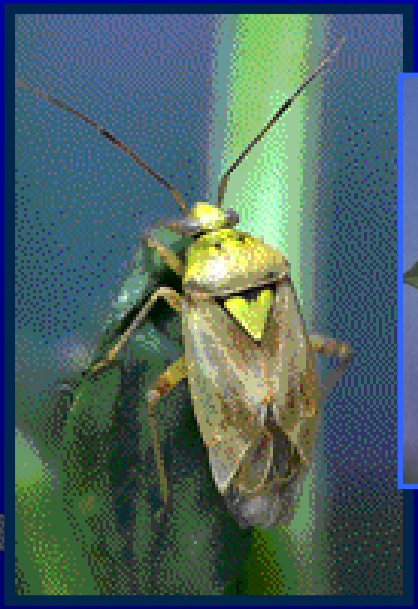
Pest Management Practices that Reduce VOCs in Field Crops in the SJV

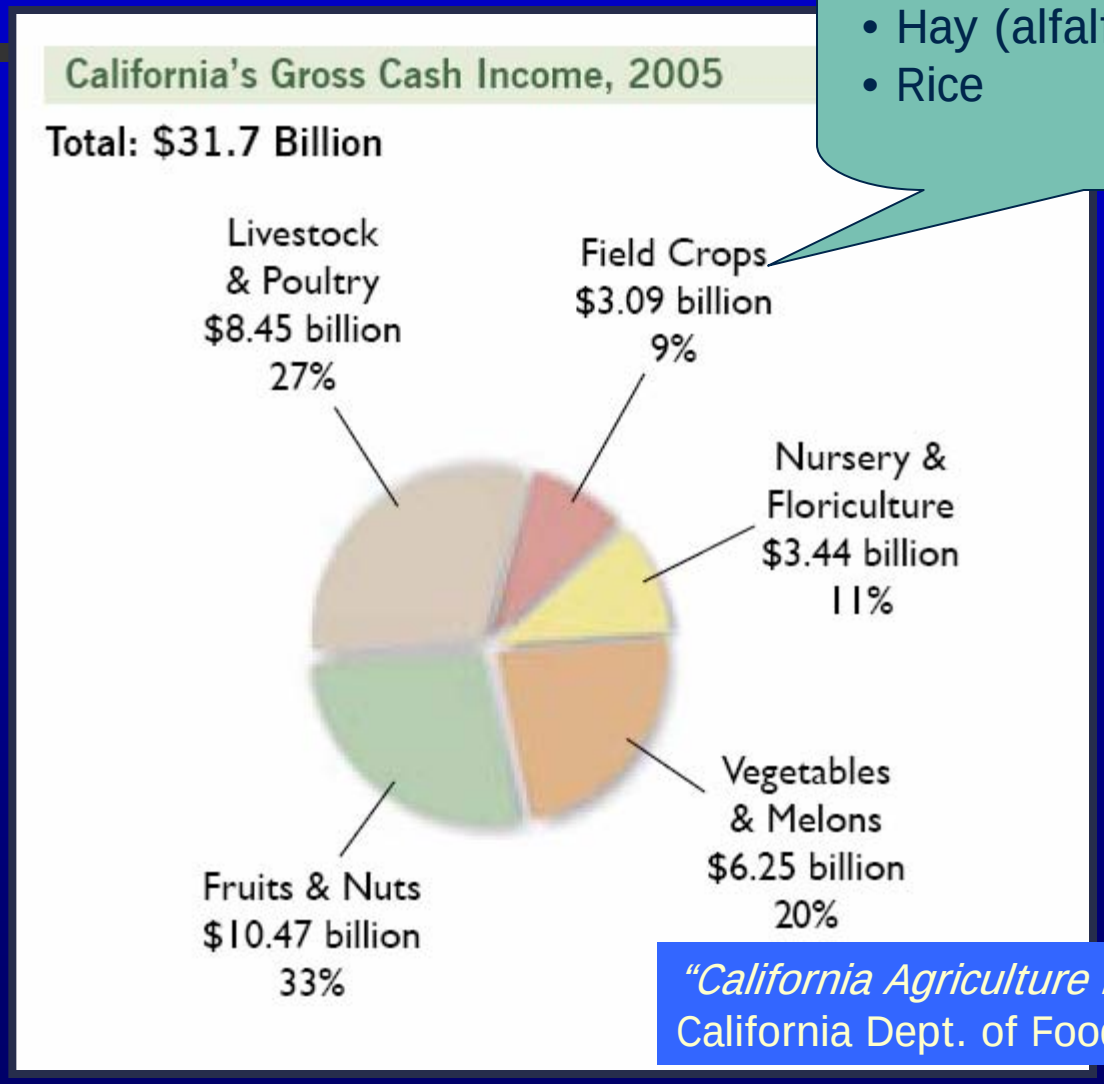
Larry D. Godfrey

Dept. of Entomology, Univ. of California, Davis, CA



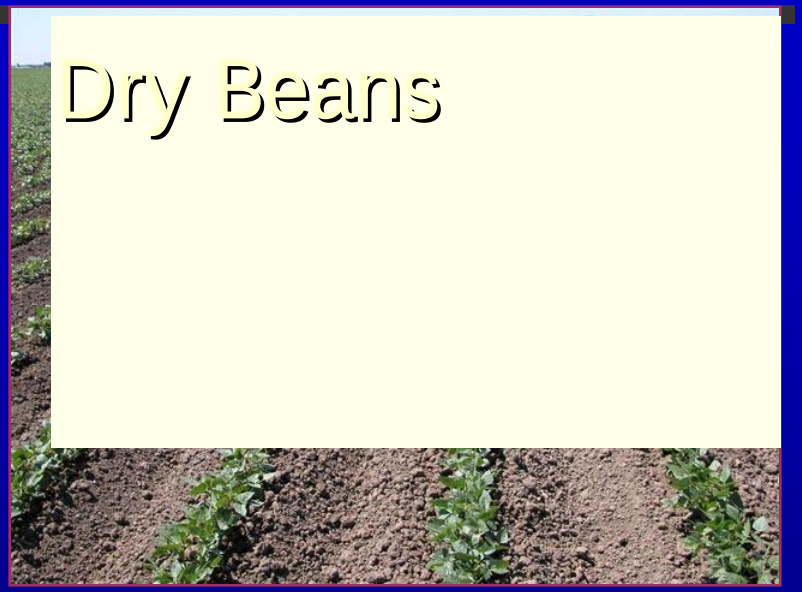
California Field Crops

- Cotton
- Hay (alfalfa)
- Rice
- Wheat
- Dry Beans
- Corn



"California Agriculture Highlights, 2006"
California Dept. of Food and Agriculture

California Field Crops



Alfalfa

Research Support and Cooperators

Agrichemical company cooperators

- ✓Steve Wright
- ✓Mick Canevari
- ✓Treanna Pierce
- ✓Richard Lewis
- ✓Wade Pinkston

California Field Crops

- Acreages of these annual (or short-term perennial) crops fairly dynamic
- Production practices (varieties) quickly changed
- Long history of Research and Extension on these crops
- Many of the principles of integrated pest management developed from efforts in these systems

History of Lygus Bug Research in California

LYGUS BUG MEETING

BERKELEY, CALIFORNIA, OCTOBER 19, 1961

Lygus

MEMBERS PRESENT:

466

7-

William W. Allen	Woodrow W. Middlekauf
Oscar G. Bacon	Harold P. Reynolds
Vernon E. Burton	Harry H. Shorey
Elmer C. Carlson	Vernon M. Stern
Andrew S. Deal	John E. Swift
Thomas F. Leigh	R. van den Bosch

Chairman Leigh called the meeting to order and presented a brief review of the lygus bug problem. He indicated that lygus bugs are resistant to insecticides in many areas of the state, that residue problems occur as a result of drift from treatments, and that while some chemicals are effective against lygus bugs, they result in a build-up of other pests because of the killing of beneficial species.

Ed Swift asked for a discussion of possible cases of crop failures as a result of using organophosphorus or carbamate type insecticides in order to avoid residues due to drift. He pointed out that hay in the Imperial Valley had been recently sampled and that many lots had an over-tolerance of DDT. There have also been many recent cases of residues in milk throughout the state. Swift indicated that there has been an increasing sloppiness in the use of pesticides. There has also been a movement back to DDT for bollworm control as a result of dissatisfaction with Sevin. R. van den Bosch then stated that his observations and studies showed that the use of organophosphorus insecticides created many unusual problems. The suggestion was then made that each research entomologist present, report on his work. The group agreed.

Chairman Tom Leigh then called on each worker in turn. These reports with accompanying discussion are as follows:

