FMC's Cotton Beltwide Cotton Consultant Meeting

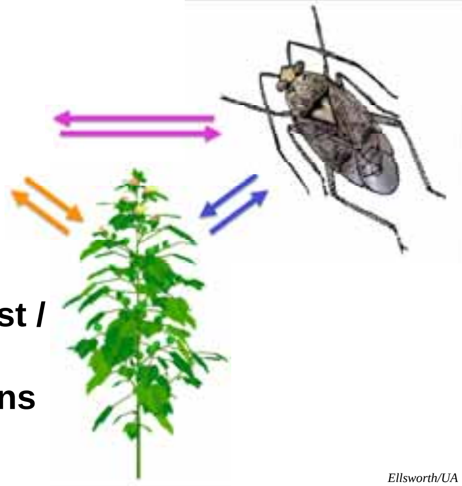
Flonicamid Efficacy on *Lygus hesperus* in Arizona

Peter C. Ellsworth
IPM Specialist & State IPM Coordinator
Arizona Pest Management Center / Department of Entomology
University of Arizona

Carbine Insecticide / Aphicide Launch, January 3, 2006

Ellsworth/UA

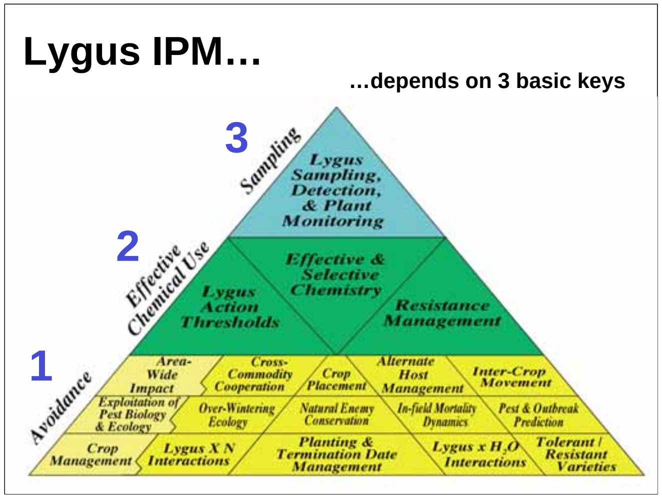
This presentation was invited by Craig Heim (FMC). As part of FMC's launch of Carbine insecticide, I was asked to cover Lygus management from a western perspective with specific information on Carbine / flonicamid efficacy on Lygus hesperus.



Plant / Pest / Pesticide Interactions

Ellsworth/UA

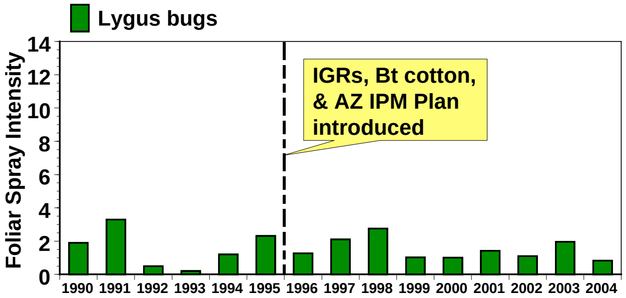
Today I hope to cover the key elements of the plant - pest - pesticide interaction. Your industry is charged with managing insect pests in the most efficient and economical manner. As an entomologist, we have a tendency to examine this interaction with the bug at the center of this interaction. As an industry, many focus on the insecticide. However, we can all recognize that the plant, ultimately is at the center of this interaction, and as such, should be the focus of our discussions. As you will see, I will conclude my talk with an examination of plant response in this system.



However, before I discuss this 3-way interaction, I would like to remind everyone that Lygus management, as in the management of any pest, is much more than just having the next new compound. For us, and likely for anyone in any system, IPM boils down to 3 essential keys of “Sampling”, “Effective Chemical Use” and “Avoidance. Within this framework, we see once again that the plant or crop is the most important foundation element of our management plant. On this base layer of “Avoidance”, we can overlay many of the building blocks of an integrated and stable management plan. “Effective Chemical Use” is surely important, and when pest densities reach economic levels, we want to be sure that we have effective compounds in our arsenal and some tools for deploying them rationally such as action thresholds and resistance management plans. However, I hope you will also see that our system of cotton pest management is moving more and more towards a selective approach whereby we can strategically eliminate pest threats while still conserving those natural elements -- free pest control, if you will -- that makes the system more sustainable and economical, and less susceptible to pest resurgences and secondary pest outbreaks.

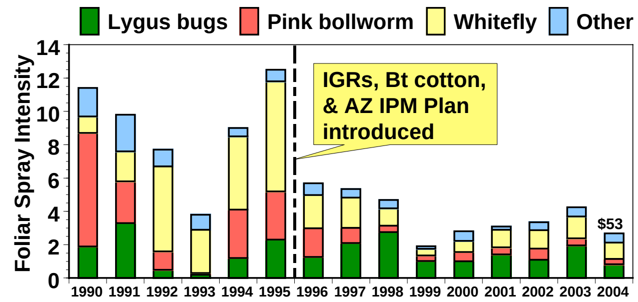
This goal of selectivity is supported by our most recent history in pest control. Consider that boll weevil has been eliminated over much of its previous range in the U.S. including AZ since 1991. Consider the introduction of Bt cottons that have eliminated the economic threat of tobacco budworm, pink bollworm in AZ, and lessened our exposure to many other lepidopteran pests. And for us in AZ where we combat the whitefly regularly, we have seen the introduction of very specific and selective whitefly insect growth regulators.

Historical Trends in Lygus Control in Arizona Cotton

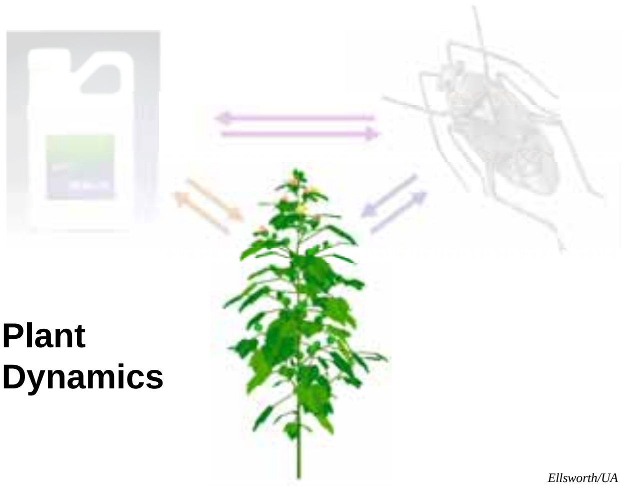


This chart shows the statewide foliar spray intensity for Lygus bugs since 1990. In general, you can see that we have been spraying Lygus ca. 1-3 times per season. This trend appears consistent even after the introduction of Bt cotton and selective whitefly IGRs.

