Cross-commodity Guidelines and Resistance Management:

Is There a Correlation ?

THE UNIVERSITY OF ARIZONA.
Cooperative Extension

Cross-commodity Guidelines for Neonicotinoids in Arizona

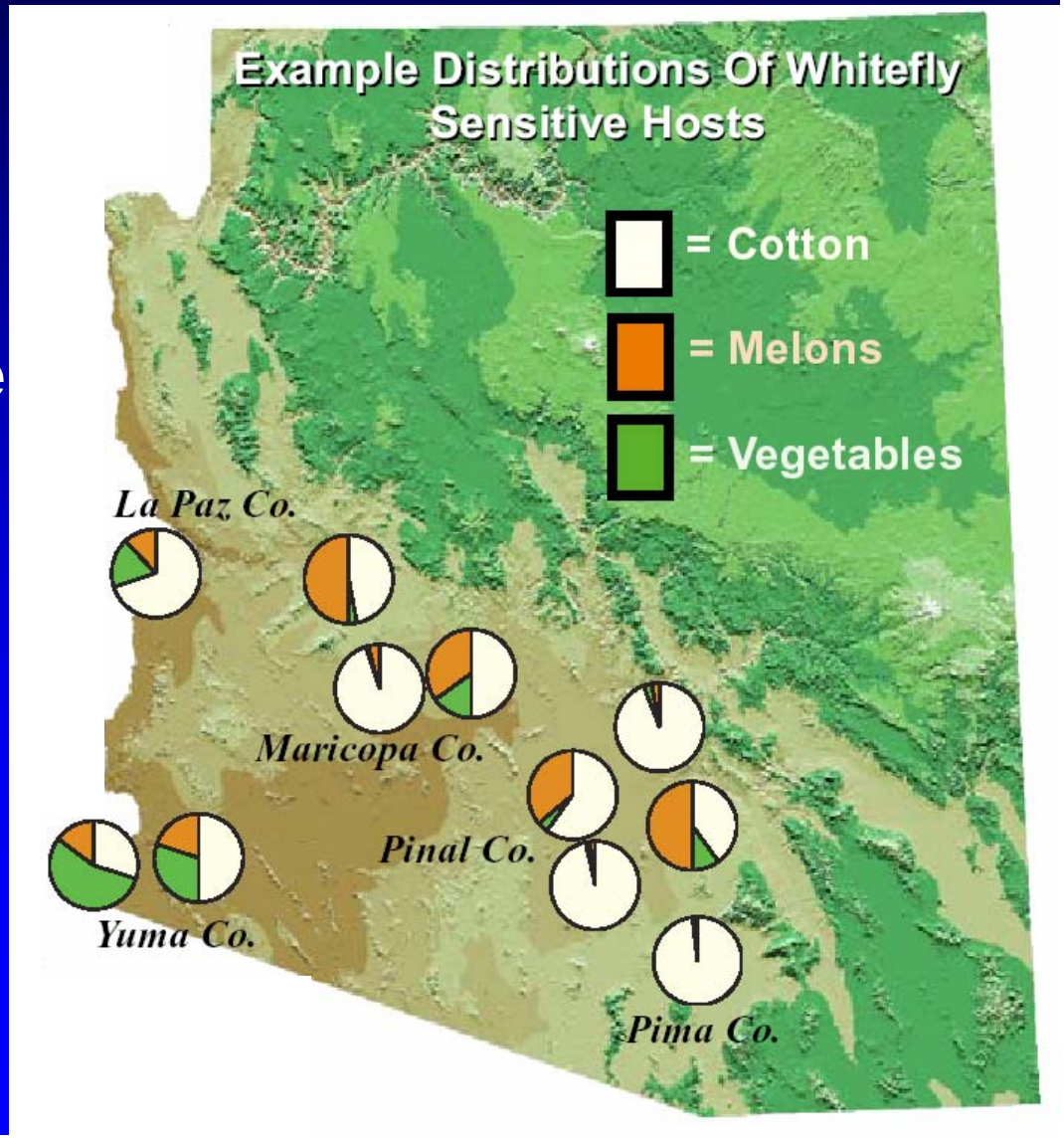
Our Goal: Given the tremendous value of this insecticide class to all parties involved, secure the long-term efficacy of the neonicotinoids and protect growers' interests in sustainable and economical whitefly management.

Defining a Crop Community

1) Multi-crop

2) Cotton Intensive

3) Melon/Cotton Intensive



THE UNIVERSITY OF ARIZONA
Cooperative Extension

***Summary Guidelines**: Maximum number of uses per crop season for neonicotinoids in three different cropping communities.*