Ongoing research and field crop issues in 1961……

Bacon
- Lygus species breakdown
- insecticide tolerance

Stern
- alfalfa intercropping

van den Bosch
- biological control
- *Geocoris*

Reynolds
- new carbamates

Middlekauf
- control in beans

Carlson
- economic thresholds on vegetable seed crops, safflower

Shorey
- insecticide efficacy on central coast area

Allen
- Lygus in strawberries

Leigh
- Lygus in cotton
- host plant resistance
- Lygus biology

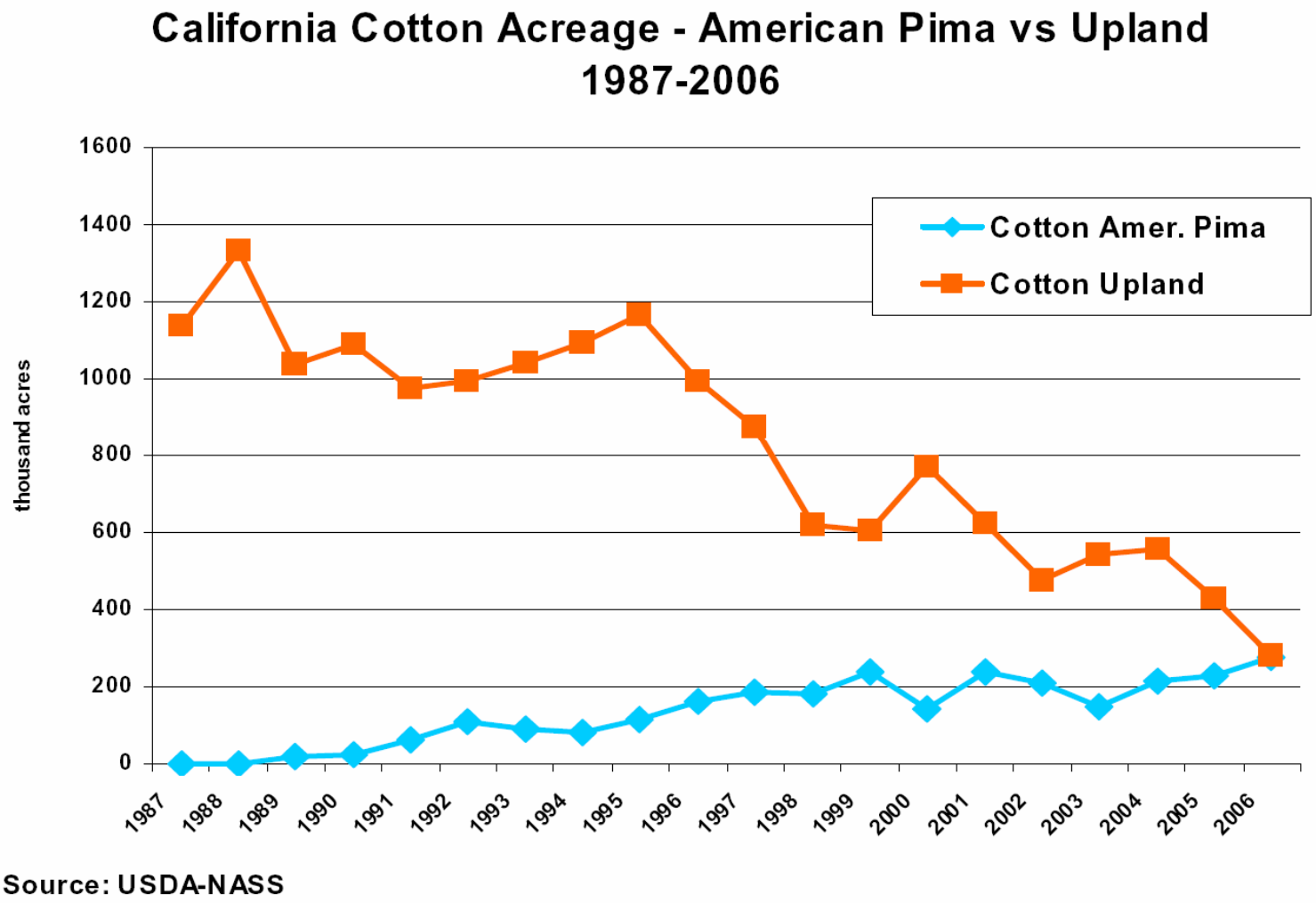
Present Situation ……

- Few, if any, easy answers
- Dealing with systems and pests that are dynamic and unstable
- Market considerations limit pest management options
  - costs
  - demands for high yields and excellent crop quality
- "answers" are not setting on the shelf or in the file cabinet

Present Situation ……

- Genetically modified crop technology not readily accepted or not a viable alternative in many situations in California
  - Bt cotton technology in Southern U.S cotton
  - Bt field corn for corn borer and/or rootworm control in the Midwest

Present Situation ……



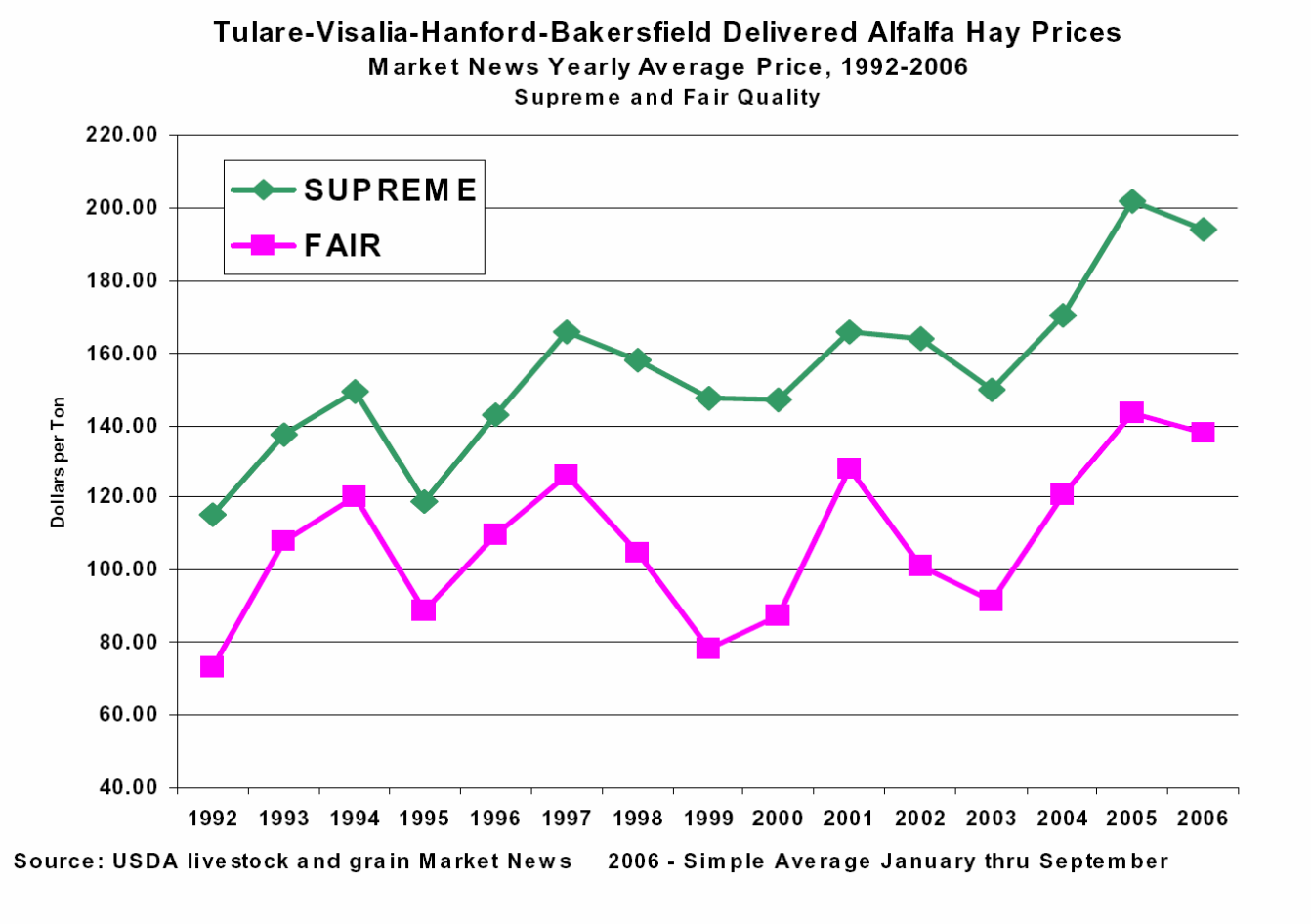
Cotton Production

- Switch in cotton species from upland (acala) cotton, *Gossypium hirsutum*, to Pima cotton, *G. barbadense*
  - started in 1991
  - this year ~50:50
- much of information that had been developed on upland cotton is of limited utility
- *Prunus* contains several species of economic crops

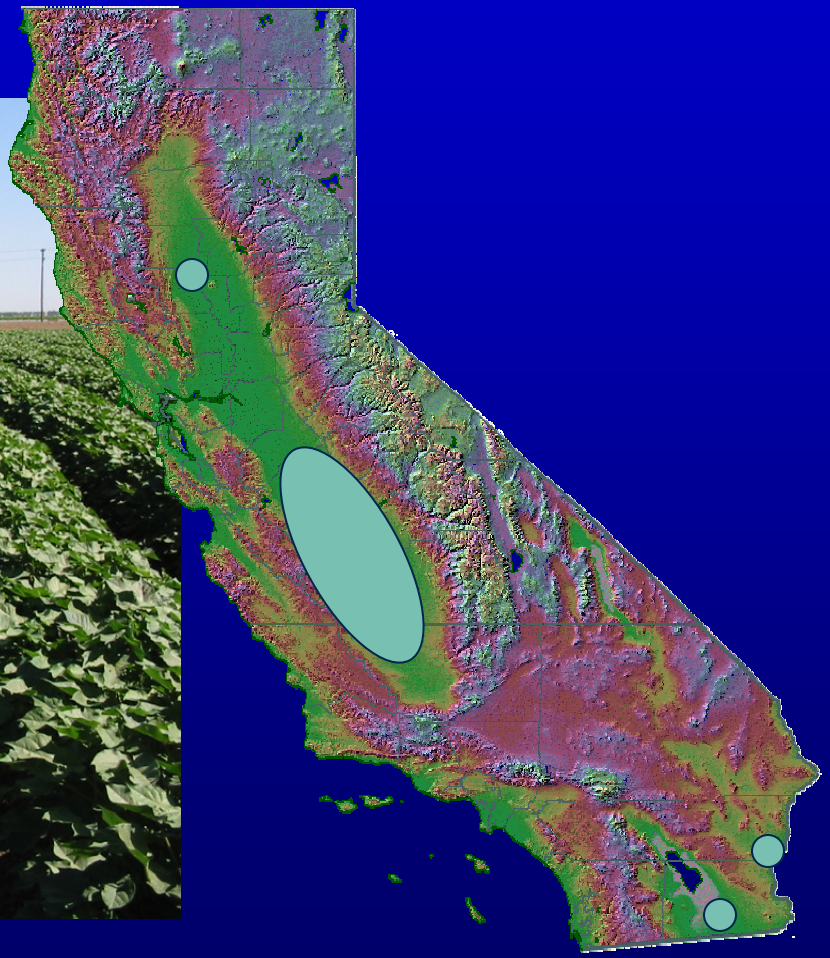
Alfalfa Production

- price varies greatly
- closely linked to livestock (dairy) industry as well as to corn silage price
- several management intensities for alfalfa
  - rotational crop
  - growing for use on farm
  - growing as a commodity and selling through broker