One of Three Key Pests



As just one of our three key pests, Lygus has gained in importance simply because it occupies a greater proportion of our spray requirements and budgets. In fact, it is the largest yield threat to AZ cotton, and has been our number 1 pest since 1997. So while our sprays are about the same against this pest, sprays for everything else has gone down dramatically.



Plant Dynamics

Ellsworth/UA

Before we look at the 2-way interactions, it is important that we review some fundamentals of plant dynamics.

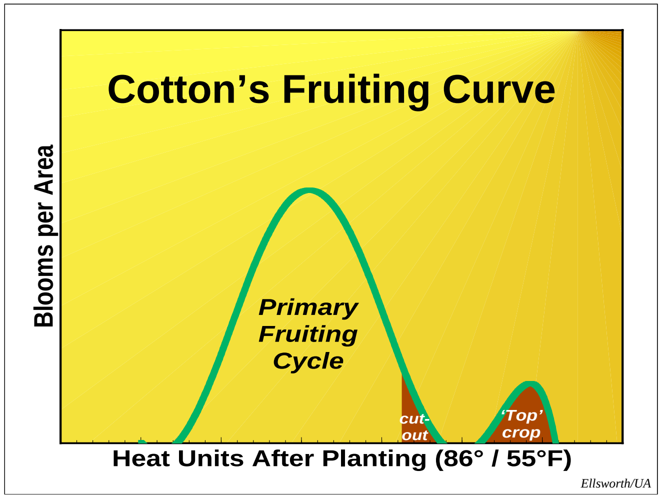
Plant Dynamics

Hanan, 1996

- **Indeterminant growth habit**
  - **Susceptible plant parts at all times**
- **Redundancy**
  - **50% final fruit retention**
- **Compensation**

Ellsworth/UA

Cotton is an incredibly dynamic plant. As you all know, it is essentially a perennial grown as an annual. As such, it has an indeterminant growth habit. This means that there are plant parts susceptible to Lygus and other insects at all times. We also know that there is much redundancy in the plant machinery and a great capacity for compensation even under shorter seasons.



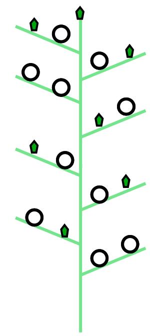
Cotton's Fruiting Curve

Looked at another way, that of blooms produced per acre, we can see a typical blooming curve for cotton, and in particular, AZ cotton, where we actually do have the capacity in some varieties to grow a second or top crop after crop cut-out.

As we will see, protection of the primary fruiting cycle from 1st bloom to at or just before cut-out is our main goal in Lygus management.

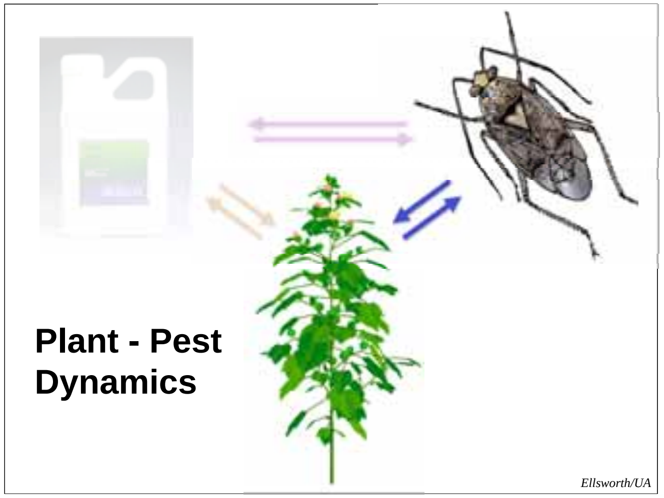
Cotton Development

- **Under ideal conditions, final fruit retention (1st two fruiting positions) is around 45–55%**
- **If early fruiting is very good, ability to retain fruit later is often lower**
- **Physiological stress in the form of a heavy boll load reduces chances of retaining uppermost fruiting positions**

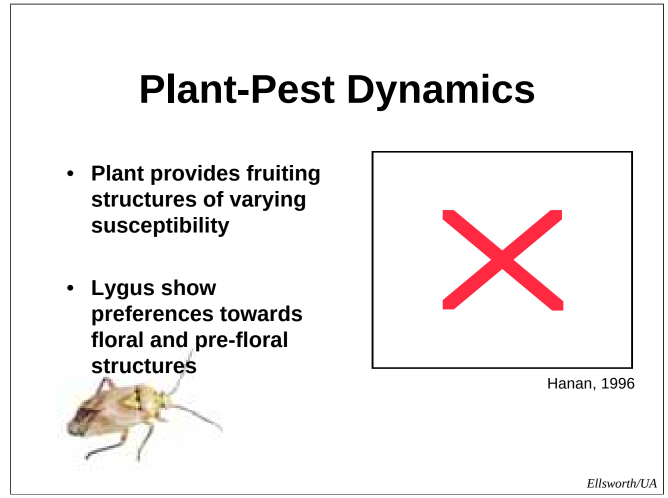


Ellsworth/UA

This point is very important that it bears repeating. Physiologically, the cotton plant has the capacity under optimal growing conditions to retain just 45–55% of all its fruit. While we like retentions to be as high as possible, it is true that higher retentions early lead to lower chances of retaining fruit later, and vice versa. Boll load, itself, is a physiological stress on the plant and affects the plants overall ability to retain more fruit.

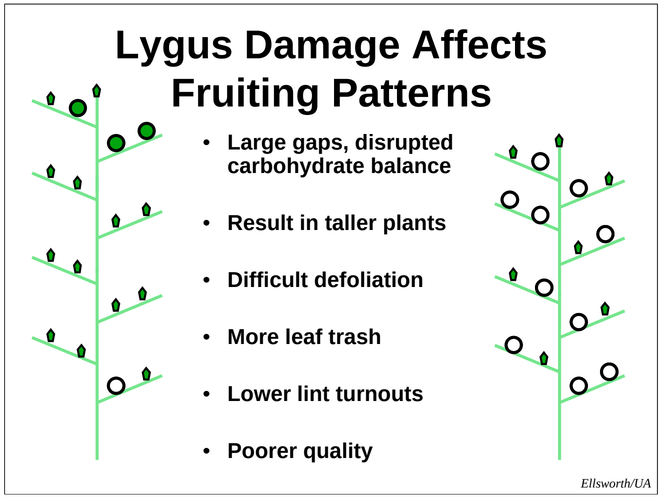


Let’s examine the Plant - Pest set of interactions next.



