currently underway with clientele through our Cross-Commodity Research and Outreach Program working group.



Resistance would seem to be a rather cut and dried subject. Reduced susceptibilities can be measured on field collected insects brought into the lab. A concomitant reduction of performance is also measured in the field (think careful tracking as John Palumbo has done). And all this leads to the inevitable and simultaneous changes in management by growers. If only it was this well-behaved, things would be simple to understand.

Resistance: Theory & Practice

A problem of rhetoric

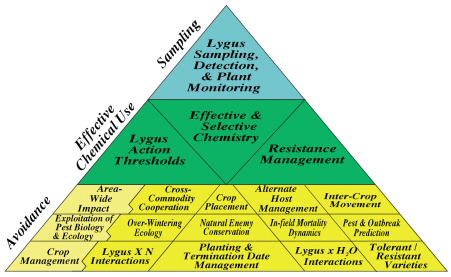
	Reduced Susceptibility	Reduced Performance	Change in Management
Compound X	Reduced	Reduced	Yes
pyriproxyfen	Reduced	No Change	No Change
imidacloprid	No Change?	Reduced	Yes?

Genetic Basis

Ellsworth/UA

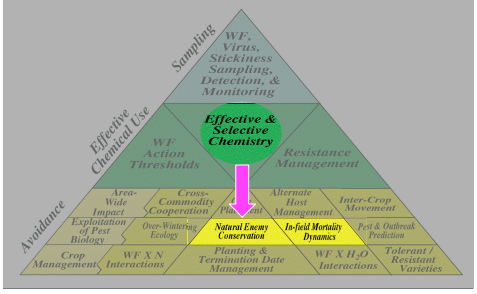
However, things are rarely this simple. With Knack, there have been reduced susceptibilities measured in lab assays for years. Yet precise measurements of field performance have showed no reductions in performance and furthermore growers have not changed their management practices as a result. In contrast, through much of this period, statewide resistance monitoring data showed no appreciable change in susceptibility of our whiteflies to imidacloprid. Yet, the detailed field performance data from John Palumbo's studies are unequivocal and dramatically document a progressive decline in performance of imidacloprid especially in the longest control intervals. At first, this change did not result in changes in practitioner practice. However, in the last 2–3 years, some PCAs have in fact changed practices by overspraying with foliar and doing so sooner, or substituting a foliar control program for the soil imidacloprid altogether.

IPM Today

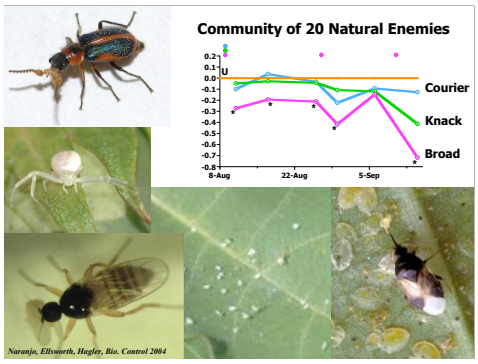


So here we are today with our IPM plan for cotton. It is a well-developed management plan firmly rooted in a broad foundation of avoidance tactics. I would like to focus on some of these avoidance tactics especially in how this relates to resistance management and the use of selective chemistry.

Chemical Control & Natural Enemies



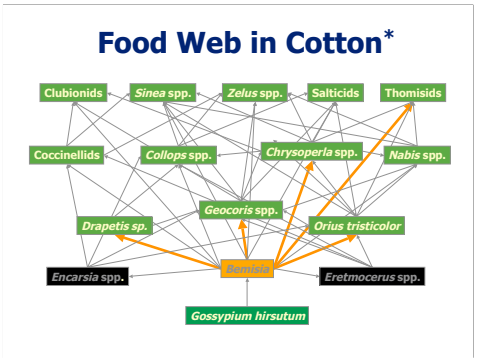
Central to remedial tactics is an effective chemical arsenal. In AZ, we have shown that when selective options are available and effective, huge gains in both target and collateral control can be achieved due to much better natural enemy conservation and other natural mortalities. This ecosystem service is a foundational element of "Avoidance," and one made compatible with the these specific and selective chemical controls in our system.



Without dwelling on the data for each year, let me say that we can show convincingly that sparing usage of IGRs (often just one spray) provided equivalent control as multiple sprays of broad spectrum insecticides, but also conserved a whole suite of natural enemies important in the control of whiteflies and other pests. Conventional chemistry, the purple line, significantly lowered densities of all predators.

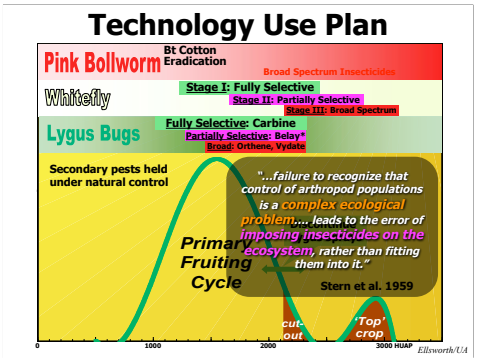
Because we are working in a very dynamic system, in some years 1 set of species may drive the control dynamic, while in other years another set of species drives the relationship.

These are our opportunities with selective Stage I chemistry for whitefly control to gain additional benefit from natural enemies!