Alfalfa Production



Cotton



Cotton – Pests

VOC Concerns

Western Tarnished Plant Bug

Cotton – Pests

VOC Concerns

Spider Mites

Cotton – Pests

VOC Concerns

Spider Mites

Late-Season Cotton Aphid and Whitefly Infestations - Cotton Lint Quality

- **Sticky cotton became an issue in the SJV with the 2001 crop**
- combination of late-season cotton aphid and silverleaf whitefly infestations

Late-Season Insect Pests and Cotton Lint Quality

Cotton Aphids

- aphids developed mid-season and populations persisted into the late-season

Late-Season Insect Pests and Cotton Lint Quality

Silverleaf Whitefly

- populations peak in Aug. and Sept.
- southern end and eastern side of SJV had highest levels
- in recent years populations have developed earlier and are more widespread

Late-Season Insect Pests and Cotton Lint Quality

- Insecticide use increased
  - 2.7 applications per acre in 2001
  - 2.9 applications per acre in 2002
  - 3.5 applications per acre in 2003
- thiamethoxam and endosulfan (aphid controls) and pyriproxyfen and buprofezin (whitefly materials) were primary products with increased use in 2002
- acetamiprid use increased by over 500% from 2002 to 2003

Cotton IPM
California Situation

- Host plant resistance
  - none
- Biological control
  - Natural enemies introduced and released for Lygus bugs, cotton aphids, and whiteflies
  - Naturally occurring predators and parasites helpful

The Cotton Arthropod Food Web

Aphid

BAW

Lygus

Mites

Thrips

Whitefly

Parasitoids

Lady Bug

Lacewing

Minute Pirate

Big-eyed Bug

Damsel Bug

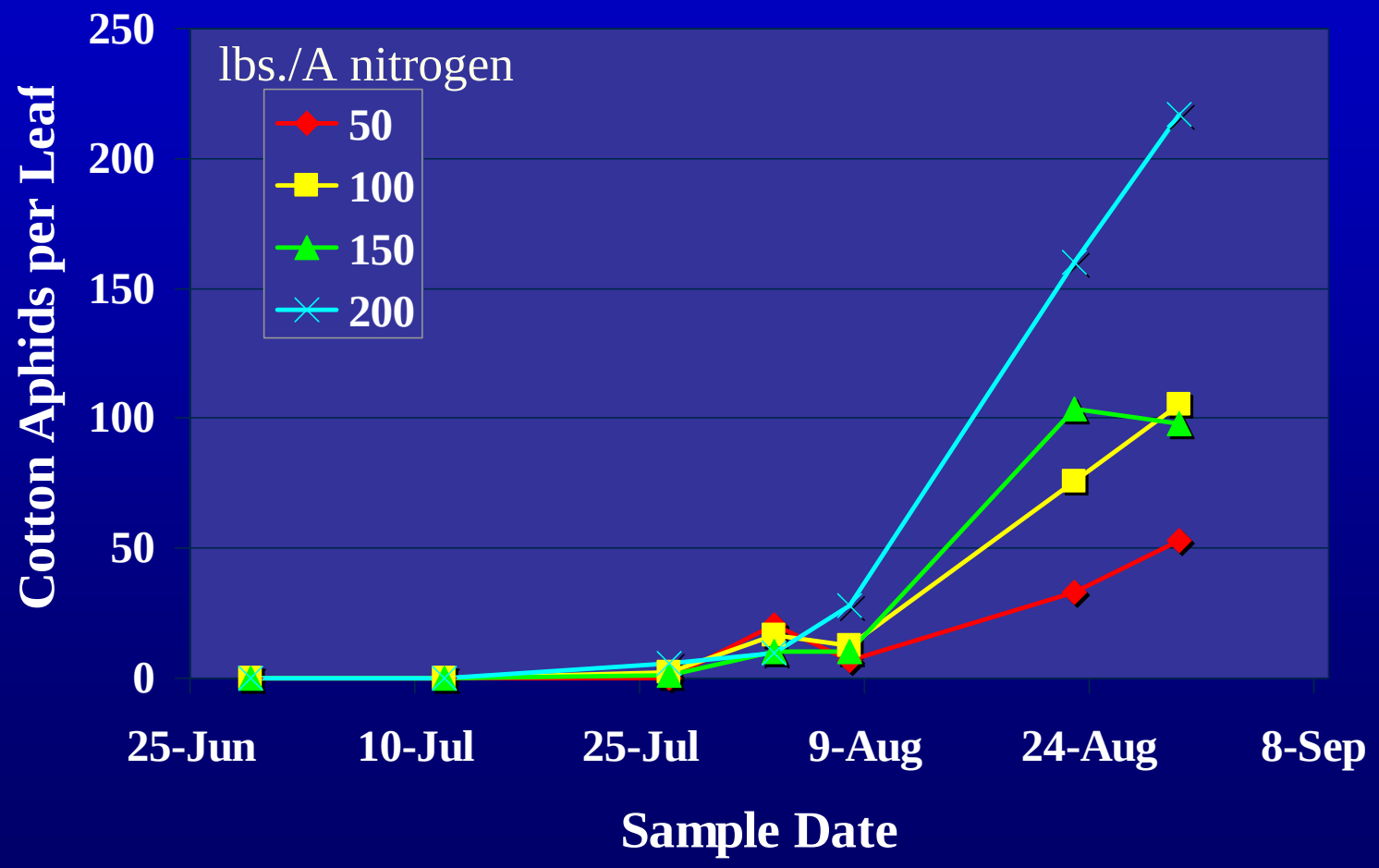
Hyper-Parasite

Zelus

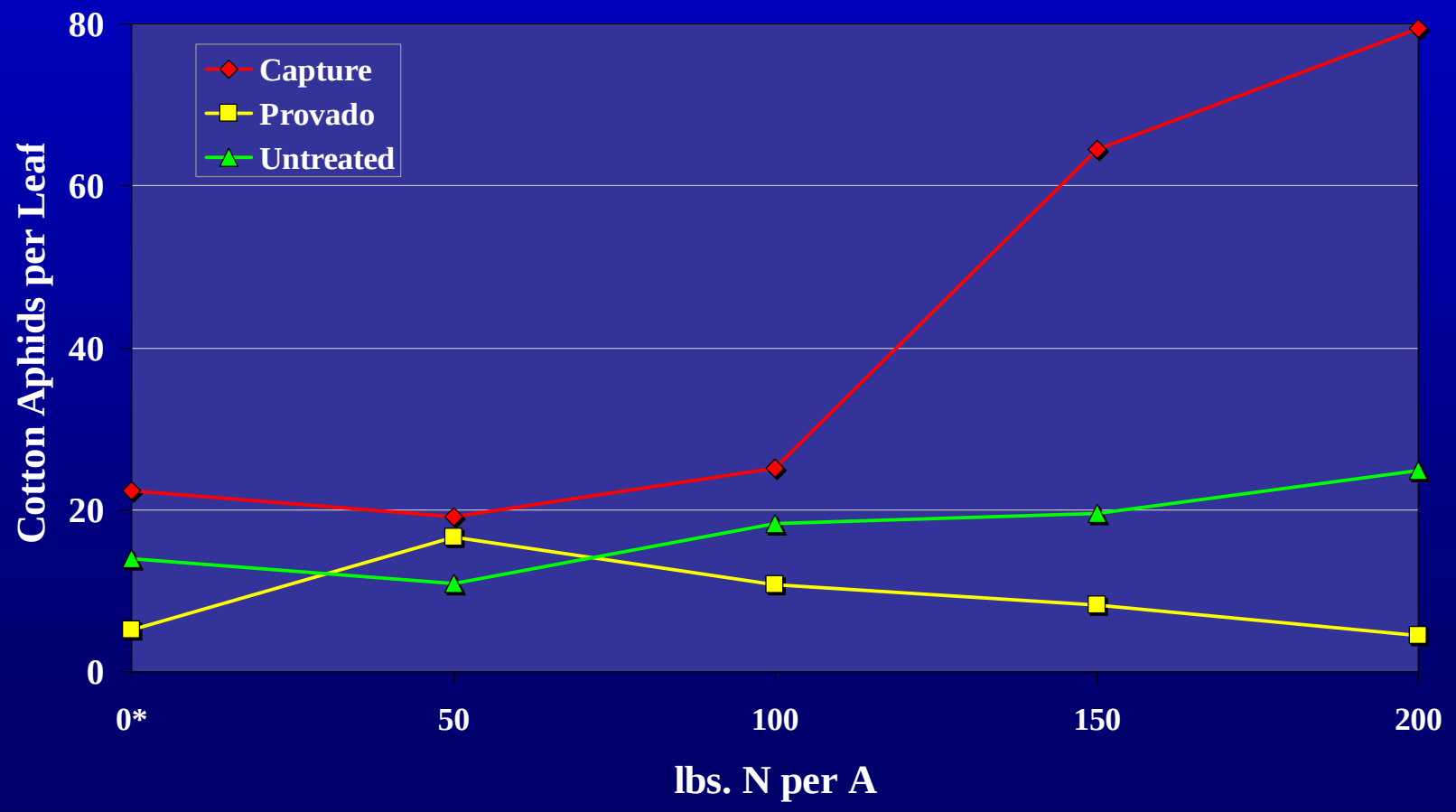
Cotton IPM
California Situation

- Cultural controls
  - Movement of lygus populations
  - Planting date and aphid populations
  - Nitrogen level and aphid populations
    - Interactions with pyrethroid insecticides
  - Harvest aids and late-season insect populations
- Sampling and thresholds

Cotton IPM
California Situation



Cotton IPM
California Situation



Cotton IPM
California Situation

- Insecticides
  - Critical for producing high quality cotton
  - Importance has increased to protect lint quality
- Minimizing and delaying the development of resistance is key
  - Important to maintain a range of cost-effective options for cotton growers

Cotton IPM
California Situation

Cotton aphids

Carbamate		Organophosphate	
aldicarb	granular - sidedress	chlorpyrifos	key product
oxamyl	low efficacy	dimethoate	low efficacy
carbofuran	very effective – no section 3 reg.	MSR	low efficacy
		naled	low efficacy