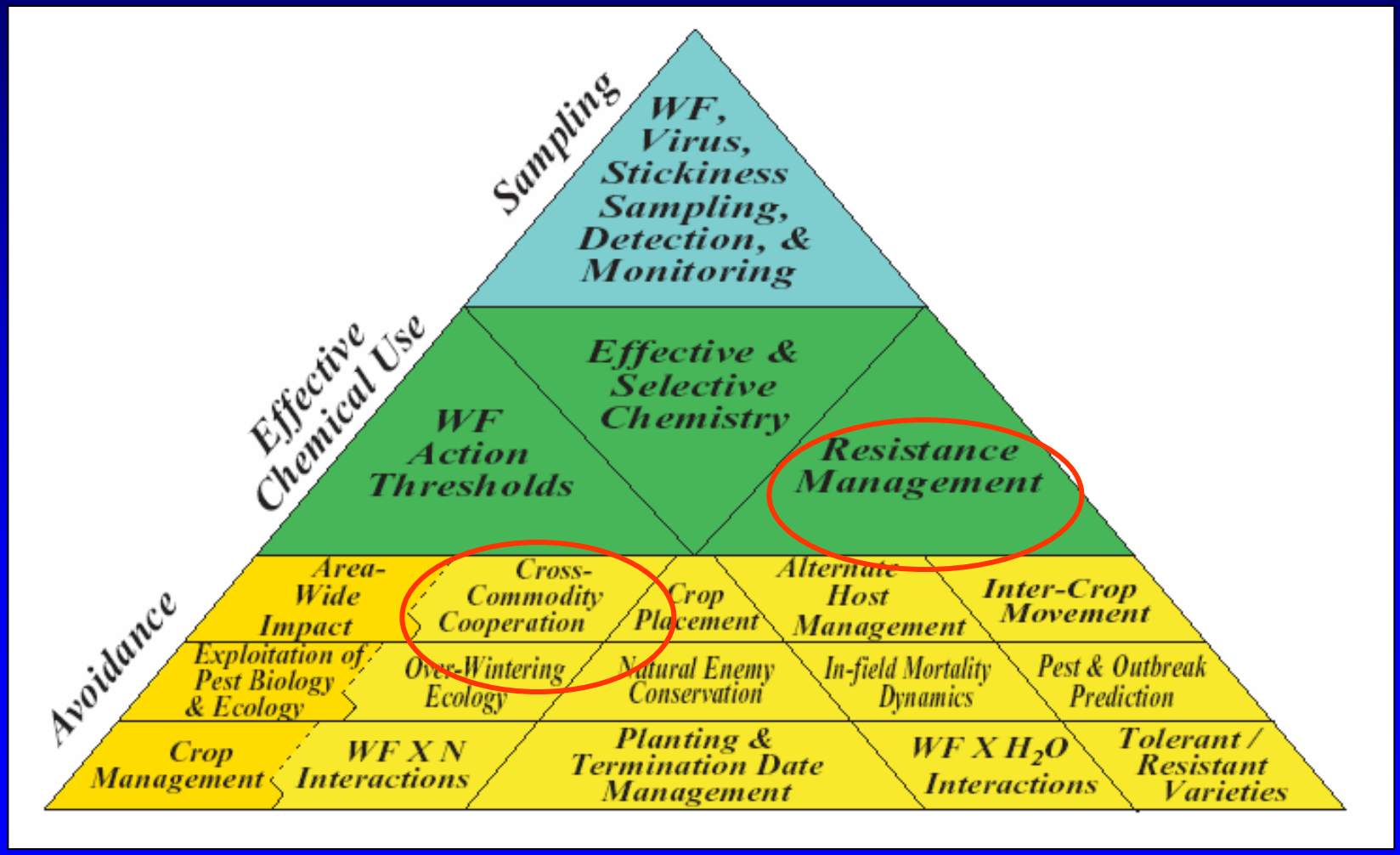
Community	Cotton	Melons	Vegetables
Multi-Crop	0	1*	1**
Cotton / Melon	1	1*	—
Cotton-Intensive	2	—	—

**Soil only; **Soil or Foliar*

http://ag.arizona.edu/crops

Fundamentals of Pest Management

Fundamental to any insect pest management program is a practical insecticide resistance management program



Will Following the Cross-commodity Guidelines

Sustained long-term efficacy of *Neonicotinoids* in our complex cropping communities

?


Those who forget the past
are destined to repeat it.
George Santayana

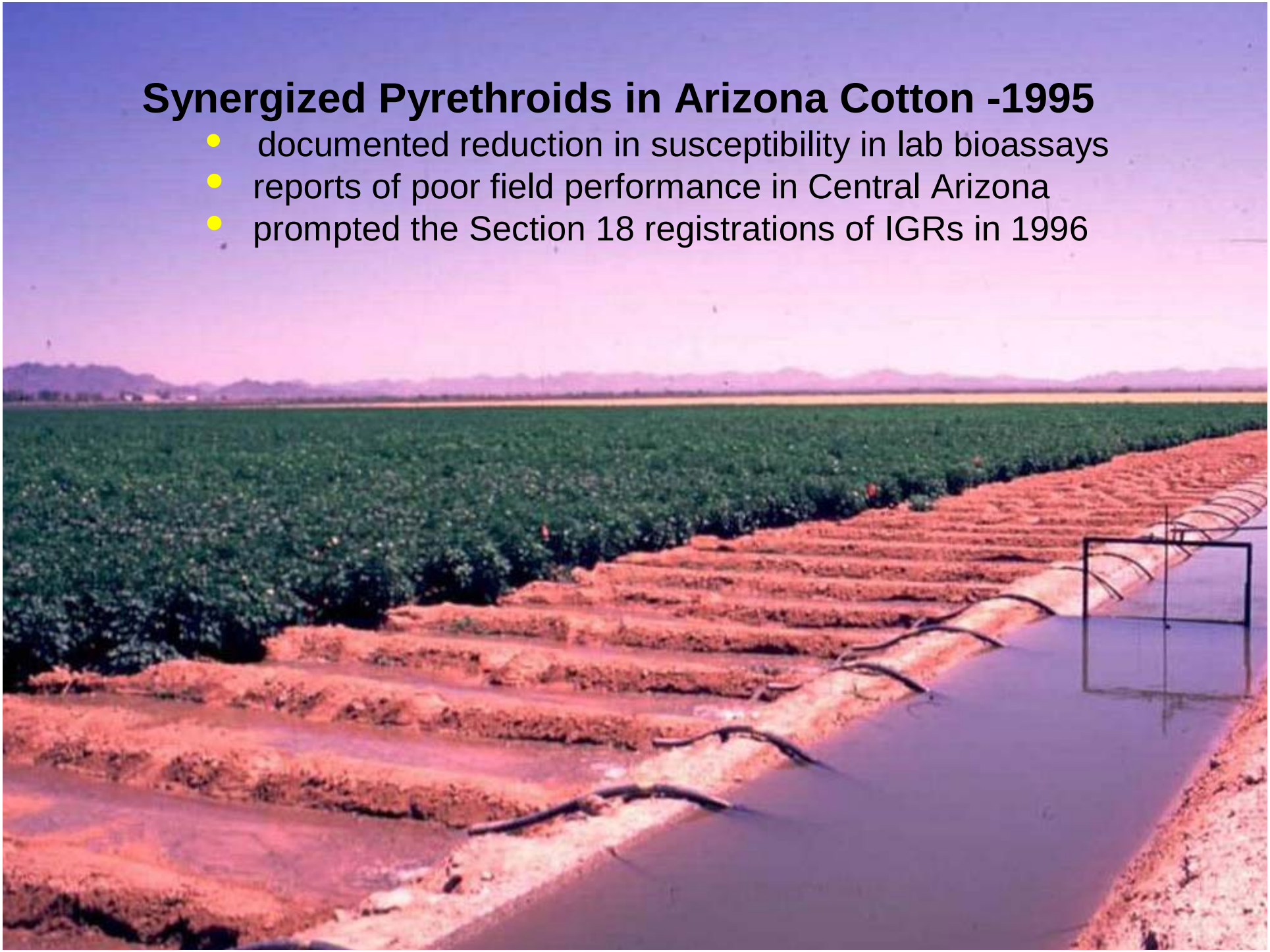
Resistance to Conventional Insecticides by the end of the 1980s