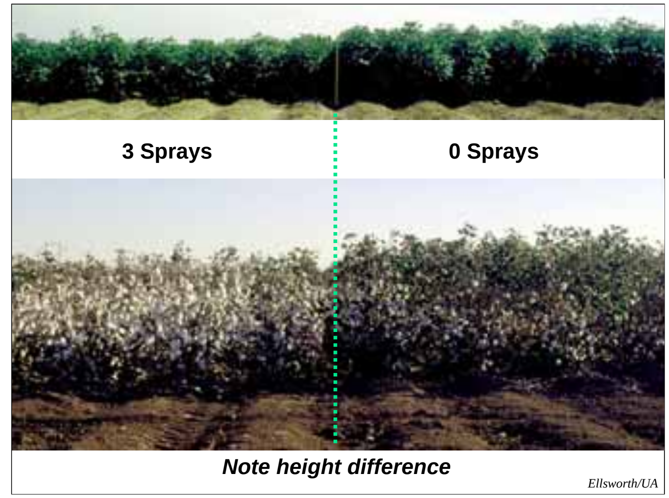
At any given time, the plant provides fruiting structures, squares, flowers, bolls, of varying susceptibility to Lygus. Clearly a hard boll is impervious to Lygus attack, whereas a young pinhead square might be exceptionally vulnerable.

We should also recognize that Lygus are attracted to florals. This is why they come to cotton or any other blooming plant to begin with. However, there attraction extends to feeding preferences as well. At least for L. hesperus, we see a preference by Lygus for floral and pre-floral (square) structures. Obviously, this preference has grave consequences for our yield component. However…



Lygus damage also affects the pattern of fruiting to such extent that large gaps can sometimes be created. These gaps represent disruptions to the allocation of carbohydrates. Where normally, carbohydrates are shunted to the boll sinks, now they are redirected to the growing tip of the plant, making for a taller plant, one that is more difficult to defoliate (also because of disrupted / excess N-balance). This leads to more leaf trash in the harvest, which in turn, lowers lint turnouts and produces lint of poorer quality.

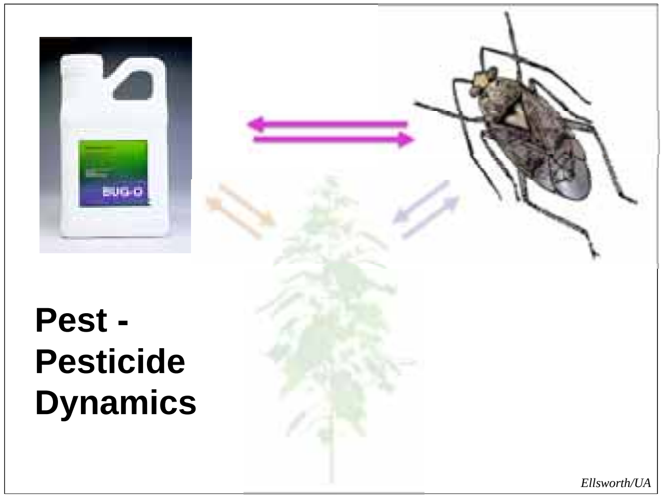
Each of these effects has been measured in our studies and represents some of the hidden costs of Lygus damage. Yield impacts can be great, but we should not forget these other losses as well.



To show this re-allocation of carbohydrates graphically, we can look at a field that was all planted to the same Bt variety. One half was sprayed 3 times for Lygus and the other was left untreated for this pest. No other insect pests were yield-limiting. On the right, you can see in profile and increase in height of the plants.

Closer to harvest, it becomes apparent why. There is only one third the yield on the untreated side in comparison to the well-managed left side.

Remember this down to the “inch” effect in adjacent rows. I’ll refer to it later.

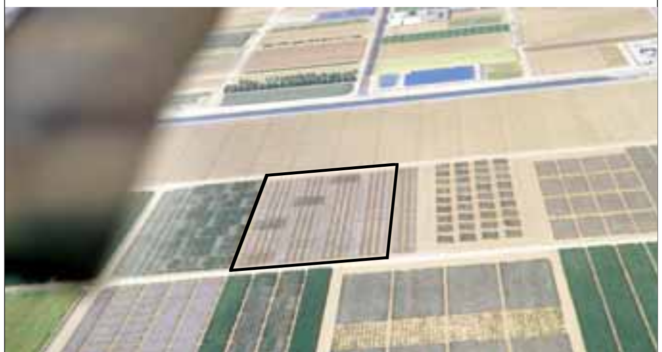


Next up in our triad of interactions is the Pest - Pesticide set of interactions. This is one that many of us deal with on a day to day basis in our consulting operations.

My results in AZ have been consistent and in my opinion definitive on the following points; however, it is important not to generalize to L. lineolaris or to other places without checking out the details first.

Current chemical controls (as well as new chemistries under development) are not really ovicidal and none controls adults outright. Sure, on occasion, we might see very short-term reductions in adult numbers, say for 24-48 hrs, and it is true, over the long haul, we can see some reductions in adult numbers compared to untreated areas, but this, in my opinion, is as a result of continually killing nymphs and lowering recruitment to the adult stage. For this reason, in our system, our attention is appropriately focused on nymphs, while still recognizing that adults are key to movement and reproduction.

Adults move; Nymphs don't



00F3threshold

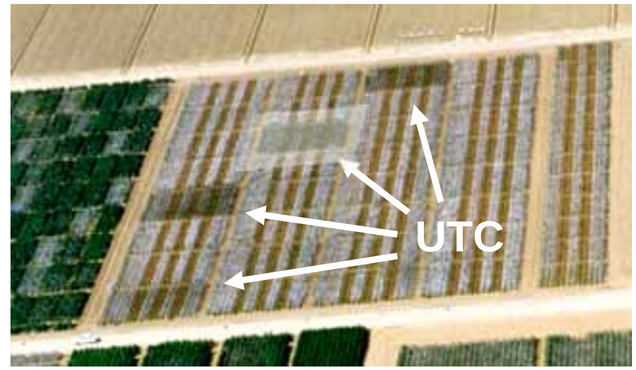
Ellsworth/UA

First, we all know that only adults have wings and therefore only they can move any significant distances. In fact it is unlikely that nymphs move across or down rows very much. Remember our down to the row photograph from a moment ago.

This is an aerial photograph of my 2000 Threshold study. In the outlined area you can see several borders of cotton each with 3 harvested strips taken from them. However, in addition to the 3 dark stripes down each border, we can also see some darker areas of growth.

This is photographic evidence that adults are not major damagers of cotton. If they were…

Adults move; Nymphs eat!



Ellsworth/UA

We would expect a halo of damage to develop around these UTC plots due to the frequent movements of Lygus adults from those plots. However, the demarcation between unprotected v. adjacent protected areas is distinct. This indicates damage by a plant-bound life form, nymphs. Lygus were well-managed in all areas around these untreated plots. Yet, no pattern of damage occurs around these UTC plots.