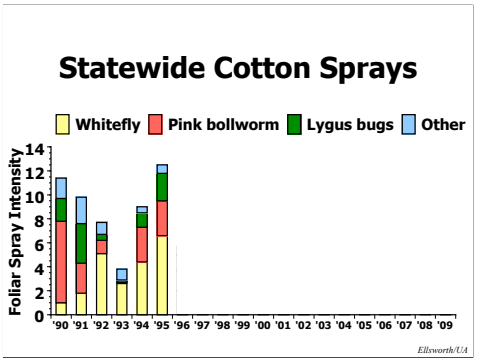


The idea that different species dominate the control dynamic in different years or locations in AZ cotton is a remarkable testament to the complexity of the food web. Certain conditions may favor certain pathways in certain years and other pathways in other years. Yet the same, generally, level of natural mortality is expressed.

Note parasitoids (in black boxes) in general, while present, rarely contributed major sources of irreplaceable mortality in this system, despite rather large shifts in parasitoid diversity favoring exotic species.



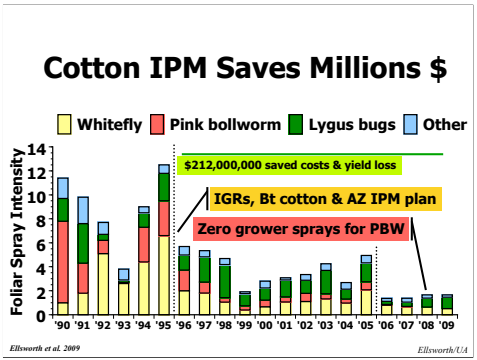
Our system breaks down to 3 key pests and a large array of secondary pests that never become significant, IF disruptions of natural controls do not occur. For PBW, Bt cotton is the ultimate biorational, and now with eradication, broad spectrum insecticides for its control are fading completely from our system. For whitefly, we have organized our insecticides into 3-stages based on selectivity, deferring all broad-spectrum inputs until the end of the season, if needed at all. For Lygus, we have one selective insecticide, flonicamid, and perhaps one partially selective compound, Belay, that was registered in 2010. Cotton IPM in AZ has become an exceptionally well-developed and selective system where conservation biological control is firmly established as a key element. All other pests are held under natural control most, if not, all the time. This is the way technology should be deployed. Stern way back in 1959 made this important statement and one we heed each day.



The need was great; the situation 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., 2008).

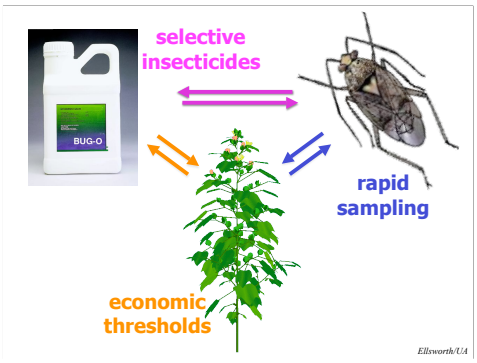


The results have been striking. A watershed of change occurred in 1996 with the introduction of very safe and selective Insect Growth Regulators for whitefly control, and transgenic Bt cotton, along with an IPM plan for whitefly management.

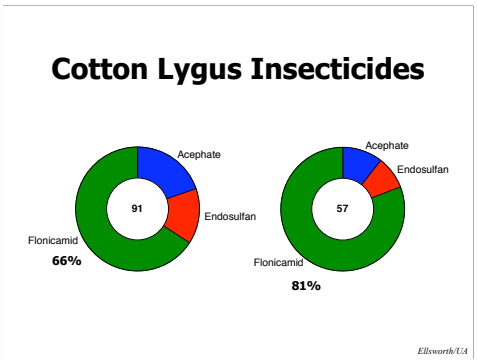
More recently, state agencies began PBW eradication in 2006. For the first time since the mid-1960's, AZ growers statewide did not spray at all for PBW! Bt cotton is grown on 98.25% of the acreage. And whiteflies have faded from memory as a severe and unmanageable pest.

[Carbine for Lygus control first adopted in 2006.]

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.

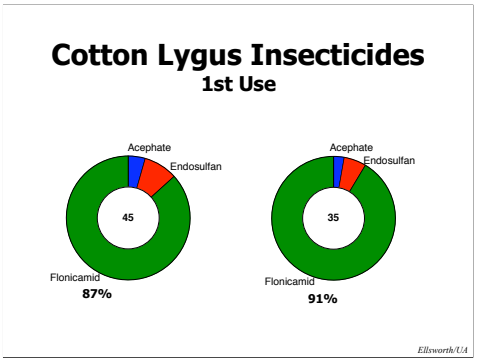


So how does this work for Lygus management. IPM optimizes this 3-way interaction. Carbine has been the selective insecticide we have used since 2006. We have rapid sampling plans using a sweepnet and very well researched and robust economic thresholds for Lygus.



In a random survey of central Arizona cotton fields in 2008 and 2009, we can see this pattern of cotton insecticide use.

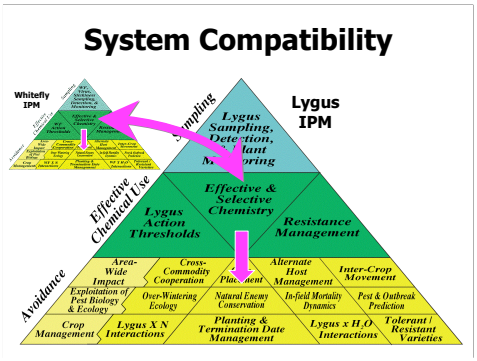
Two thirds of the sprays targeting Lygus were Carbine in 2008 and grew to 81% in 2009! This has been at the expense of the cheaper, but much more broad spectrum insecticides, Orthene and Endosulfan.