Cotton IPM
California Situation

Cotton aphids

			useful product

Biorational products	
Soaps, oils, pyrethrum, etc.	not effective

Cotton IPM
California Situation

Cotton aphids

Neonicotinoids	
Acetamiprid	Very effective
Imidacloprid	Very effective
Thiamethoxam	Very effective

Also used as seed treatment, lygus bug control, and whitefly management

Tolerance to this class has already been shown in cotton aphids in southern cotton

Cotton IPM
California Situation

Cotton aphids

New Chemistry	
Flonicamid	Very effective

Cotton IPM
Spider Mites

Two-spotted spider mite
Tetranychus urticae

Pacific spider mite
Tetranychus pacificus

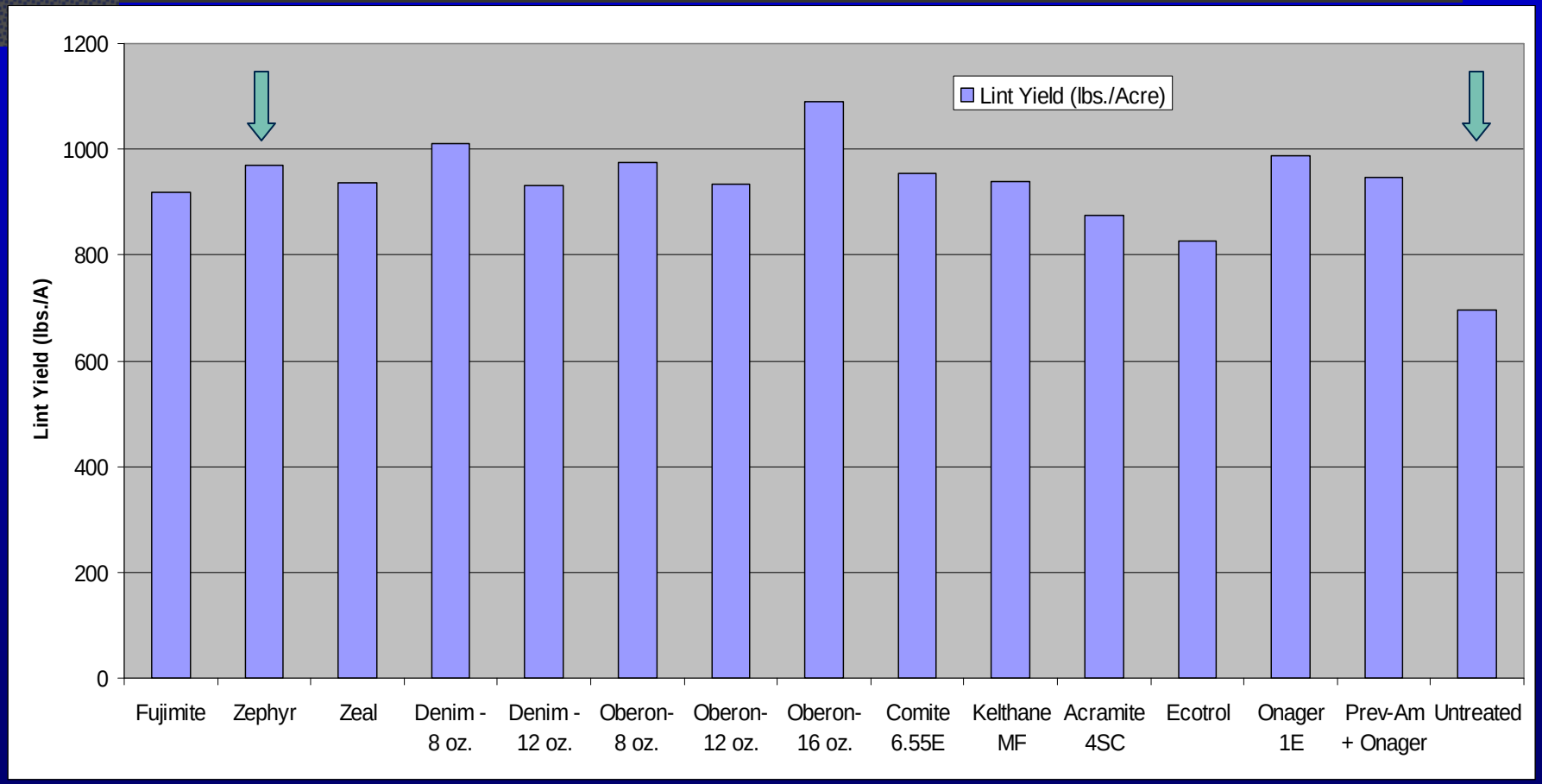
Strawberry spider mite
Tetranychus turkestani

Spider Mites

Trade Name	Chemical Name	Chemical Class	Mode of Action
Acramite	bifenazate	carboxylic acid ester	probable GABA agonist
Fujimite	fenpyroximate	phenoxypyrazole	mitochondrial electron transport inhibitor
Oberon	spiromesifen	tetronic acid derivative	lipid biosynthesis, growth regulator
Zeal	extoxazole	diphenyloxazoline	mite growth inhibitor (unknown/unspecific mode of action)
Comite	**propargite**	sulfite	inhibits magnesium-stimulated ATPase
Kelthane	**dicofol**	organochlorine	site II electron transport inhibitor
Onager	**hexythiazox**	thiazolidinone	mite growth inhibitor (unknown/unspecific mode of action)
Zephyr	**abamectin**	avermectin	chloride channel inhibitor

Cotton IPM
Spider Mites

Cotton IPM
Spider Mites



Lygus Bugs

Cotton IPM
Lygus Bugs

- More IPM compatible insecticides
- Alternative modes of action

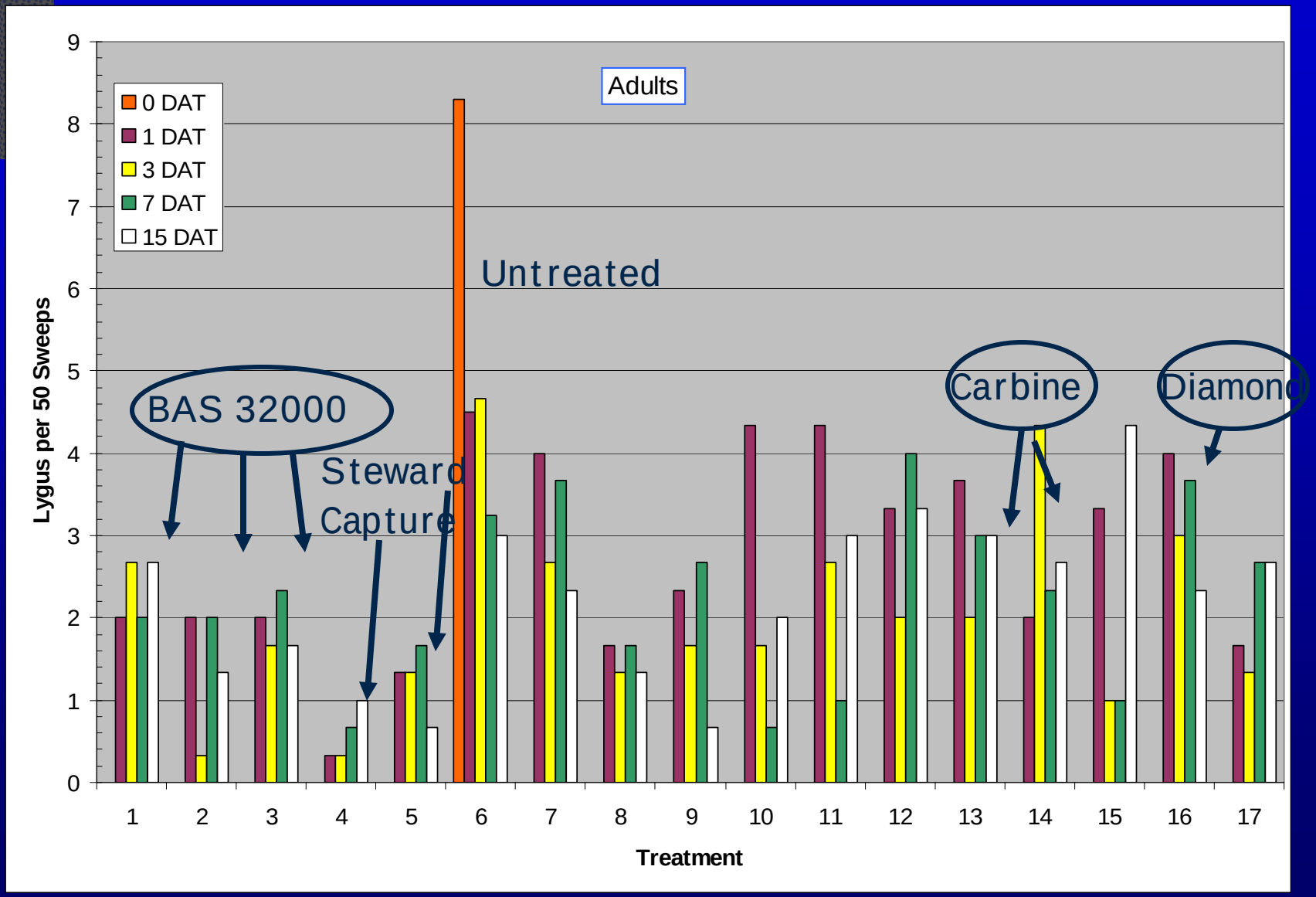
BAS320	Metaflumizone	BASF
Carbine 50WG	Flonicamid	FMC
Diamond 0.83EC	Novaluron	Chemtura