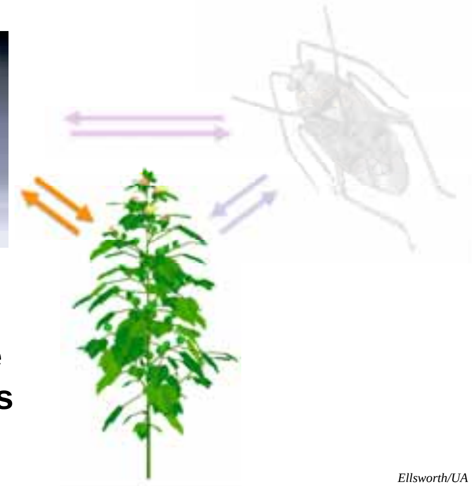
Indeed, adults do move and probably do eat as well, but comparatively they are in this world to move and reproduce, whereas nymphs have one objective in life, to eat and grow.

Lygus Can Be Managed!

Even side-by-side

Ellsworth/UA

Let's not lose sight of the fact that even though we do not have effective adulticides (or ovicides) Lygus can be managed, despite heavy numbers and some losses. All the studies discussed today are in the context of overwhelming Lygus bug pressure sustained over fairly long periods. An average field with an average grower might never encounter as high or as sustained levels as tested here. In this example, 3 well-timed sprays resulted in 3x the yield.



Plant - Pesticide Dynamics

Ellsworth/UA

Finally, let's take a look at the last set of 2-way interactions, the Plant - Pesticide dynamics.

Plant-Pesticide Dynamics

Hanan, 1996

- Sprays reach only a portion of a closed canopy
- Current materials have residuals of 10-14 days
- Plant increases in size by 2 – 2.5 nodes per week

Ellsworth/UA

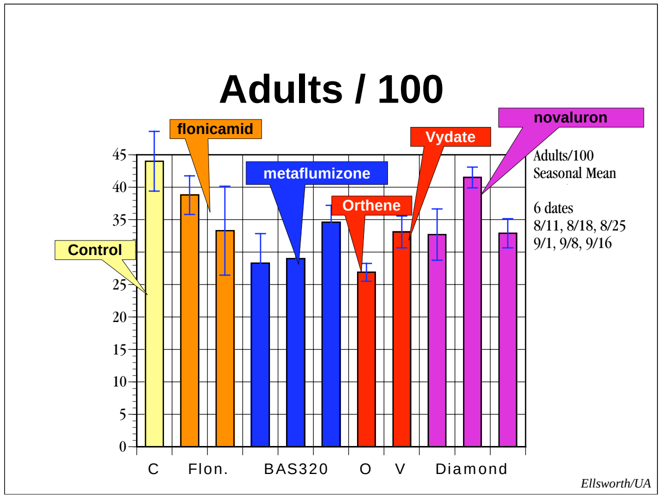
This may be apparent to most of you, but it is worth reviewing. Note in this simulation when the leaves turn red symbolizing the application of an insecticide. Only a portion of the canopy can be reached, and our current control chemicals last no more than 10-14 d. In that time, the plant continues to grow out of the treated zone at a rate of up to 2 or 2.5 nodes per week during our fastest growth period. Thus, there is continually new vegetation that becomes available to attack.

Pest Control Reality

- Ca. 80% of insecticide applications to cotton are by air
- Carrier volume of 3-5 GPA
- Not a 100% “control” system

Ellsworth/UA

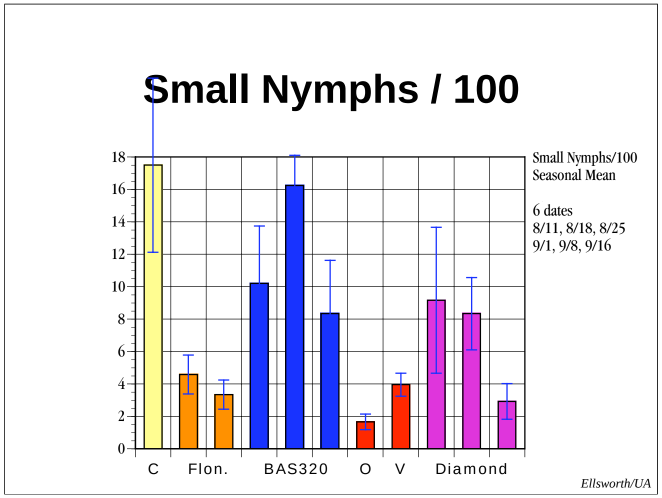
In AZ, we have to face the reality of our pest control system. Most applications are by air, where they are delivered at 3-5 GPA under very dry conditions. Clearly, this is not a 100% “control” system. And we should not expect that all our chemistry can overcome these limitations of application.



So let's look at some efficacy data. These are seasonal means from 6 evaluation dates looking at Lygus adults per 100 sweeps for the following materials:

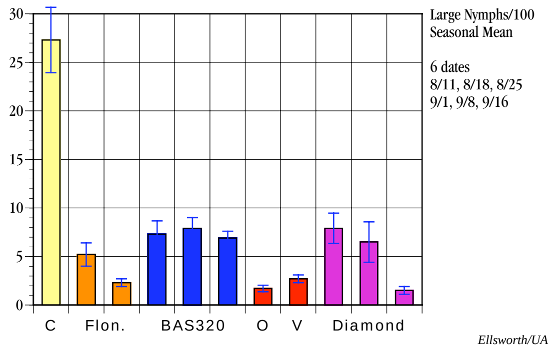
Control, flonicamid at two rates (Carbine), BAS320 at 3 rates (metaflumizone), Orthene at the maximum labelled rate for us (1.0) -- this is our standard, and Vydate C-LV also at the max rate of 1.0 lbs ai/A, and two rates of Diamond (novaluron) and a Diamond+Orthene combination.

As noted before, we do not control Lygus adults outright. Yes, there are reductions, but they are not major ones and only after multiple sprays season-long. Note: our threshold is 15 total lygus with 4 nymphs per 100 sweeps.



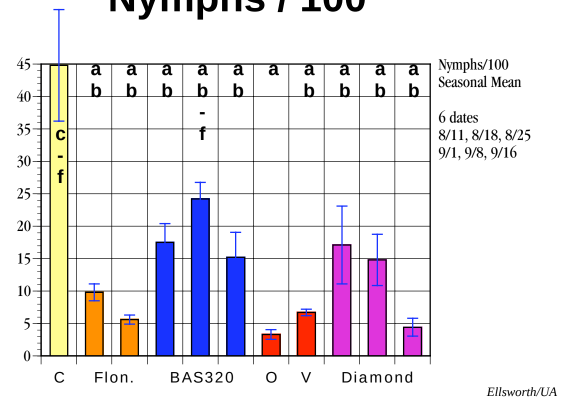
Small nymphs are the easiest thing to kill, but they do continually hatch. Flonicamid did very well here, similar to our standard and better than BAS320 or Diamond.