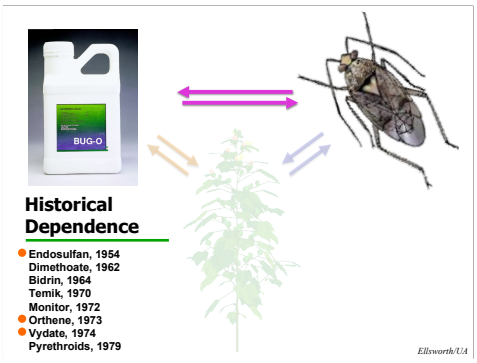
Our guidelines specifically suggest using Carbine first against Lygus as a way of deferring the use of any broad spectrum insecticides.

Your industry has embraced this approach with 87% of Lygus 1st sprays being Carbine in 2008 and 91% in 2009!

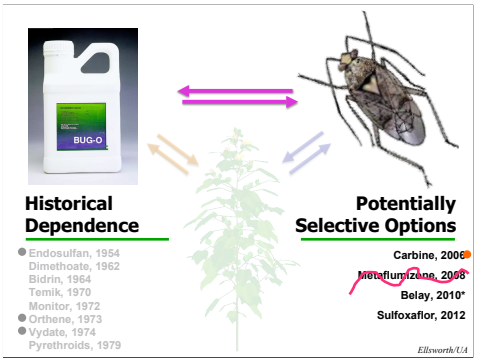
I run annual assessments of insect control chemistry in my small plot evaluations. Plots are 12 rows x 40 ft, typically.



In 1996, many quickly pointed out that IGRs were great but what gains we make in NE conservation through their use could be wiped out by broad spectrum insecticides needed for Lygus control. However, since then we have made major progress in achieving compatibility between these two pest management systems.

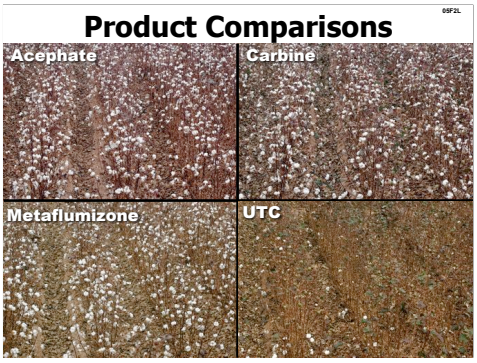


For many years now, we have depended on a set of broad spectrum options. That is, compounds that are effective but are rather broad spectrum in their impact on the arthropods present in the system. These include acephate, methamidophos (which sees little use today), oxamyl, endosulfan, all in AZ, but also dimethoate, Temik, and Bidrin, throughout the South, and pyrethroids in other parts of the West. Until only very recently — nearly 30 years! — there have been no new chemistries developed with consistent control of the Lygus bug complex.



More recently, we have had exciting new advances with potentially selective options: flonicamid was recently registered as Carbine and is very effective against Lygus, and metaflumizone was on track for being quite selective, too. But alas, development of this product has ceased for the U.S. and we may never enjoy its benefits. However, Belay has been recently registered and may provide some selectivity benefits to us in the future. A more exciting prospect is sulfoxaflor which we hope to see commercialized in 2012. These compounds bring us new chemistry that may in fact be more selective than our traditional, broad spectrum options.

This not only gives us new "effective" options, but provides new opportunities to exploit the benefits of natural enemy conservation in our system.



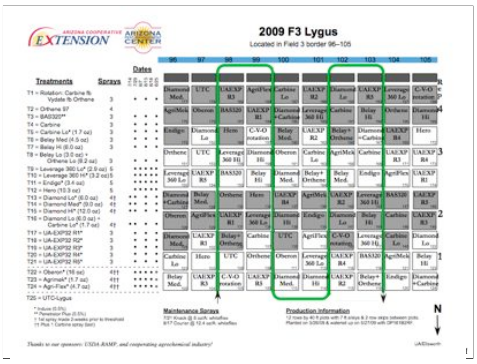
05F2L-T18 Carbine WG (2.8 oz) in NE, Orthene (1.0 lb ai/A) in NW, 320WVI (0.25 lbs ai/A) in SW, UTC in SE; 5-fold yield increase over the Untreated Check.

While flonicamid and metaflumizone have performed admirably against Lygus and helped to preserve the yield component in dramatic fashion, a major potential attribute of their use in our system will be to drive more and more to a selective system that helps preserve our natural enemy complex.

The way we know this is from trials we routinely perform for independent product testing. This was from 2005, before flonicamid registration. We told you this would be an important technology, a Lygus feeding inhibitor, through talks like this. But there are other powerful ways to learn about these things.

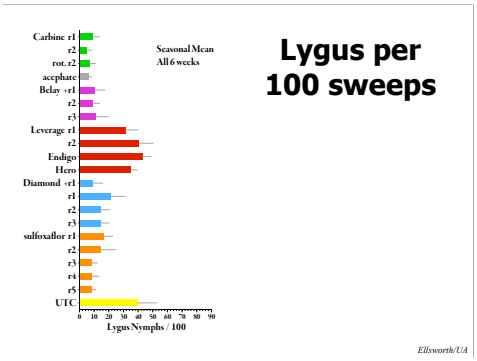
Last year, we decided to try something different. We held a small field day and prepared an old cotton trailer so that it could be pulled through the field. This way we could carry nearly 40 people right through and over the top of our cotton plots. The ability to see the impact of mites, whiteflies and of course Lygus bugs was dramatic. I hope to see you this coming year when we do this once again sometime in September.