Lygus Bugs – 2006

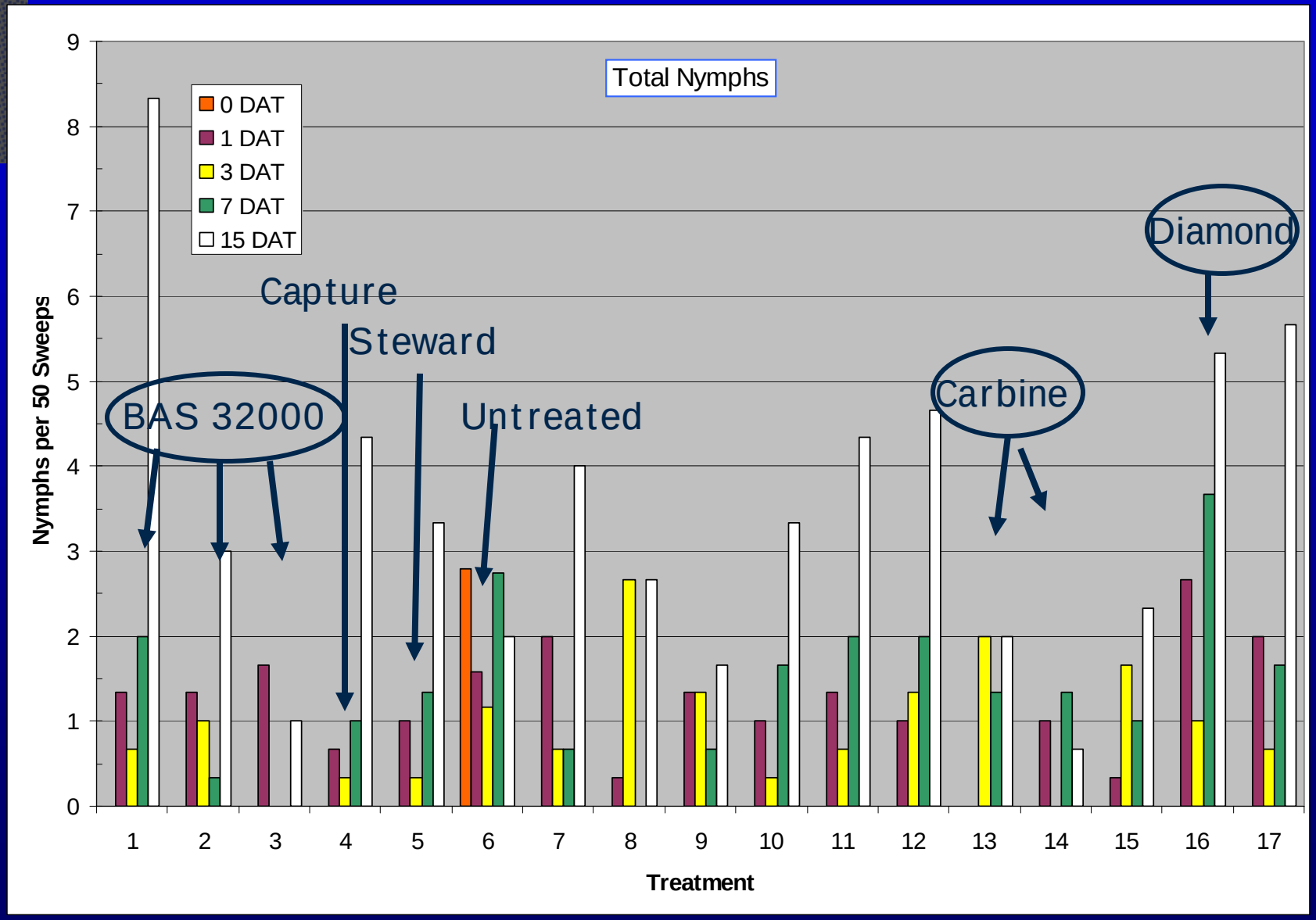
- West Side REC
- Primary objective was to look at the efficacy of experimental and registered products and to look at product rotations
- Applications were made on 18 July, 2 August, 17 August
- Plots measuring 12 rows by 75’ with four replications
- Efficacy was assessed with sweep net samples at 1,3,7,15 days after first application, 5 and 12 days after second application, and 5 days after third application

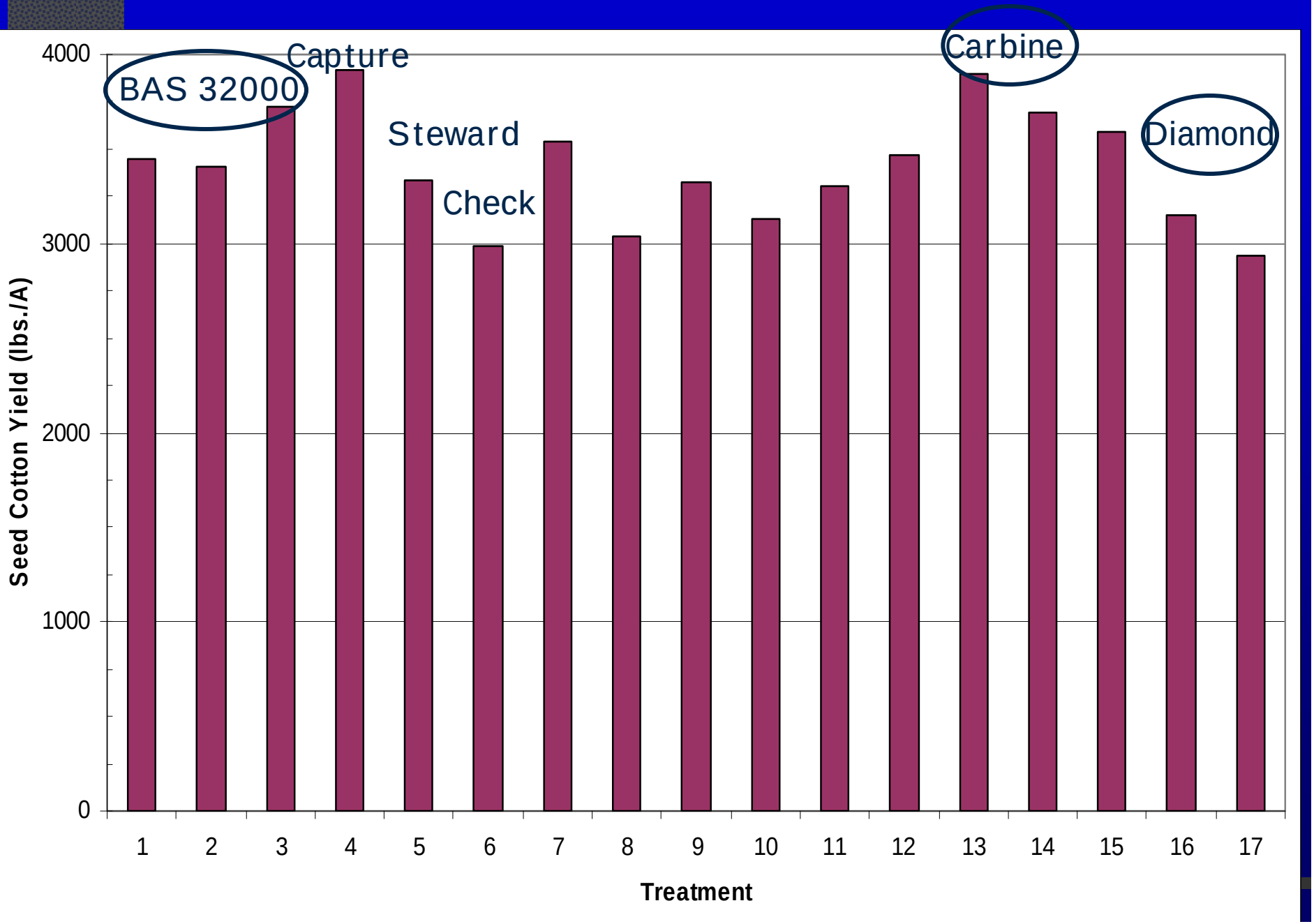
Lygus Bugs – 2006

Cotton - Lygus Bugs, 2006



Cotton - Lygus Bugs, 2006

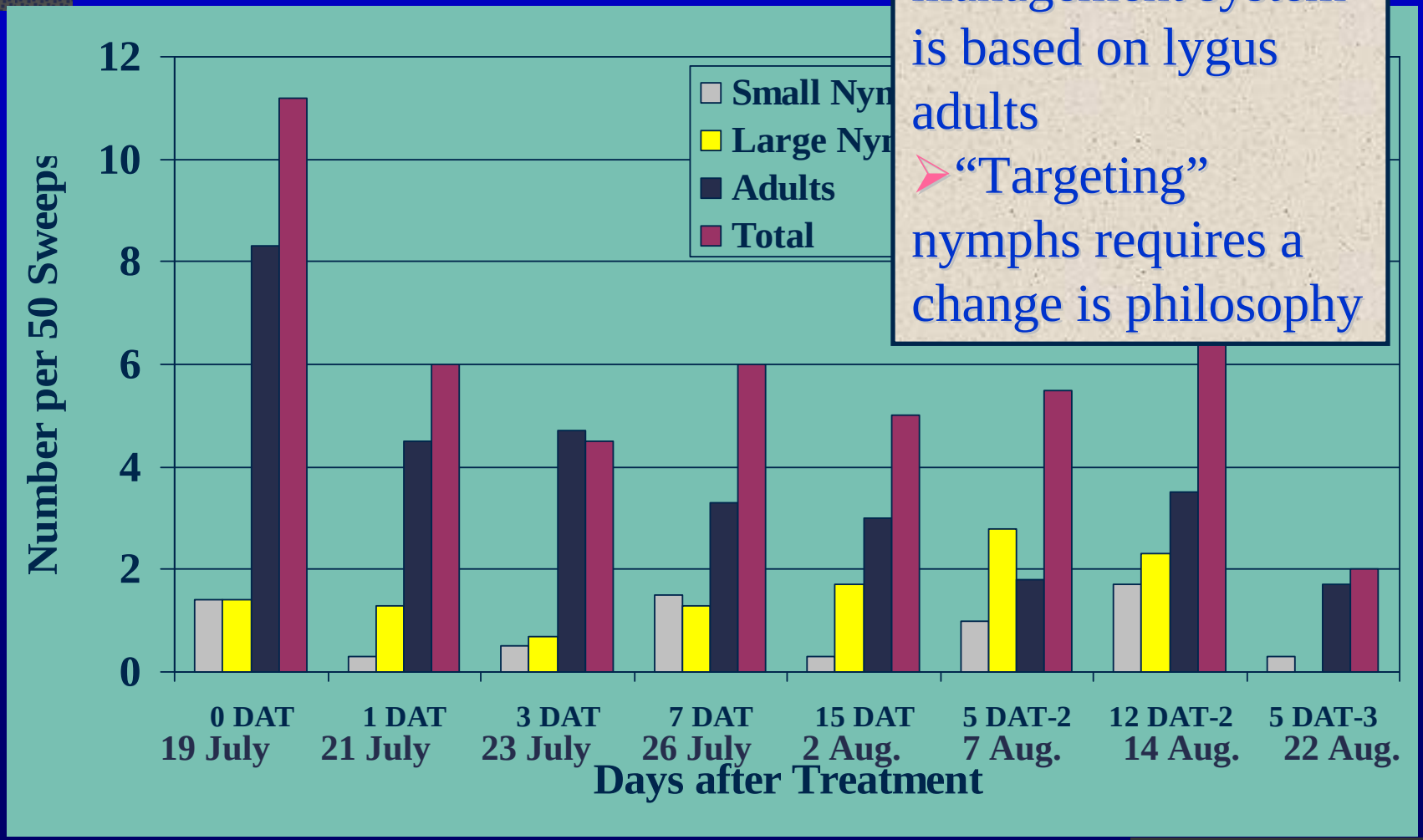



Seed Cotton Yield (lbs./A)
4000
3000
2000
1000
0
BAS 32000
Capture
Steward
Check
Carbine
Diamond
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Treatment