Large Nymphs / 100



Large nymphs are the most damaging forms of this insect. These numbers might represent outright control of this stage, as with Orthene, or the reduced recruitment to this life stage through control of the young nymphs, as seems to be the case with BAS320. We believe that flonicamid is killing both large and small nymphs outright.

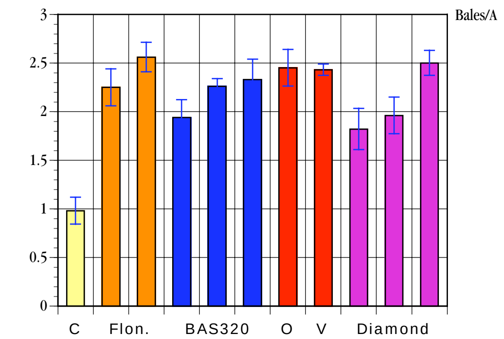
Nymphs / 100



Taken together, we can see that flonicamid is quite effective at controlling nymphs, very similar to our standard, Orthene.

However, the proof is in the pudding, as they say. What happened to yields?

Yield (Bales / A)

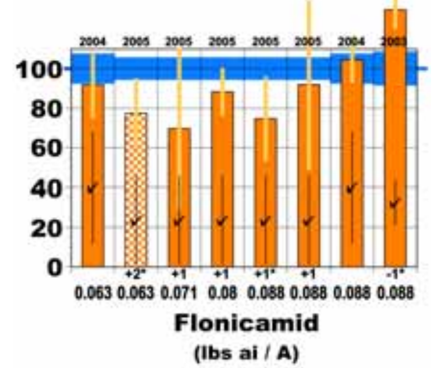


Ellsworth/UA

This was a late-planted, low yield potential trial. The control was severely damaged, losing over 1.5 bales to Lygus. Carbine numerically outyielded all others in this year's test, though statistically it was similar to Orthene or Vydate. All of this loss was due to Lygus; plots were planted to Bt cotton and treated for other pests (whiteflies) as needed and selectively where possible (IGRs).

To look at flonicamid's performance over years, we can use Orthene as our yield standard and plot Carbine yields as a percentage of this standard.

Carbine by FMC



Ellsworth/UA

So the blue band above is the 100% yield standard that Orthene provides. Over a range of rates and timing, flonicamid has been a consistent performer, yielding significantly more than the checks (see check marks) and as much or sometimes more than the Orthene standard. In general, the higher rates have performed somewhat better.

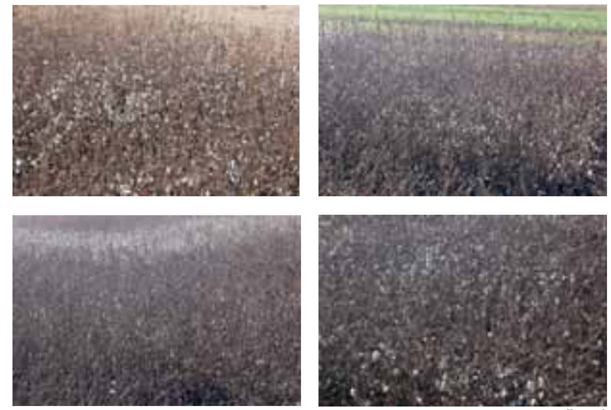
More Data!