	Resistance Ratio (cotton)				
	OP	PYR	Fen/Bif	Aldicarb	Endo
Sudan	60-660	30-38	1-3	3	11
Turkey	19-300	29-208	6-8	2	5
Guatemala	28-400	760-2000	300-460	9	14

Source: Dittrich et al. 1990

Synergized Pyrethroids in Arizona Cotton -1995

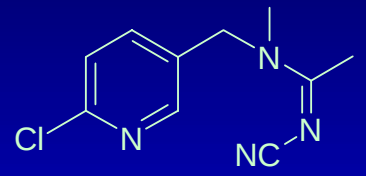
- documented reduction in susceptibility in lab bioassays
- reports of poor field performance in Central Arizona
- prompted the Section 18 registrations of IGRs in 1996



Neonicotinoid Chemistry

Imidacloprid
(Bayer)
Ist used in AZ in 1993

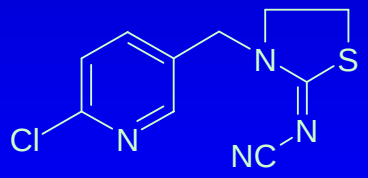
Thiamethoxam
(Syngenta)



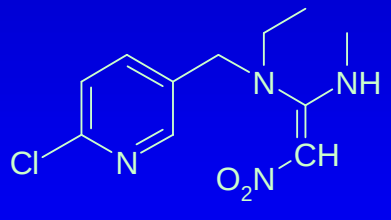
Acetamiprid
(Nippon Soda)

Clothianidin
(Bayer/Takeda)

Dinotefuran
(Mitsui Toatsu)



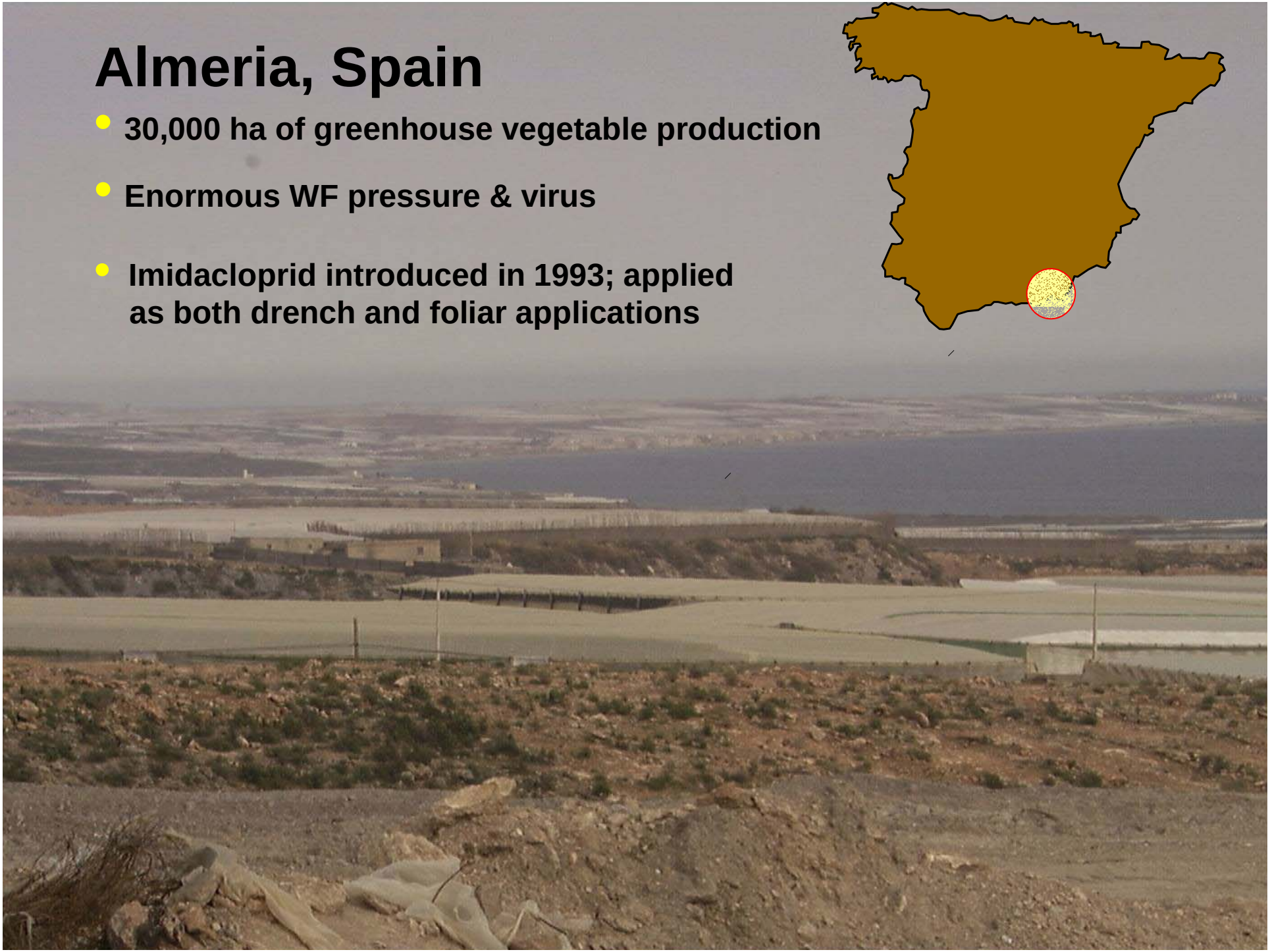
Thiacloprid
(Bayer)