Carbine

Untreated

Cotton - Lygus Bugs, 2006



- Present management system is based on lygus adults
- "Targeting" nymphs requires a change is philosophy

Cotton Aphids – Mid-Season

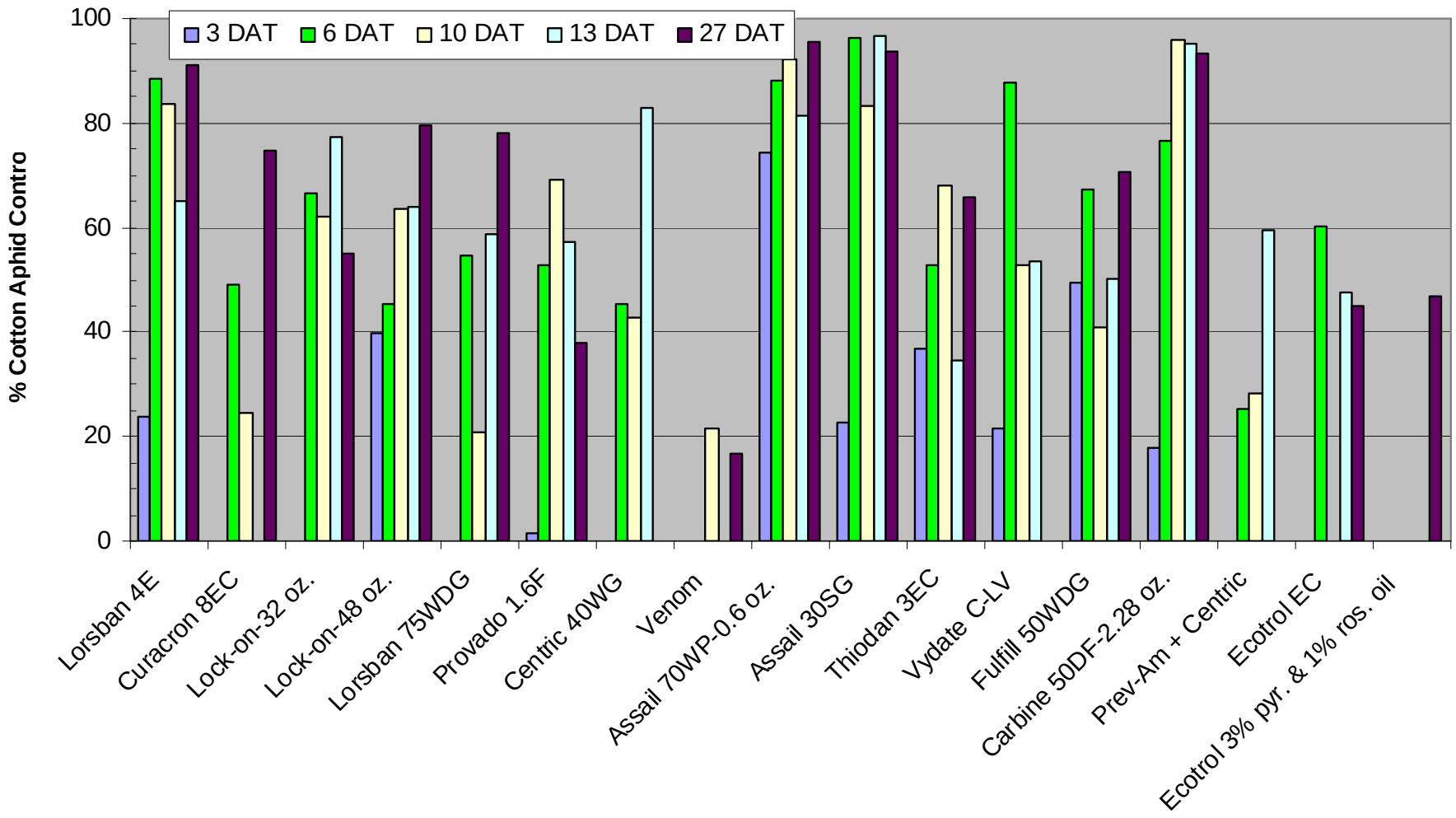
- Applied on 18 August - 24 treatments total
- Aphid populations
  - ~10 per leaf through late July
  - Pretreatments levels = 148 aphids/leaf
- Sampled at 3, 6, 10, 13, and 27 days after trt.
- Objective was to evaluate registered and experimental products particularly those that could help with the VOC issue

Cotton Aphids – Mid-Season

Treatment*	Rate (Product/A)
1. Provado 1.6F	3.75 fl. oz
2. Lorsban 4E	24 fl. oz.
3. Centric 40WG	2 oz.
4. Provado 1.6	5 fl. oz.
5. Carbine 50DF	2.8 oz
6. Carbine 50DF	2.28 oz
7. Assail 70WP	0.6 oz
8. Assail 70WP	1.1 oz.
9. Assail 30SG	2.5 oz
10. Trimax Pro	1.8 fl. oz.
11. Thiodan 3EC	24 fl. oz.
12. Untreated	---

Treatment*	Rate (Product/A)
13. Lock-on	32 fl. oz.
14. Fulfill 50WDG	2.75 oz.
15. Curacron 8EC	0.5 pts.
16. Venom	3 oz.
17. Prev-Am + Centric	0.6% + 2 oz
18. Vydate C-LV	25.5 fl. oz.
19. Lorsban 75WDG	1 lb.
20. Ecotrol EC**	2 qts.
21. Ecosmart 3% pyrethrum & 1% rosemary oil**	16 fl. oz.
22. NUP 06023	3.8 fl. oz.
23. NUP 06023 + NUP 06116	3.8 fl. oz. + 3 pts./100 gal.
24. Lock-on	48 fl. oz.

Cotton Aphids – Mid-Season



Cotton Aphids – Late-Season, 2005

- Applied on 18 Sept.
- 20 treatments total

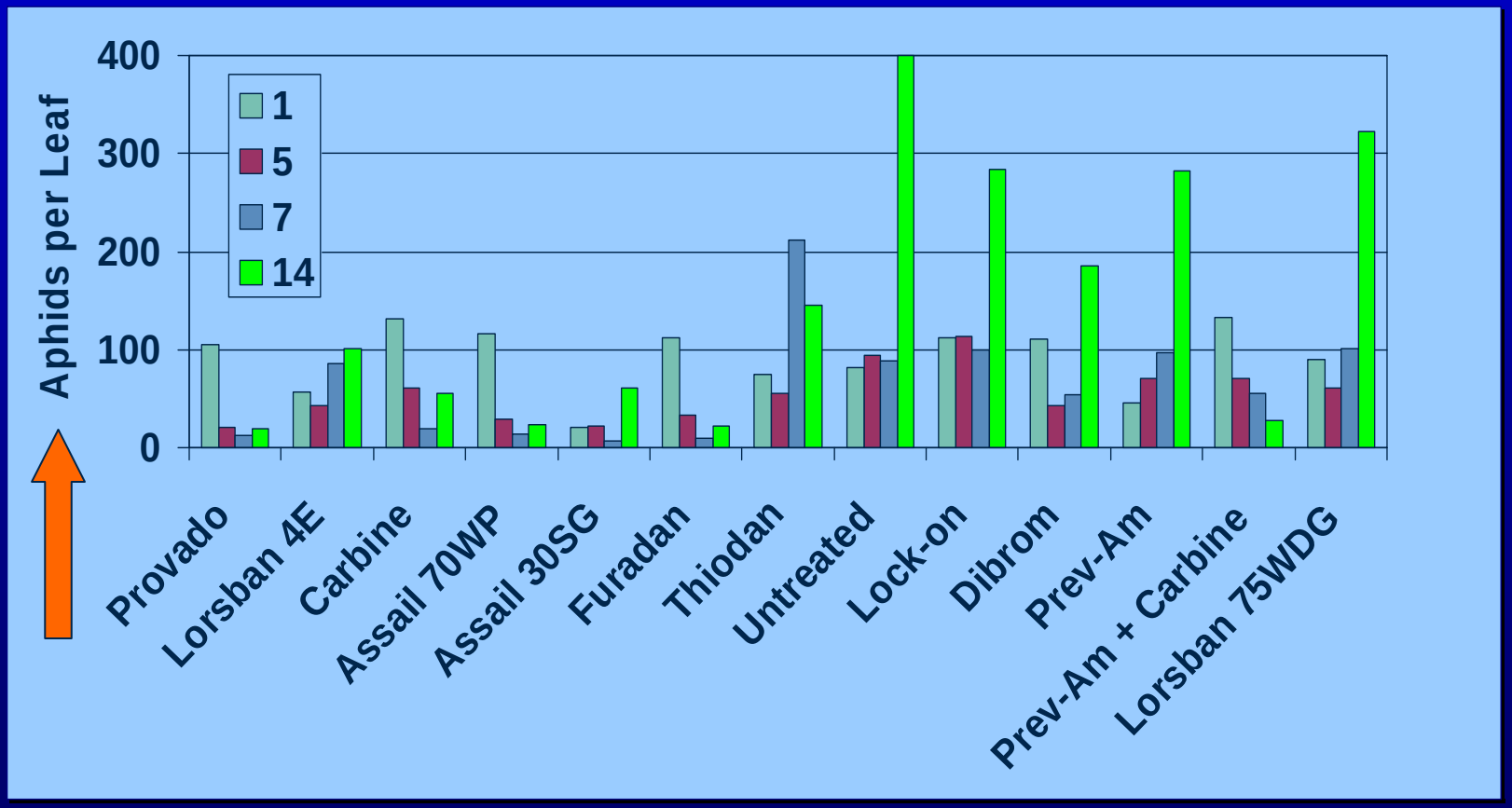
- Pretreatments levels = 27 aphids/leaf

- Sampled at 1, 5, 7, and 14 days after treatment

➢ Objective was to evaluate registered and experimental products particularly those that could help with the VOC issue while still providing protection of lint quality