Date	Trts	Product1	N Rows	Mean(Sdctn/A)	Mean(Bales/A)	Mean(T.O.)	Mean(%SeedT.O	Mean(%Trash)	Mean(%Lint)	Mean(%Seed)	Std Err(Sdctn/A)	Std Err(Bales/A)	Std Err(T.O.)	Std Err(%SeedT.(	Std Err(%Trash)	Std Err(%Lint)	Std Err(%Seed)
11/8/05	0	UTC-Lygus	4	502	0.36	0.3461	0.5836	0.0703	0.3725	0.6275	60	0.040	0.00453	0.01415	0.01619	0.00538	0.00538
11/8/05	1	Carbine2oz+MM+	4	1629	1.19	0.3499	0.6036	0.0465	0.3670	0.6330	137	0.107	0.00545	0.00743	0.00682	0.00560	0.00560
11/8/05	2	Carbine2.8oz+	4	1589	1.15	0.3455	0.5977	0.0568	0.3663	0.6337	156	0.123	0.00341	0.00579	0.00638	0.00339	0.00339
11/8/05	3	BAS32000llo+alt	4	1782	1.30	0.3488	0.6004	0.0508	0.3674	0.6326	77	0.066	0.00289	0.00255	0.00235	0.00266	0.00266
11/8/05	4	BAS32000lhi+	4	1841	1.34	0.3499	0.5983	0.0518	0.3691	0.6309	84	0.073	0.00469	0.00732	0.00313	0.00592	0.00592
11/8/05	5	BAS320WUlhi+	4	1824	1.32	0.3461	0.5908	0.0631	0.3694	0.6306	204	0.166	0.00564	0.00802	0.00671	0.00614	0.00614
11/8/05	6	BAS320WVlhi+	4	2188	1.62	0.3553	0.6001	0.0445	0.3718	0.6282	24	0.021	0.00492	0.00282	0.00706	0.00265	0.00265
11/8/05	7	V10170 1.4oz	4	1908	1.39	0.3462	0.6007	0.0532	0.3655	0.6345	245	0.197	0.00638	0.00338	0.00696	0.00460	0.00460
11/8/05	8	V10170 1.8oz	4	1824	1.32	0.3463	0.6033	0.0504	0.3646	0.6354	122	0.121	0.00834	0.00525	0.00627	0.00700	0.00700
11/8/05	9	O97hi+	4	2121	1.53	0.3471	0.6014	0.0516	0.3659	0.6341	110	0.089	0.00271	0.00334	0.00370	0.00247	0.00247
11/8/05	10	K2NO3	4	609	0.45	0.3502	0.5634	0.0864	0.3832	0.6168	103	0.078	0.00994	0.00783	0.00470	0.00972	0.00972
11/8/05	11	K2NO3+O97	4	1386	0.98	0.3356	0.5962	0.0682	0.3600	0.6400	268	0.215	0.00879	0.00428	0.00822	0.00683	0.00683
11/8/05	12	O97lo	4	1668	1.19	0.3401	0.5996	0.0602	0.3618	0.6382	103	0.097	0.00768	0.00409	0.00470	0.00659	0.00659
11/8/05	13	Diamond 9oz	4	1490	1.03	0.3300	0.6037	0.0663	0.3533	0.6467	91	0.079	0.00896	0.00573	0.01141	0.00618	0.00618
11/8/05	14	Diamond 12oz	4	1240	0.86	0.3289	0.6122	0.0589	0.3493	0.6507	134	0.123	0.01047	0.00479	0.01281	0.00674	0.00674
11/8/05	15	Diamond 6oz + O97	4	1475	1.03	0.3368	0.6088	0.0545	0.3562	0.6438	105	0.074	0.00123	0.00796	0.00770	0.00335	0.00335
11/8/05	16	CarbineWG 2.4oz	4	1495	1.07	0.3393	0.5971	0.0636	0.3622	0.6378	272	0.218	0.00772	0.00301	0.00478	0.00640	0.00640
11/8/05	17	CarbineWG 2.6oz	4	1864	1.36	0.3486	0.5843	0.0671	0.3737	0.6263	96	0.082	0.00335	0.00208	0.00350	0.00258	0.00258
11/8/05	18	CarbineWG 2.8oz	4	1931	1.41	0.3452	0.5942	0.0606	0.3674	0.6326	361	0.303	0.01151	0.01008	0.01321	0.00942	0.00942
Date	Trts	Product1	N Rows	Mean(Sdctn/A)	Mean(Bales/A)	Mean(T.O.)	Mean(%SeedT.O	Mean(%Trash)	Mean(%Lint)	Mean(%Seed)	Std Err(Sdctn/A)	Std Err(Bales/A)	Std Err(T.O.)	Std Err(%SeedT.(	Std Err(%Trash)	Std Err(%Lint)	Std Err(%Seed)
11/8/05	0	UTC-Lygus	4	502	0.36	0.3461	0.5836	0.0703	0.3725	0.6275	60	0.040	0.00453	0.01415	0.01619	0.00538	0.00538
11/8/05	1	Carbine2oz+MM+	4	1629	1.19	0.3499	0.6036	0.0465	0.3670	0.6330	137	0.107	0.00545	0.00743	0.00682	0.00560	0.00560
11/8/05	2	Carbine2.8oz+	4	1589	1.15	0.3455	0.5977	0.0568	0.3663	0.6337	156	0.123	0.00341	0.00579	0.00638	0.00339	0.00339
11/8/05	3	BAS32000llo+alt	4	1782	1.30	0.3488	0.6004	0.0508	0.3674	0.6326	77	0.066	0.00289	0.00255	0.00235	0.00266	0.00266
11/8/05	4	BAS32000lhi+	4	1841	1.34	0.3499	0.5983	0.0518	0.3691	0.6309	84	0.073	0.00469	0.00732	0.00313	0.00592	0.00592
11/8/05	5	BAS320WUlhi+	4	1824	1.32	0.3461	0.5908	0.0631	0.3694	0.6306	204	0.166	0.00564	0.00802	0.00671	0.00614	0.00614
11/8/05	6	BAS320WVlhi+	4	2188	1.62	0.3553	0.6001	0.0445	0.3718	0.6282	24	0.021	0.00492	0.00282	0.00706	0.00265	0.00265
11/8/05	7	V10170 1.4oz	4	1908	1.39	0.3462	0.6007	0.0532	0.3655	0.6345	245	0.197	0.00638	0.00338	0.00696	0.00460	0.00460
11/8/05	8	V10170 1.8oz	4	1824	1.32	0.3463	0.6033	0.0504	0.3646	0.6354	122	0.121	0.00834	0.00525	0.00627	0.00700	0.00700
11/8/05	9	O97hi+	4	2121	1.53	0.3471	0.6014	0.0516	0.3659	0.6341	110	0.089	0.00271	0.00334	0.00370	0.00247	0.00247
11/8/05	10	K2NO3	4	609	0.45	0.3502	0.5634	0.0864	0.3832	0.6168	103	0.078	0.00994	0.00783	0.00470	0.00972	0.00972
11/8/05	11	K2NO3+O97	4	1386	0.98	0.3356	0.5962	0.0682	0.3600	0.6400	268	0.215	0.00879	0.00428	0.00822	0.00683	0.00683
11/8/05	12	O97lo	4	1668	1.19	0.3401	0.5996	0.0602	0.3618	0.6382	103	0.097	0.00768	0.00409	0.00470	0.00659	0.00659
11/8/05	13	Diamond 9oz	4	1490	1.03	0.3300	0.6037	0.0663	0.3533	0.6467	91	0.079	0.00896	0.00573	0.01141	0.00618	0.00618
11/8/05	14	Diamond 12oz	4	1240	0.86	0.3289	0.6122	0.0589	0.3493	0.6507	134	0.123	0.01047	0.00479	0.01281	0.00674	0.00674
11/8/05	15	Diamond 6oz + O97	4	1475	1.03	0.3368	0.6088	0.0545	0.3562	0.6438	105	0.074	0.00123	0.00796	0.00770	0.00335	0.00335
11/8/05	16	CarbineWG 2.4oz	4	1495	1.07	0.3393	0.5971	0.0636	0.3622	0.6378	272	0.218	0.00772	0.00301	0.00478	0.00640	0.00640
11/8/05	17	CarbineWG 2.6oz	4	1864	1.36	0.3486	0.5843	0.0671	0.3737	0.6263	96	0.082	0.00335	0.00208	0.00350	0.00258	0.00258
11/8/05	18	CarbineWG 2.8oz	4	1931	1.41	0.3452	0.5942	0.0606	0.3674	0.6326	361	0.303	0.01151	0.01008	0.01321	0.00942	0.00942
Date	Trts	Product1	N Rows	Mean(Sdctn/A)	Mean(Bales/A)	Mean(T.O.)	Mean(%SeedT.O	Mean(%Trash)	Mean(%Lint)	Mean(%Seed)	Std Err(Sdctn/A)	Std Err(Bales/A)	Std Err(T.O.)	Std Err(%SeedT.(	Std Err(%Trash)	Std Err(%Lint)	Std Err(%Seed)
11/8/05	0	UTC-Lygus	4	502	0.36	0.3461	0.5836	0.0703	0.3725	0.6275	60	0.040	0.00453	0.01415	0.01619	0.00538	0.00538
11/8/05	1	Carbine2oz+MM+	4	1629	1.19	0.3499	0.6036	0.0465	0.3670	0.6330	137	0.107	0.00545	0.00743	0.00682	0.00560	0.00560
11/8/05	2	Carbine2.8oz+	4	1589	1.15	0.3455	0.5977	0.0568	0.3663	0.6337	156	0.123	0.00341	0.00579	0.00638	0.00339	0.00339
11/8/05	3	BAS32000llo+alt	4	1782	1.30	0.3488	0.6004	0.0508	0.3674	0.6326	77	0.066	0.00289	0.00255	0.00235	0.00266	0.00266
11/8/05	4	BAS32000lhi+	4	1841	1.34	0.3499	0.5983	0.0518	0.3691	0.6309	84	0.073	0.00469	0.00732	0.00313	0.00592	0.00592
11/8/05	5	BAS320WUlhi+	4	1824	1.32	0.3461	0.5908	0.0631	0.3694	0.6306	204	0.166	0.00564	0.00802	0.00671	0.00614	0.00614
11/8/05	6	BAS320WVlhi+	4	2188	1.62	0.3553	0.6001	0.0445	0.3718	0.6282	24	0.021	0.00492	0.00282	0.00706	0.00265	0.00265
11/8/05	7	V10170 1.4oz	4	1908	1.39	0.3462	0.6007	0.0532	0.3655	0.6345	245	0.197	0.00638	0.00338	0.00696	0.00460	0.00460
11/8/05	8	V10170 1.8oz	4	1824	1.32	0.3463	0.6033	0.0504	0.3646	0.6354	122	0.121	0.00834	0.00525	0.00627	0.00700	0.00700
11/8/05	9	O97hi+	4	2121	1.53	0.3471	0.6014	0.0516	0.3659	0.6341	110	0.089	0.00271	0.00334	0.00370	0.00247	0.00247
11/8/05	10	K2NO3	4	609	0.45	0.3502	0.5634	0.0864	0.3832	0.6168	103	0.078	0.00994	0.00783	0.00470	0.00972	0.00972
11/8/05	11	K2NO3+O97	4	1386	0.98	0.3356	0.5962	0.0682	0.3600	0.6400	268	0.215	0.00879	0.00428	0.00822	0.00683	0.00683
11/8/05	12	O97lo	4	1668	1.19	0.3401	0.5996	0.0602	0.3618	0.6382	103	0.097	0.00768	0.00409	0.00470	0.00659	0.00659
11/8/05	13	Diamond 9oz	4	1490	1.03	0.3300	0.6037	0.0663	0.3533	0.6467	91	0.079	0.00896	0.00573	0.01141	0.00618	0.00618
11/8/05	14	Diamond 12oz	4	1240	0.86	0.3289	0.6122	0.0589	0.3493	0.6507	134	0.123	0.01047	0.00479	0.01281	0.00674	0.00674
11/8/05	15	Diamond 6oz + O97	4	1475	1.03	0.3368	0.6088	0.0545	0.3562	0.6438	105	0.074	0.00123	0.00796	0.00770	0.00335	0.00335
11/8/05	16	CarbineWG 2.4oz	4	1495	1.07	0.3393	0.5971	0.0636	0.3622	0.6378	272	0.218	0.00772	0.00301	0.00478	0.00640	0.00640
11/8/05	17	CarbineWG 2.6oz	4	1864	1.36	0.3486	0.5843	0.0671	0.3737	0.6263	96	0.082	0.00335	0.00208	0.00350	0.00258	0.00258
11/8/05	18	CarbineWG 2.8oz	4	1931	1.41	0.3452	0.5942	0.0606	0.3674	0.6326	361	0.303	0.01151	0.01008	0.01321	0.00942	0.00942