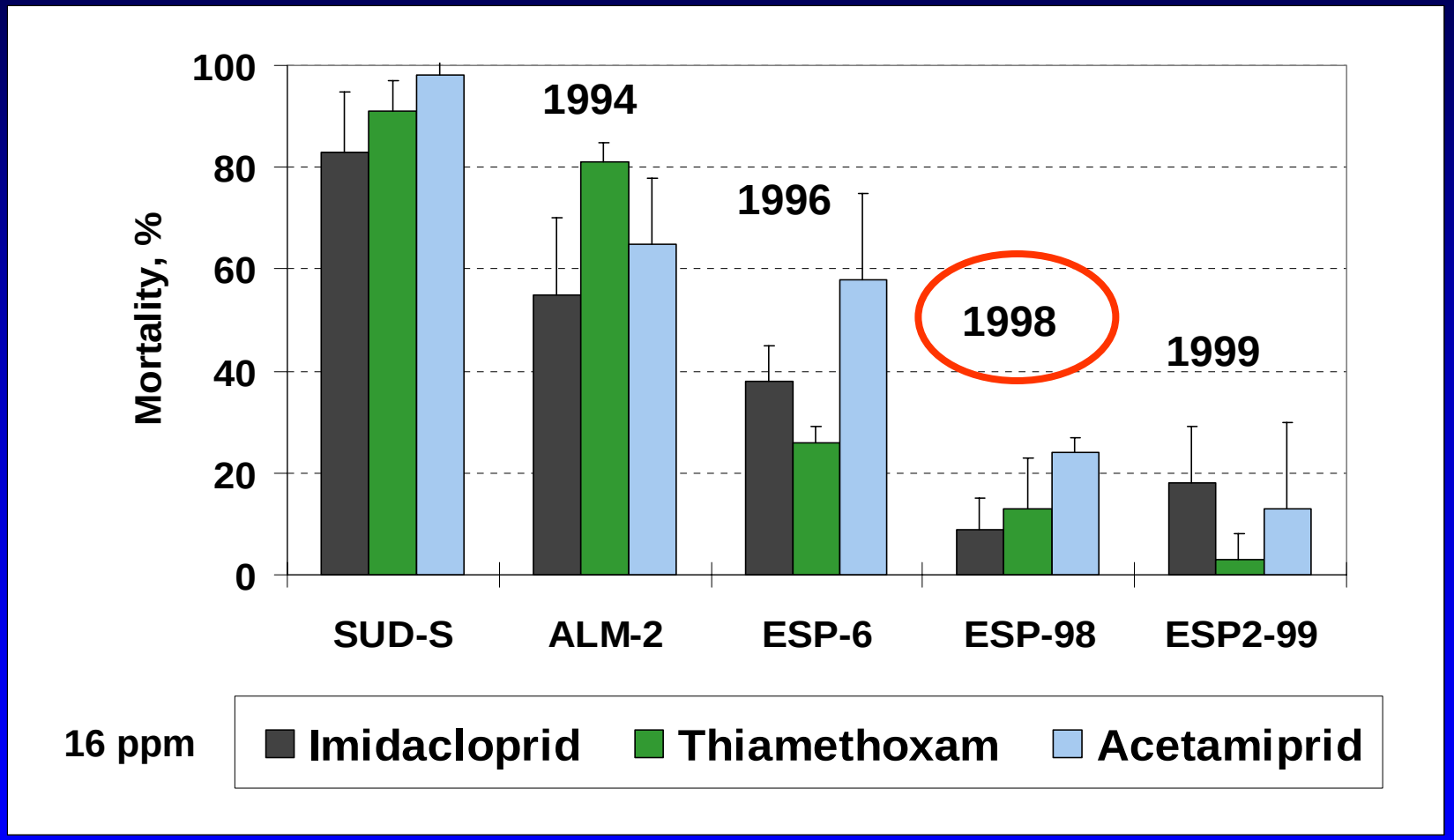
Nitenpyram
(Takeda)