Here are some photos showing how the tour proceeded.



We are able to look at so many different products at once, scientifically replicated, and independently. It's as if we were growing and watching 100 different fields. We can accomplish contrasts and comparisons that would take you years to see in normal observation of commercial fields. Plus, we see compounds very early on in the developmental process and this helps us steward the process of product development with the collaborating companies. As growers, you get the first glimpses of these technologies well before they are commercialized, plus you get to see all the current products and other approaches to pest management, all without risking a dime of your own on these approaches.

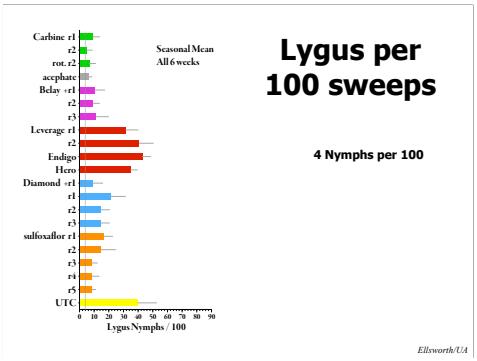
Here's a shot of one border in this trial. Pretty easy to pick out the untreated check where Lygus bugs reduced yields over 5-fold. And right next to the foreground plot where we used three products in rotation, Carbine (feeding inhibitor) followed by Vydate followed by Orthene.



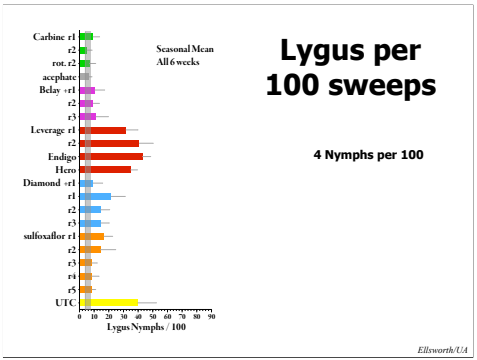
It is a challenge to show you all the data at once. But once I orient you to the overall data, we will examine it one section at a time.

Here we have Lygus NYMPHS per 100 sweeps from a seasonal mean of 6 weeks during the primary fruiting curve.

Different chemistries are color-coded.

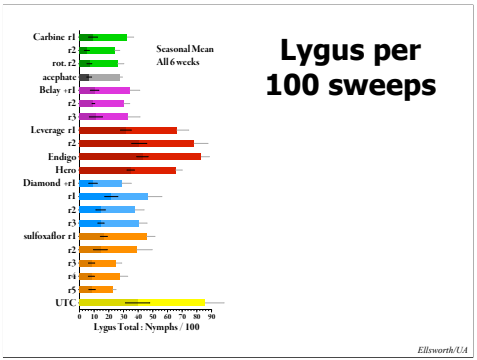


You can see that we had sustained pressure in excess of 40 nymphs / 100 sweeps. Our threshold is 15 total Lygus with just 4 nymphs per 100 sweeps (line shown). We were at 10-fold that level over a sustained period!

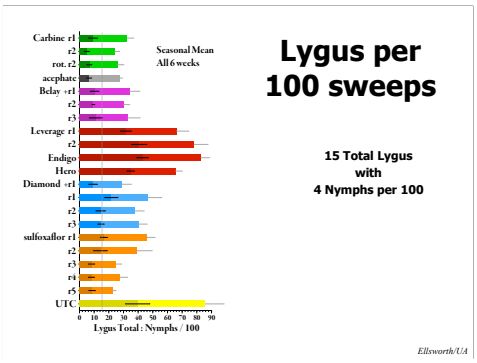


In my experience, the 4 nymphs per 100 is a good, but conservative threshold. If after spraying, under this kind of pressure, a product manages to hold nymph levels below 8 nymphs per 100 (gray bar), it is performing maximally.

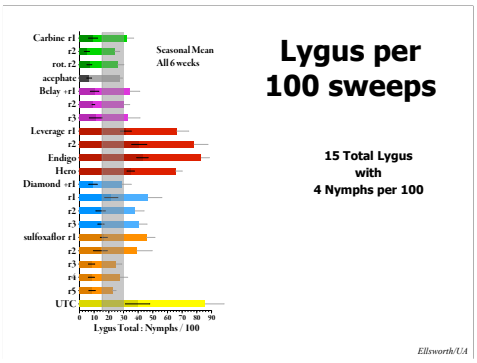
You can see that some products managed this level of control; some didn't.



Now I am overlaying the remaining Lygus numbers to give a total count (total Lygus / 100) with nymphs shaded.



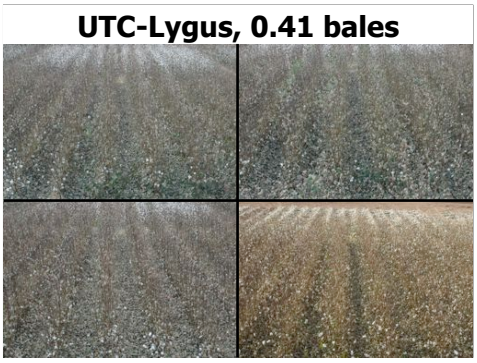
The threshold is 15 total Lygus per 100 sweeps (line shown). We sustained 5-6 times this level for 6 weeks.