Treatment	Rate (form./A)
1. Provado 1.6F*	3.75 fl.oz.
2. Lorsban 4E*	24 fl.oz.
3. Carbine 50DF*	2.56 oz.
4. Assail 70WP*	1.1 oz.
5. Assail 30SG*	2.5 oz.
6. Furadan 4F*	8 fl.oz.
7. Thiodan 3EC*	24 fl.oz.
8. Untreated	---
9. Lock-on*	32 fl.oz.
10. Dibrom 8E*	1 pts.
11. Prev-Am*	0.6%
12. Prev-Am + Carbine*	0.6% + 2.56 oz.
13. Lorsban 75WDG*	1 lb.

Cotton Aphids – Late-Season



Cotton Aphids

Mid-Season

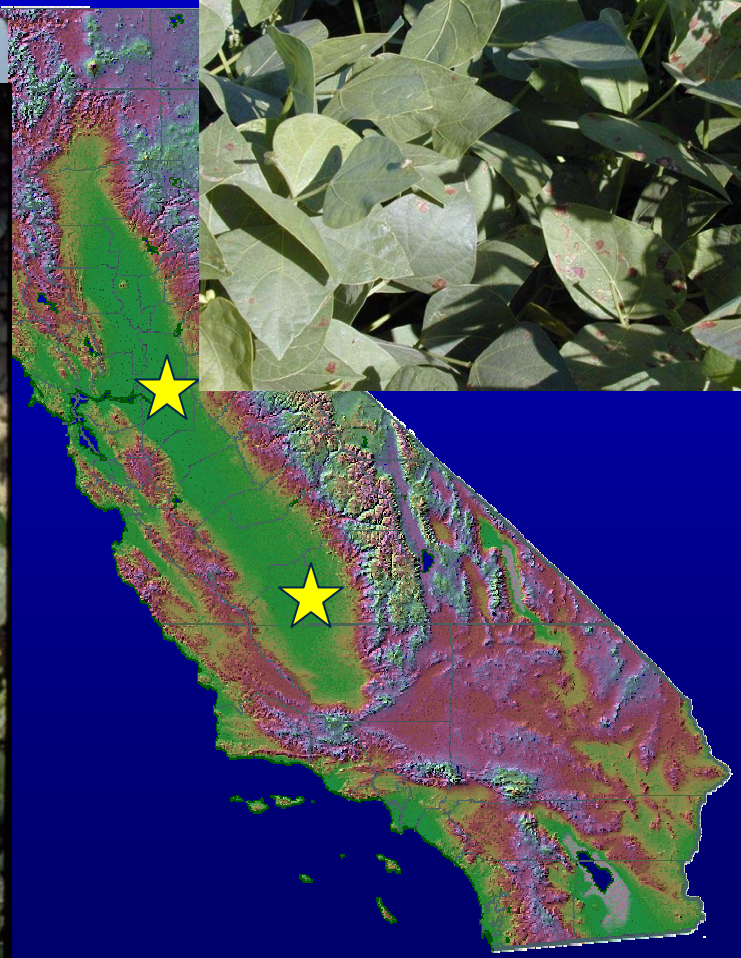
Lorsban 4E very effective and several alternatives useful

Resistance management critical (neonicotonoids)

Late-Season

No alternatives especially with aerial application

Beans



Beans

Lygus Management in Field Crops

- Cultural controls
  - alfalfa intercropping
- Biological control
- Host plant resistance
  - progress being made in beans
- Insecticides

Lygus Management in Field Crops

- Bean Insecticides
- Pyrethroids
  - zeta-cypermethrin, lambda-cyhalothrin
- Carbamates
  - methomyl
- Organophosphates
  - dimethoate, acephate

Needs

- More IPM compatible insecticides
- Alternative modes of action

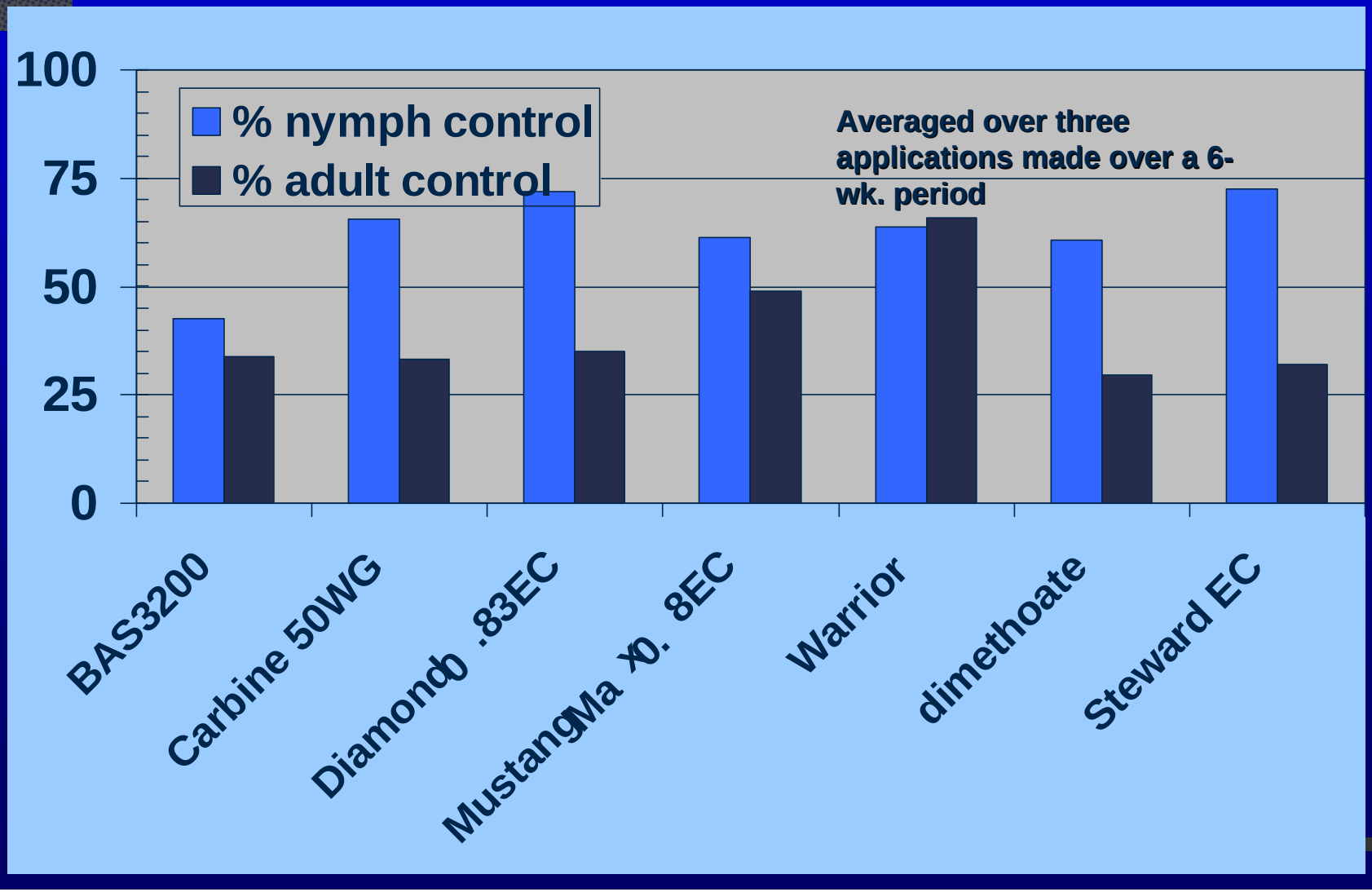
BAS320	Metaflumizone	BASF
Carbine 50WG	Flonicamid	FMC
Diamond 0.83EC	Novaluron	Chemtura
Beans Steward EC	Indoxacarb	DuPont