Almeria, Spain

- 30,000 ha of greenhouse vegetable production
- Enormous WF pressure & virus
- Imidacloprid introduced in 1993; applied as both drench and foliar applications

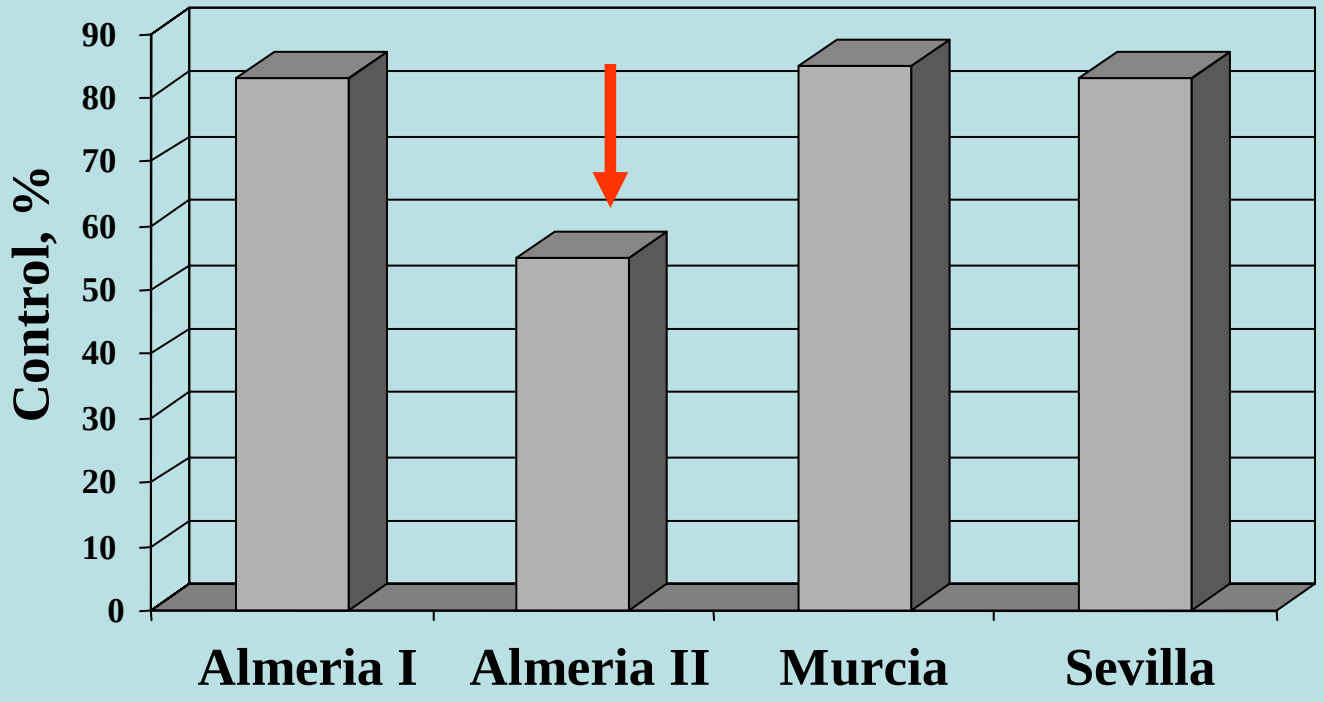


Response of whiteflies from Almeria Spain to neonicotinoids (16 ppm) in systemic bioassays compared to a suceptible strain (SUD-S)



Source: Elbert & Nauen (2000)