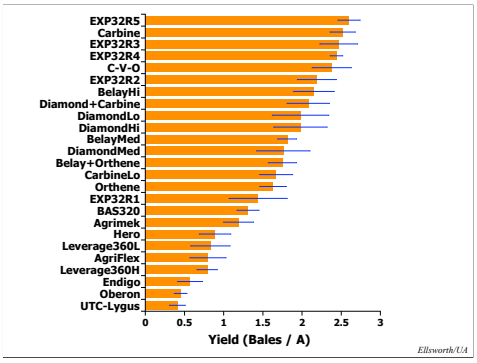
Again, operationally, if a product held levels below 30 per 100 sweeps (gray band), it was performing very, very well.

By all criteria, Carbine performed great as usual. Orthene also did well. Of the new compounds, Belay was right there and sulfoxaflor (examined at 5 rates) did very well from rate 3 and up.

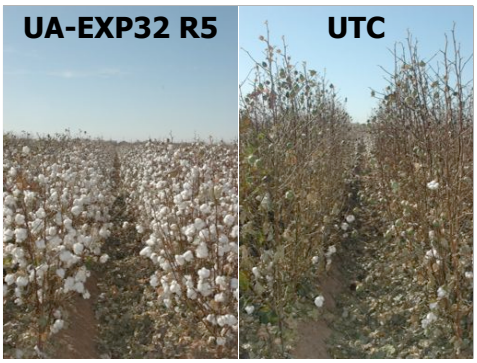
Pyrethroids and neonicotinoids (except for Belay) performed poorly.



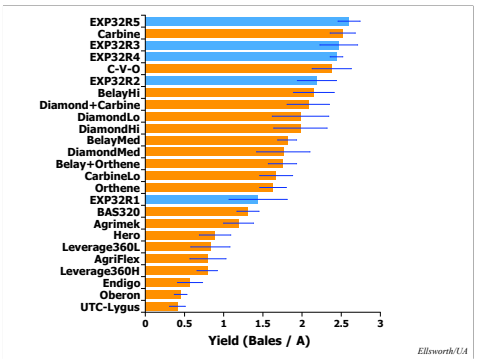
Here are the 4 replicate plots for the untreated check (UTC). Only 0.41 bales to the acre, not much cotton.



Here are the yield data, showing UTC at the bottom.



Here is sulfoxaflor used at a very high rate and showing very good Lygus control. Note the huge difference in plant heights. When Lygus are not controlled, fruiting positions (and fruit) are lost. Then all the energy the plant produces goes into unproductive vertical growth. Tall cotton is a telltale sign of Lygus injury many times.



'R3' may end up being the commercialized rate for this new compound (EXP32=sulfoxaflor). Control of Lygus and yields were excellent. The lower rates were less reliable.

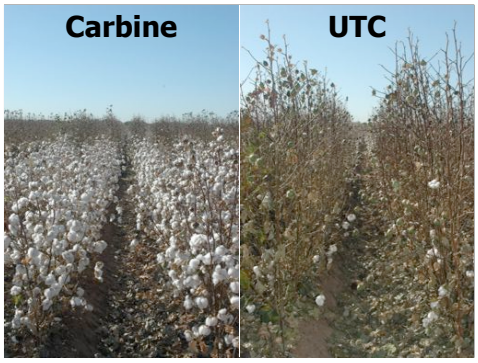
Here is the whole rate series, starting with the lowest rate (R1) for sulfoxaflor.

R2

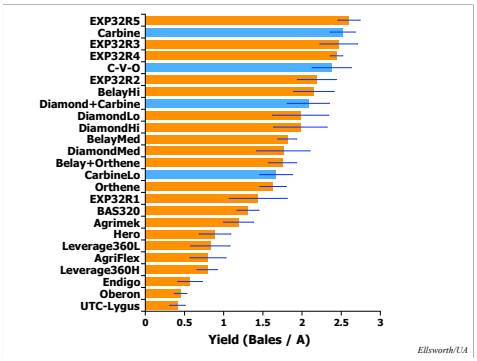
R3

R4

R5

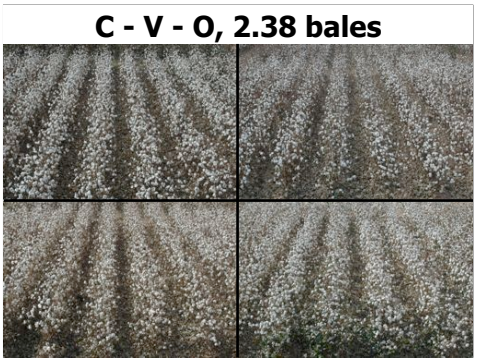


Carbine has continued to perform outstanding in control of Lygus and protection of yield.



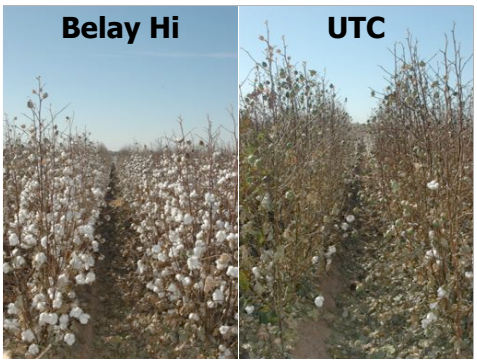
Here are the Carbine containing treatments. Note the very low rate (1.7 oz) of Carbine is too low for this kind of pressure.