Ellsworth/UA

Who wants to see more data!!?

UTC – 0.98 bales / A



Ellsworth/UA

From our 2004 small plot trial, we can view each of the four reps for the Untreated Check (UTC), where yields were severely affected by Lygus. [Bt cotton was used and whiteflies were selectively controlled with IGRs; no other yield limiting insects were present.]

BAS320-02I (0.214) – 2.33 bales

Ellsworth/UA

Metaflumizone at a moderate rate did well.

Orthene97 (1.0) – 2.45 bales

Ellsworth/UA

Orthene at a full rate, our standard, also did very well.

Flonicamid (0.088) – 2.56 bales

Ellsworth/UA

Flonicamid (Carbine) at 2.8 oz, max. rate, was the yield leader.

Product Comparisons

Ellsworth/UA

Let’s look at the leading products vs. the check, 1 rep each.

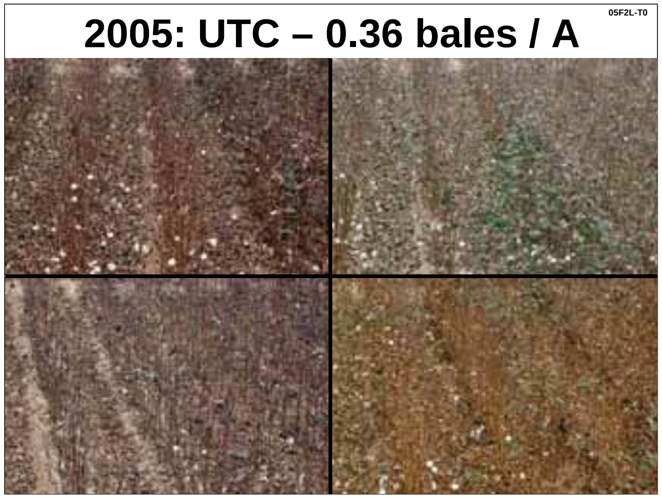
Typically our small plots are 12 rows by about 35 or 40 ft. Even so, evidence of down to the inch control is quite pronounced as we look down a series of borders at various treatements.

In this border, Carbine at 2.8 oz and 2 oz look very good, but then there is a plot (a band) of poor control with an experimental product, followed again by a plot of very good control by Vydate C-LV, max. rate, one of our other standards.

Poor control with an experimental up front, followed by fair, but only partial control, with a high rate of Diamond (novaluron).

A low rate of Diamond with a lower rate of Orthene97 (0.5 lbs ai/A) did comparatively well in this trial, about as well as Orthene at a full rate (1.0 lb ai/A). A lower rate of metaflumizone (BAS320) performed fairly well.

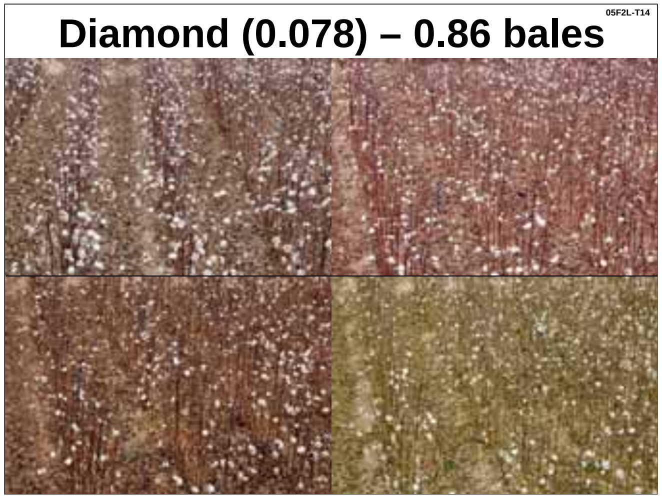
Diamond in the background was only partially effective against Lygus.