Field Performance of Imidaclorpid (foliar applied) in Almeria, Spain 1998

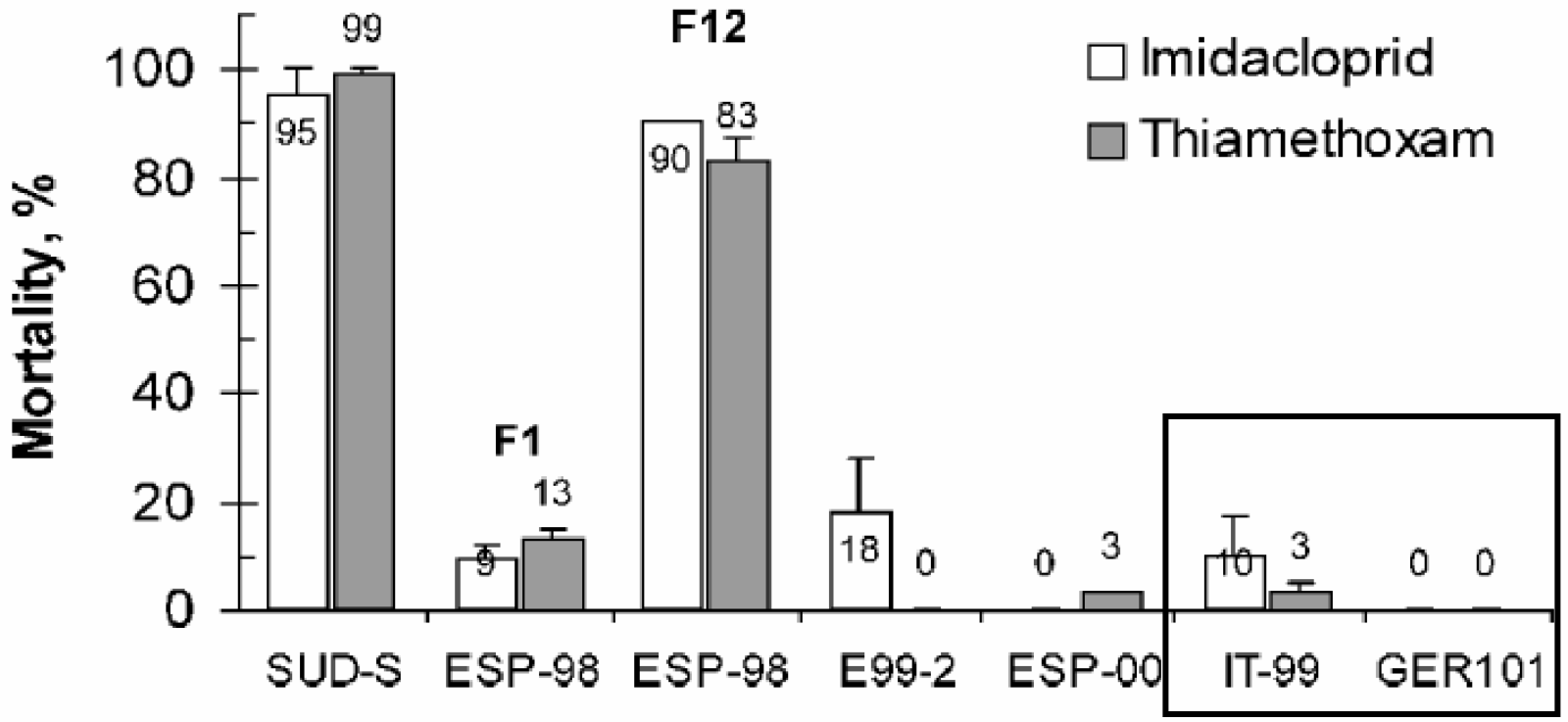


imidacloprid 0.1g ai/l, 2 applications

Source: Elbert & Nauen (2000)

Neonicotinoid Resistance found in WF collected from greenhouses In Germany and Italy -1999-2000