This is a very low rate of Carbine and I would not recommend this practice in the face of the Lygus numbers we were seeing. This was done for comparative purposes only.

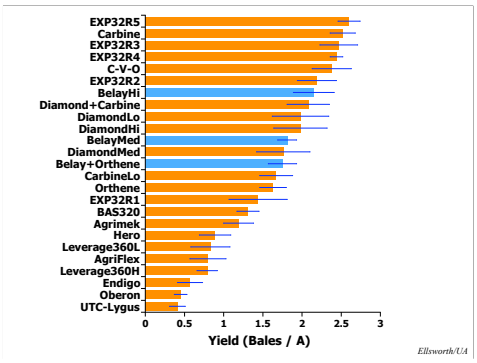


The rotation performed well, though mites resurged a bit in the end of the season.

Carbine alone at the highest labeled rate really did well, leading the trial.



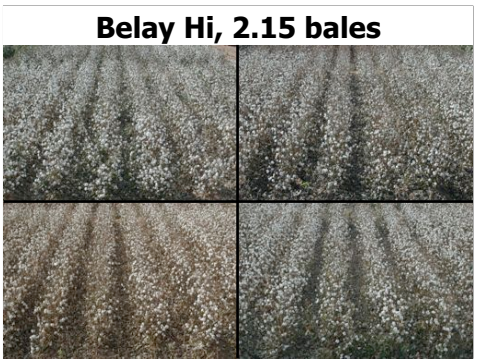
Belay was registered this past January, but the rate here shown is off-label (above the maximum currently permitted)[REVISION: as of 7/2010, the label has been expanded to include this rate (6 oz). Control was very good though somewhat less than Carbine.



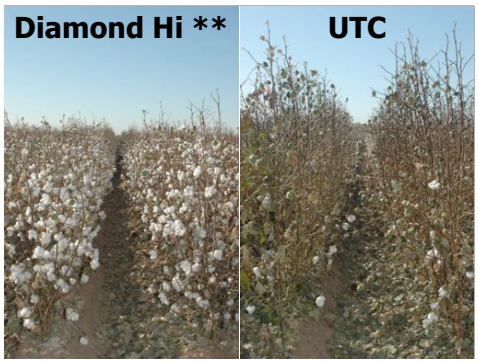
Here are the Belay treatments; the "medium" rate was 4.5 oz and performed well.

A combo with Orthene. No benefits to this practice. While Lygus control was very good, the resurgence of mites reduced yields significantly plus one more spray was made here than in the Carbine or other leading treatments. This is a tangible example of how non-selective, broad spectrum chemistry can ruin gains in target pest control by leading to resurgences of non-targets, in this case mites, but other times whiteflies, aphids, thrips, caterpillar pests, etc.

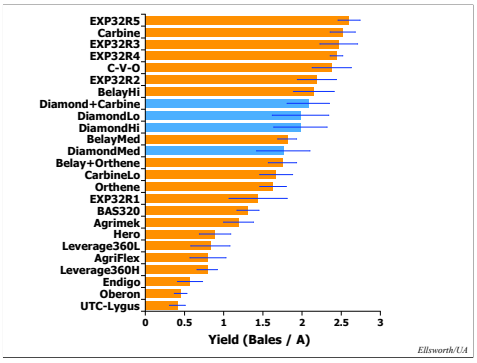
A medium rate of Belay (4.5 oz).



The high rate of Belay.



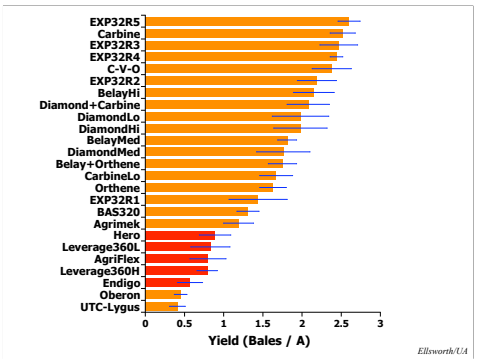
We have been testing novaluron (Diamond) for years and have never been comfortable recommending it. It is a broad spectrum IGR and as such is damaging to the beneficial insects that we need. Mites and whiteflies resurged in many of the Diamond plots. Even so, this is the best we've ever made Diamond look, albeit requiring a two week and two spray headstart over all the other products. As a result, I still cannot recommend it for Lygus control in AZ.



Here are the Diamond-containing treatments.

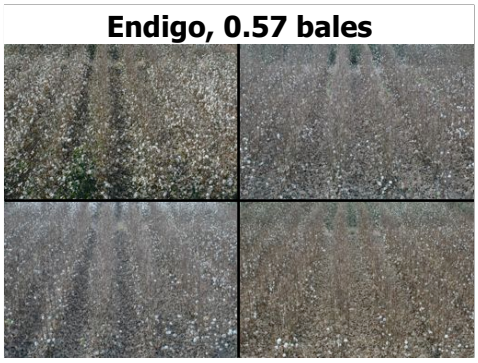
Very high rate used very early and more sprays than other products.

Pyrethroids still don't work in our system against Lygus in cotton. Every so often, people argue this point with me. So periodically, we re-examine this in trials. This time we chose to use Hero, a new very active mixture of two pyrethroids (you can think of it as Capture mixed with Mustang). As you can see there was no significant control of Lygus. Note the height of the crop.