Testing Lygus Control in Beans –, 2006

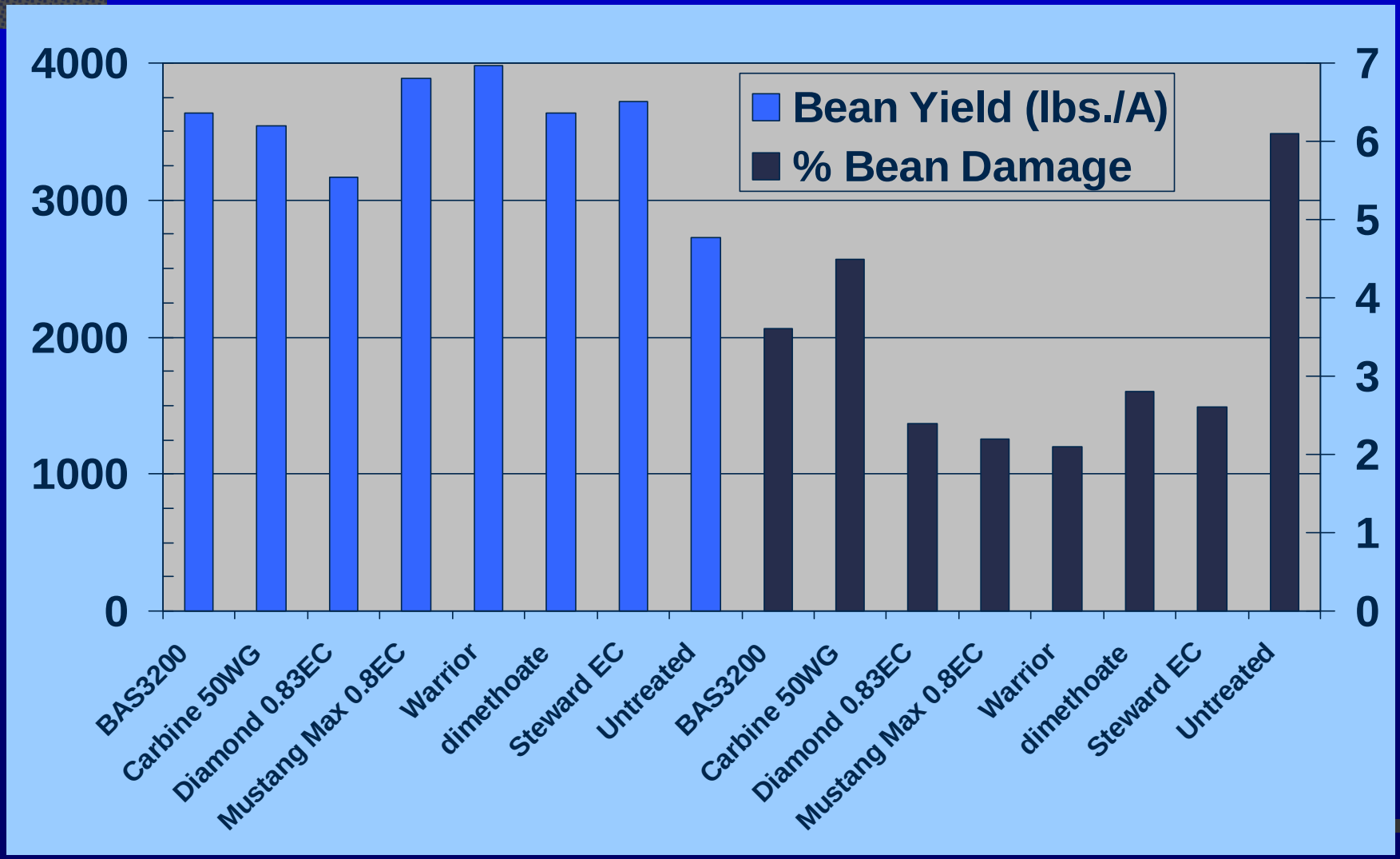
	Untreated	---	----
7	Mustang Max 0.8EC*	0.02	3.2 fl. oz.
8	Warrior*	0.03	3.84 fl. oz.
9	dimethoate*	0.5	16 fl. oz.
10	Steward EC*	0.11	11.3 fl. oz.

* added Penetrator Plus (0.5%) to treatments 1,2,3 and Dyne-Amic (0.5%) to other treatments

Beans – Field Test, 2006



Beans – Field Test, 2006



Beans

Vine Lima

Bush Lima

Alfalfa

Key Insect Pests

1. Egyptian alfalfa weevil/alfalfa weevil
   - Not a VOC issue
2. Aphids
   - Probably not a VOC issue
3. Lepidopterous larvae – alfalfa caterpillar, western yellow-striped armyworm, beet armyworm, others
   - VOC issue
   - this pest complex has become more problematic in recent years

Alfalfa

UC Statewide IPM Project
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UC Statewide IPM Project
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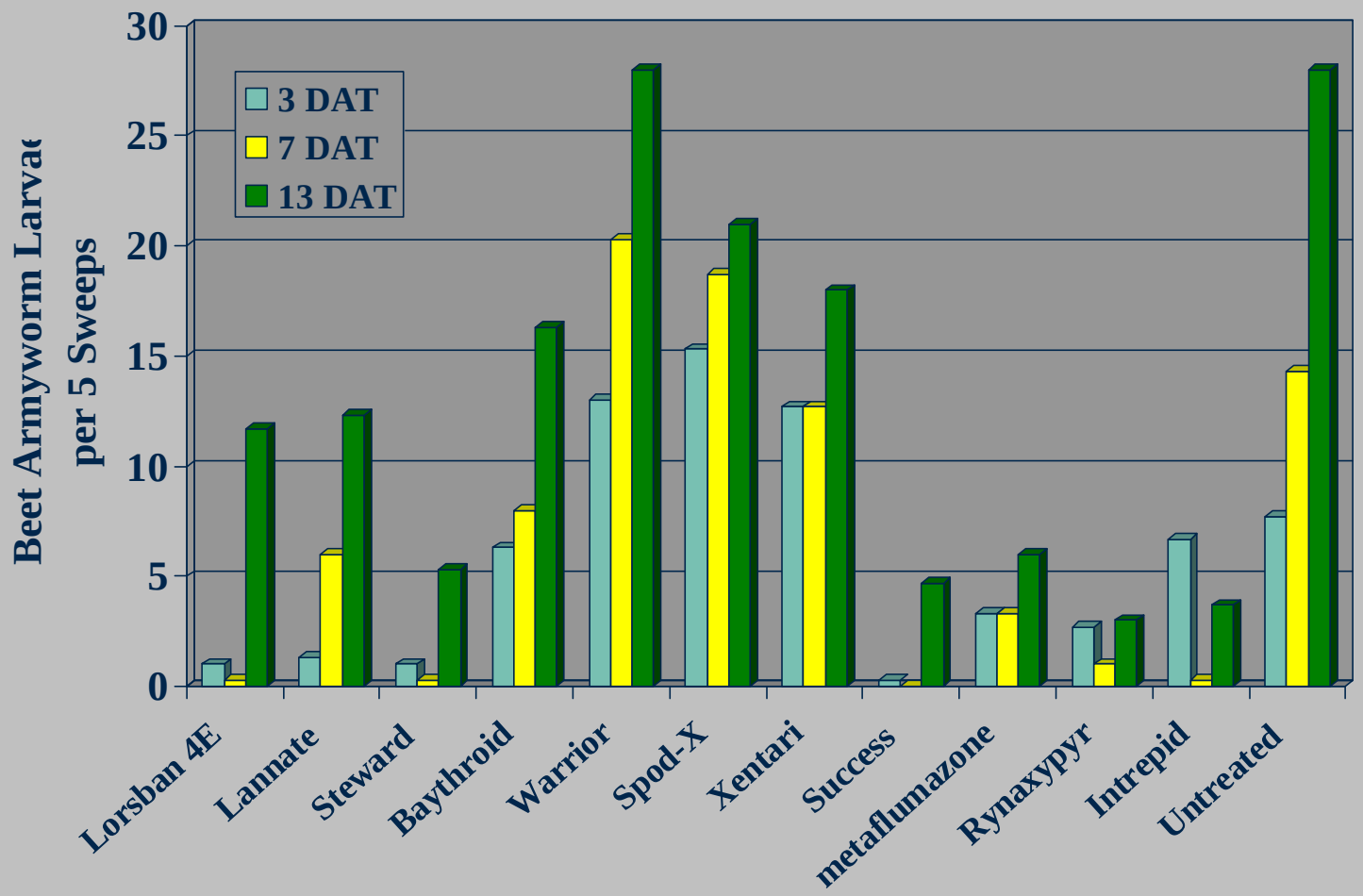
Alfalfa

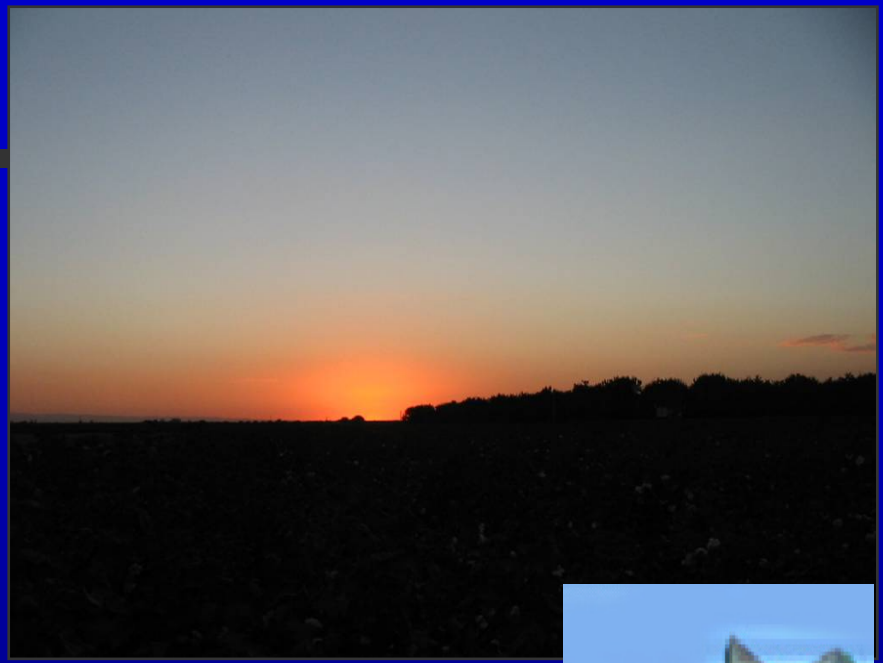
- Naturally occurring biological control common and effective

Alfalfa

- Compared 17 treatments against worms in alfalfa
- Standards – Lannate, Lorsban, pyrethroids, Steward
- Biologicals – SpodX, Xentari
- Experimentals – Intrepid, metaflumizone, Rynaxypyr

Alfalfa – BAW


Beet Armyworm Larvae
per 5 Sweeps
30
25
20
15
10
5
0
3 DAT
7 DAT
13 DAT
Lorsban 4E
Lannate
Steward
Baythroid
Warrior
Spod-X
Xentari
Success
metaflumazone
Rynaxypyr
Intrepid
Untreated

Alfalfa – BAW

- Some of the “Standards” did not provide excellent control
- Steward – excellent control
- Experimental materials show considerable promise
- Biological materials ineffective