Source: *Nauen et al. 2002*



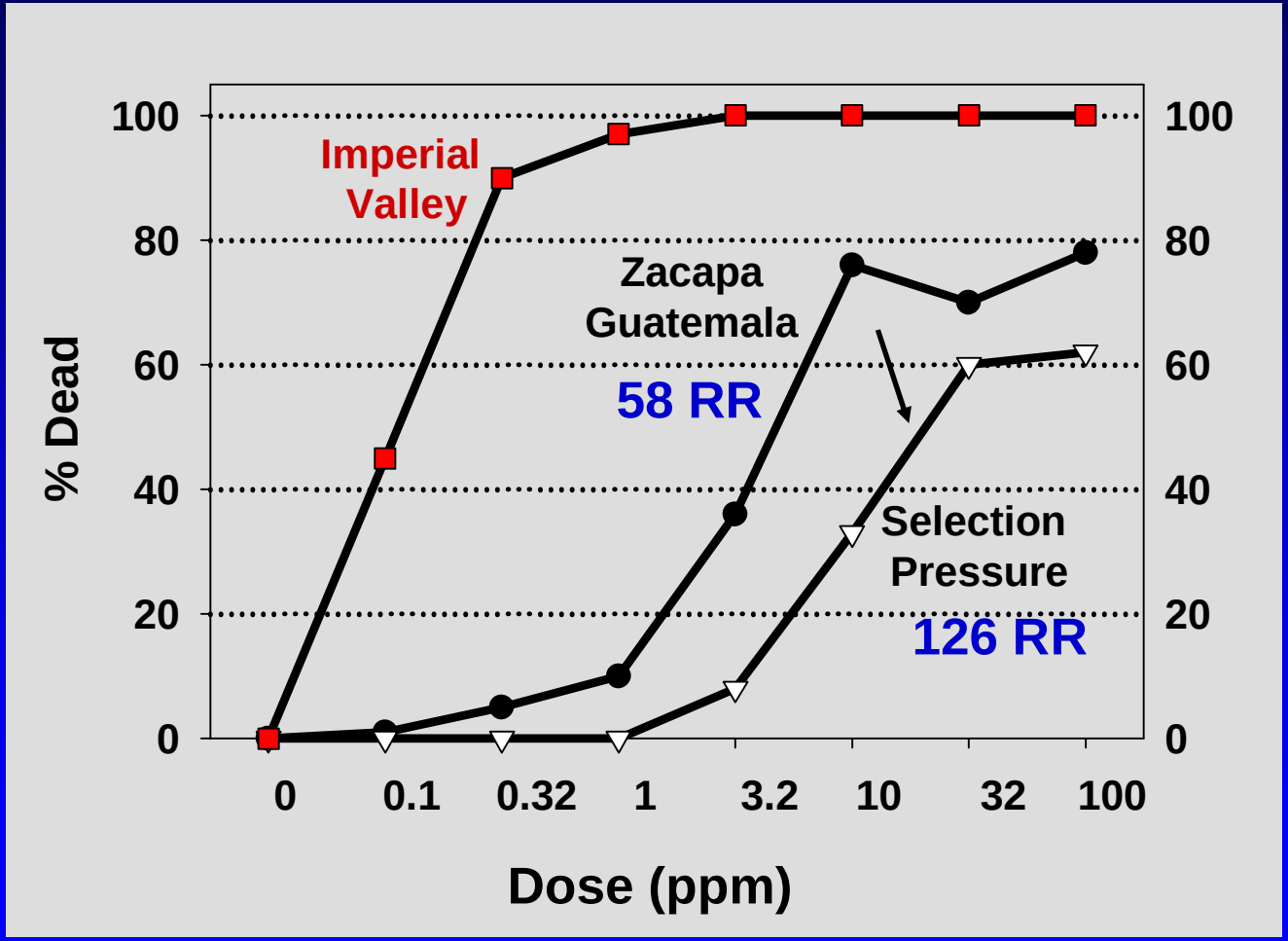
Guatemala

Zacapa Valley - Mar 2000

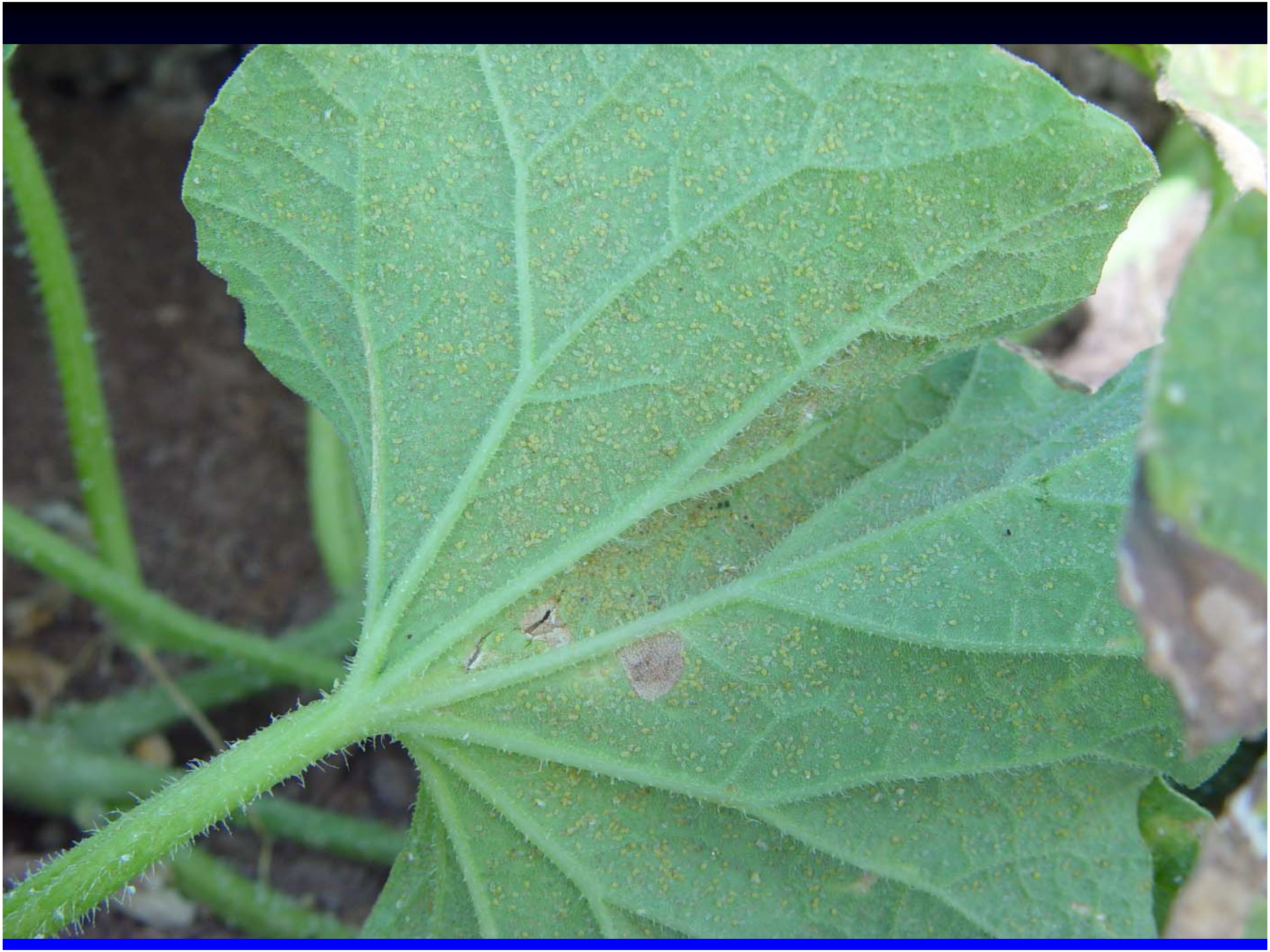
Zacapa Valley- Jan 2001

- **Monoculture of melons**
- **40,000 ha, doubled cropped**
- **Imidacloprid used since at least 1996**

Susceptibility of *Bemisia* Whiteflies to Imidacloprid Collected on melons from Guatemala (2000)