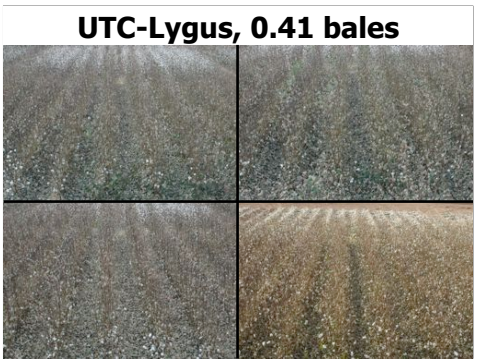


These are all pyrethroid containing treatments. None performed well.

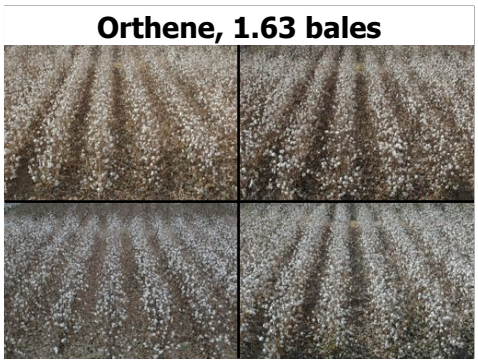
Hero.



A premix of thiamethoxam and lamba cyhalothrin.

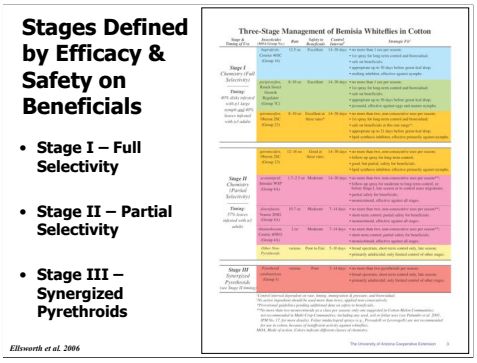


The UTC.



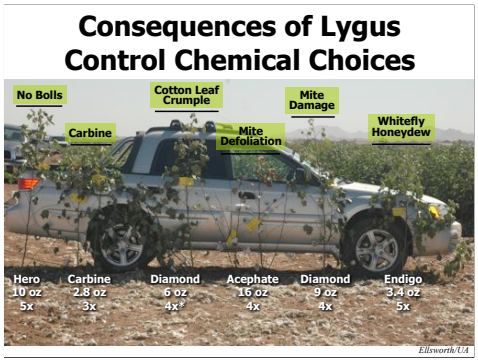
So there really is a penalty to using broad-spectrum chemistry early and repeatedly. We lost cotton here to mites, despite good control of Lygus. The Orthene plots were defoliated by mites weeks ahead of the rest of the field.

This is why we emphasize selectivity or safety for beneficials. There are economies gained by conserving these biological controls in your cotton fields.



As part of our IPM program, a 3-stage chemical use plan for whitefly control identifies chemistry based on efficacy and selectivity attributes, with the ultimate goal of exploiting selectivity as much as is possible. It does not mandate a sequence but suggests more selective approaches will create more effective ecosystem services that provide regulation of all pest species.

Not surprisingly, we wish to construct parallel recommendations for Lygus.

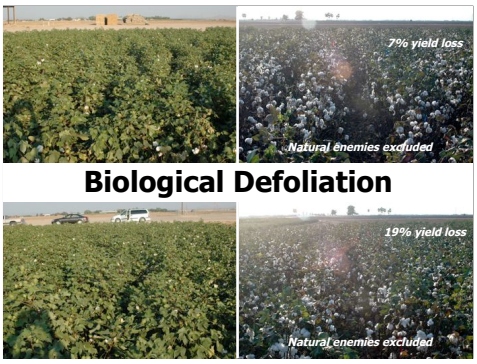


Just like in the early 1990's when we visibly saw the consequences of our control chemical choices in whitefly control, the same is true for those choices made for Lygus control.

At our recent field day, I pulled out representative plants from various plots to show how in identical environments how different the outcomes are based on Lygus product choices.

Examples of mite damage at the time of the field day. Note the entirely defoliated Orthene plants in upper right hand corner.

Peter Asiimwe, our current graduate student, is trying to understand the relative contribution of NEs and irrigation to the control dynamics of Bemisia. Last year, we had plots where NEs were chemically excluded by using a common Lygus insecticide. These broad-spectrum sprays released whiteflies from the natural control possible in the rt hand figure. The result was very sticky and sooty cotton. The left side was never sprayed at all.



Regardless of irrigation regime, there were major losses to whiteflies where NEs were excluded. These paired pictures were shot on the same day (two weeks after the ones shown on the previous slide) and show cotton that was biologically defoliated by this sucking pest. The cotton on the left was never sprayed for any pest and also had commercially unacceptable whitefly levels but at much lower densities than in the exclusion plots.

This example stresses the interactions of our control systems for Lygus and whiteflies. That is, no matter how selective our control system is for whiteflies, if growers are spraying for Lygus or other pests with broad-spectrum materials, selective advantages may be lost.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites

Oberon is a lipid biosynthesis inhibitor and an excellent miticide, too.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites
Intruder	Neonic.	Partial	Aphids !

Intruder is only partially selective, not fully selective like the IGRs and Oberon (at lower rates). Keep this in mind if your goal is to maximize natural enemy benefits. It is, however, an excellent aphicide.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites
Intruder	Neonic.	Partial	Aphids !
Spirotetramat	Ketoenol	???	Systemic !