05F2L-T0

The following series of photos are from the 2005 Lygus efficacy trial in Maricopa, AZ. Each shows all four replicate plots, which were late planted to a Bt variety where other insects (whiteflies) were controlled selectively with IGRs as needed.

The UTC was severely affected by Lygus in this trial yielding just 1/3 of a bale / A.



05F2L-T14

Diamond did show control of Lygus, but still well below our best treatments in yield results.

05F2L-T9

Orthene97 (1.0) – 1.53 bales

05F2L-T9 Orthene 1.0 + Penetrator+

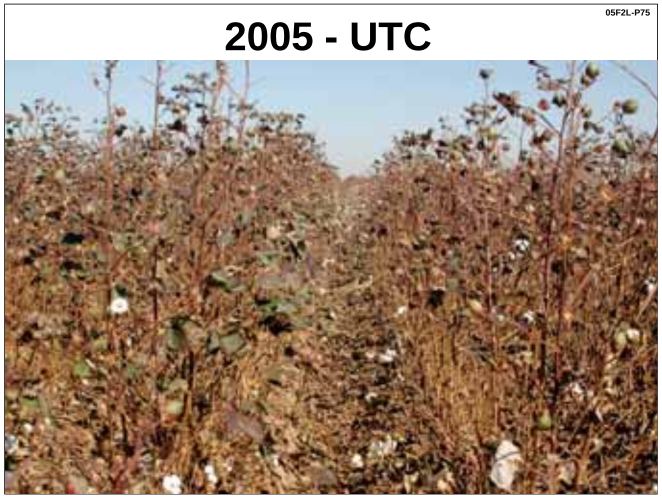
Orthene was our trial leader in yield in 2005.

05F2L-T18

Carbine WG (0.088) – 1.41 bales

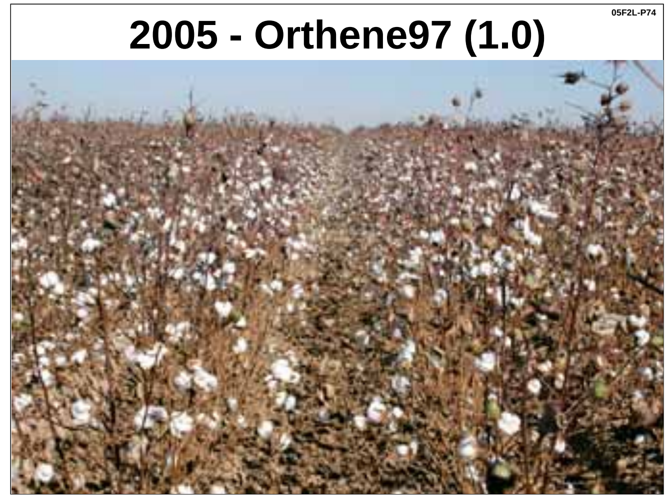
05F2L-T18 Carbine WG

But Carbine also performed very well. In fact, the highest yielding plots were from the Carbine treatment, but there were some other replicates where defoliation was not as complete and may have artificially lowered some plot yields.



05F2L-P75 UTC

From a ground view, one can see the UTC and how tall the crop is (over my head), and how even the late production failed to result in opened, harvestable bolls (delayed maturity effects).



05F2L-P74 Orthene 1.0 + Penetrator

In contrast, the adjacent plot of Orthene is much shorter and comparatively well-loaded with harvestable yield.

2005 – UTC*

05F2L-P56

05F2L-P56 K2NO3

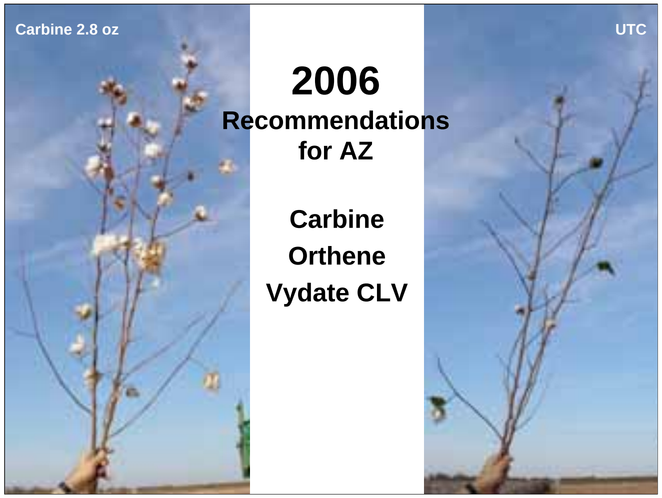
This plot was treated with foliar fertilizer (K2NO3), but also serves as a type of untreated check. It, too, is rank, and exhibiting poor defoliation.

2005 – Carbine**

05F2L-P43

05F2L-P43 T1 Carbine+MM+adj.

The adjacent plot of Carbine (this time mixed with Mustang-Max and an adjuvant) is much shorter, higher yielding, and well-defoliated.



In the end, the choices we have had in AZ for effective Lygus control have been very limited, limited to very old chemistry. In essence, prior to this year, I have only consistently recommended the usage of either Orthene or Vydate for the control of Lygus. While both good compounds, both are also broad spectrum and reduce the effectiveness of our natural enemies.

For 2006, should Carbine receive AZ registration in cotton, it, too, will be a recommended product. Furthermore, because of its selectivity potential, I will recommend the usage of this product as the first spray against Lygus as a means to extend the period of time when NEs are not exposed to broad-spectrum chemistry. In our system, natural enemies have been playing a larger and larger role in pest management as our overall system is subject to fewer sprays, and what few sprays are being made are often selective (e.g., IGRs for whitefly control).

Representative plants (2) from the Carbine (2.8 oz) plot on the left v. the same from the UTC from our 2005 trial. Photo credit: John Braun.

IPM Inventory

Let’s take an inventory of what we have and know, and can use to help manage Lygus. An important point to this talk is that we do in fact have “effective” Lygus chemical controls; however, until now, none of these options has been selective, and there has been no opportunity for rotation of modes of action for resistance management. Now, however, flonicamid, as a new class of chemistry, we have a chance to rotate our modes of action and hopefully reduce risks of resistance. And finally, we have great hope for the selectivity advantages of flonicamid over things like Orthene, which is very broad spectrum. More research is needed to understand the specific impacts of flonicamid use; however, it is clear that this is a major advance forward in effective <u>and</u> selective Lygus control.

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.

Photo credit: J. Silvertooth