Spirotetramat or Movento appears to be operating much like Oberon in terms of safety to beneficials. That is early results show it to be fully selective. But a major attribute of this compound is it is fully systemic, meaning when applied to the leaves it translocates to all plant parts, even the below ground roots! The is the first foliar insecticide with this type of mobility.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites
Intruder	Neonic.	Partial	Aphids !
Spirotetramat	Ketoenol	???	Systemic !
NNI0101, pyrifluquinazon	Unique	Partial - Full	

Pyrifluquinazon is a new chemistry. Recent tests are suggesting that at best it is partially selective, much like Intruder.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites
Intruder	Neonic.	Partial	Aphids !
Spirotetramat	Ketoenol	???	Systemic !
NNI0101, pyrifluquinazon	Unique	Partial - Full	
HGW86, cyazypyr	Diamide	???	

Cyazypyr is new chemistry and early in development for cotton.

Whitefly Chemistry Review

Compound	Class	Selectivity	Comments
Knack	IGR-Unique	Full !	Aphids !
Courier	IGR-unique	Full !	Scales !
Oberon	Ketoenol	Full	Mites
Intruder	Neonic.	Partial	Aphids !
Spirotetramat	Ketoenol	???	Systemic !
NNI0101, pyrifluquinazon	Unique	Partial - Full	
HGW86, cyazypyr	Diamide	???	
UA EXP32	New	??? (no mites)	Whiteflies !
Belay	Neonic.	Partial (?)	Lygus, beetles?

Ellsworth/UA

UA EXP32 or sulfoxaflor impacts Lygus and whiteflies, though better at controlling Lygus.

Belay has a broader spectrum of insect control and may therefore only be "partially" selective.

Lygus Chemistry Review

Compound	Class	Selectivity	Comments
Carbine	Unique	Full !	Aphids !

Ellsworth/UA

Carbine is an excellent aphicide.

Lygus Chemistry Review

Compound	Class	Selectivity	Comments
Carbine	Unique	Full !	Aphids !
Belay	Neonic.	Partial (?)	Whiteflies, beetles (?)

Ellsworth/UA

Lygus Chemistry Review

Compound	Class	Selectivity	Comments
Carbine	Unique	Full !	Aphids !
Belay	Neonic.	Partial (?)	Whiteflies, beetles (?)
UA EXP32	New	??? (no mites)	Whiteflies !

Ellsworth/UA

Lygus Chemistry Review

Compound	Class	Selectivity	Comments
Carbine	Unique	Full !	Aphids !
Belay	Neonic.	Partial (?)	Whiteflies, beetles (?)
UA EXP32	New	??? (no mites)	Whiteflies !
Acephate	O.P.	No	Late season
Vydate	Carbamate	No	Cotton leafperforator

Ellsworth/UA

Acephate and Vydate are still good compounds, but should be reserved for late season use only when needed. Vydate is excellent on cotton leafperforator.

Lygus Chemistry Review

Compound	Class	Selectivity	Comments
Carbine	Unique	Full !	Aphids !
Belay	Neonic.	Partial (?)	Whiteflies, beetles (?)
UA EXP32	New	??? (no mites)	Whiteflies !
Acephate	O.P.	No	Late season
Vydate	Carbamate	No	Cotton leafperforator
Pyrethroids	Pyr.	No	Not effective
Premixes	Neo. + Pyr.	No	Poor fit

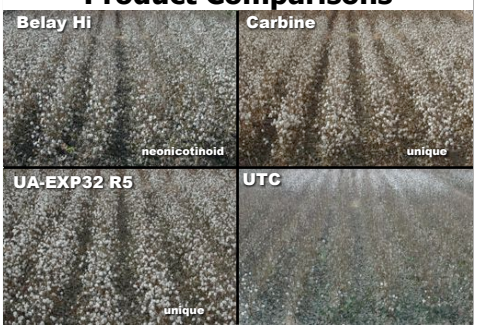
Ellsworth/UA

Pyethroids are still NOT effective on Lygus in cotton in AZ.

Premixes in general have a poor fit in AZ. Avoid them.

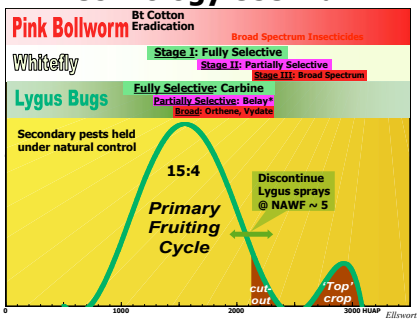
Product Comparisons

09F3L



09F3L Carbine WG (2.8 oz) in NE, Belay Hi in NW, sulfoxaflor in SW, UTC in SE; 5-fold yield increase over the Untreated Check.

Technology Use Plan



Ellsworth/UA

Here is our technology use plan that supports our cotton IPM system. It emphasizes selective approaches to the control of our three key pests supported by well-defined sampling programs and decision-making. Sprays for whiteflies depends on sampling of adults and nymphs and implementation of chemical-use stage-specific thresholds. For Lygus, adults and nymphs are also measured. Sprays are made according to a two-component threshold. Additional sprays are made as needed when Lygus are increasing and above threshold, but discontinued at a time in crop development based on variety, planting date, and irrigation plans.

There is no doubt. IPM and resistance management are completely interdependent. We need good, selective chemistry to help us conserve beneficials and control our target pests effectively.