Source: Steve Castle, USDA-ARS

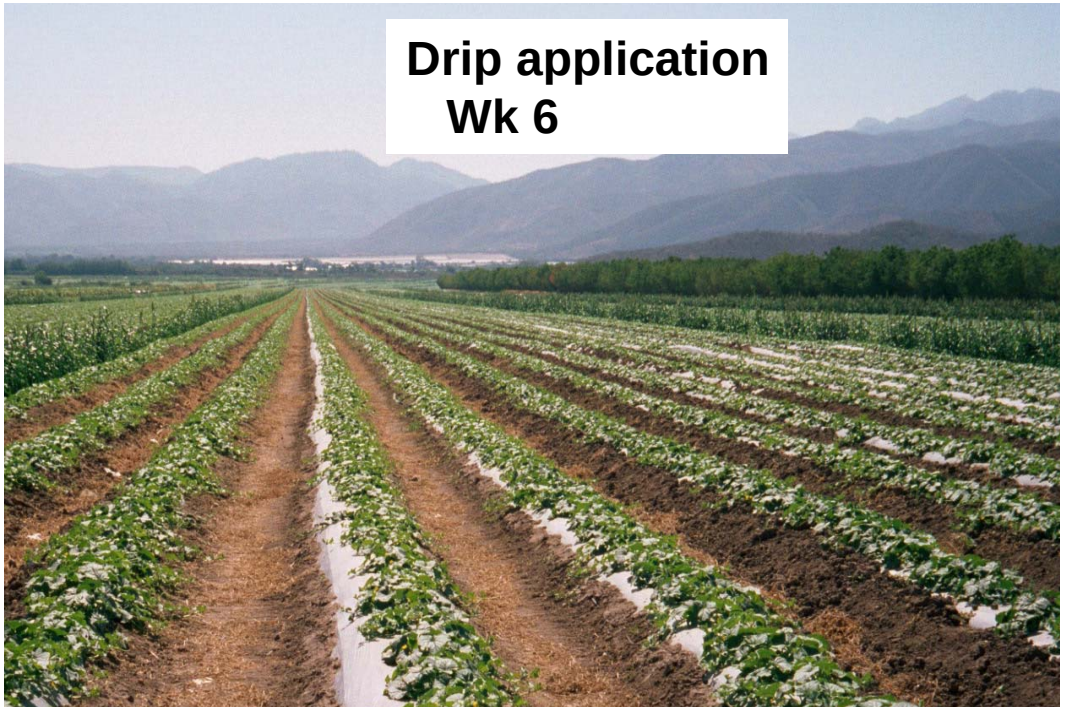


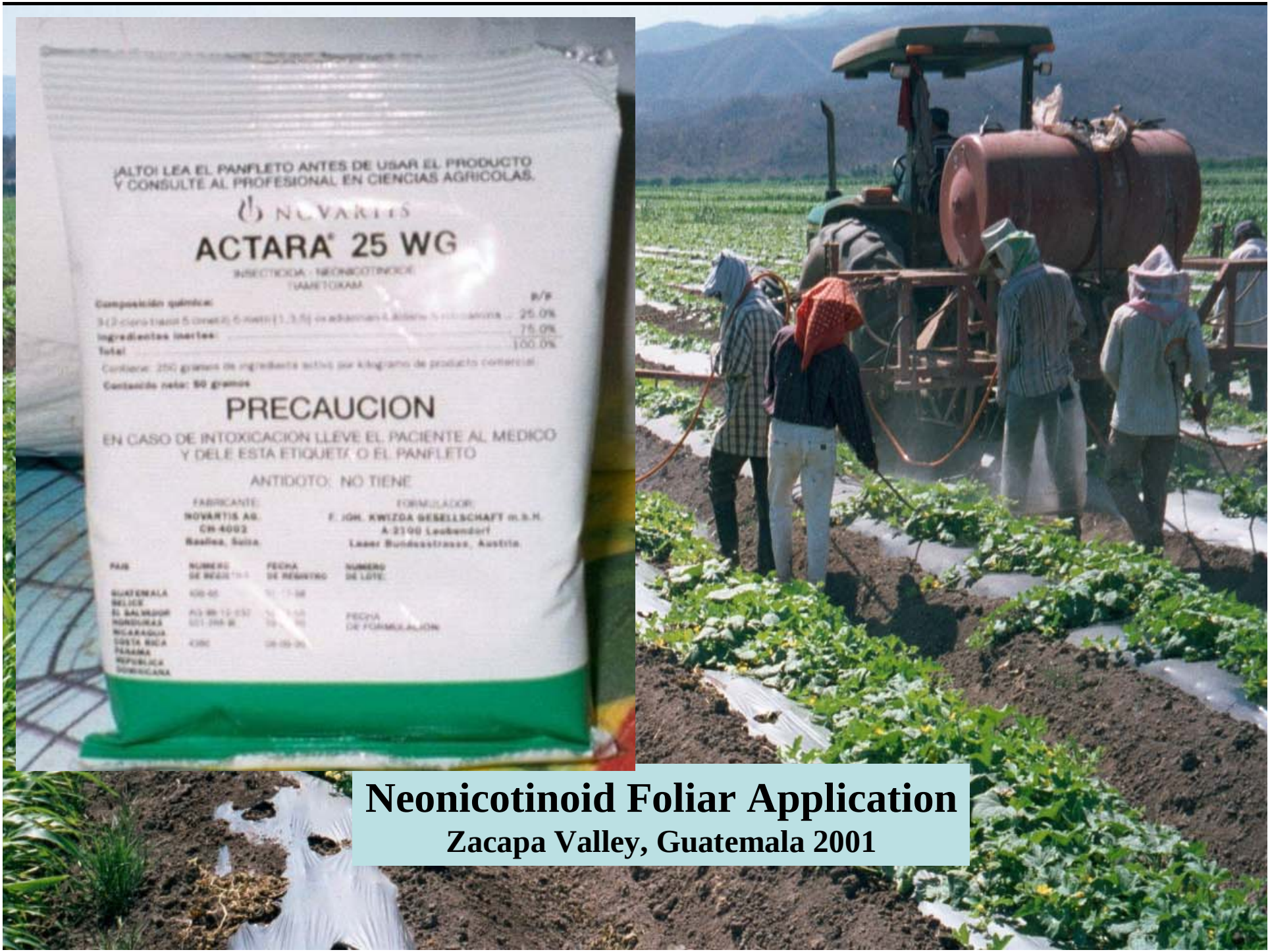
Why Did Resistance Develop ?

- Lack of Chemical Diversity
- Excessive Chemical Use
- Lack of Alternative IPM tactics
- Cropping System
- Whitefly Genetics


Transplant Drench
Wk 1


Drip application
Wk 3


Drip application
Wk 6



Neonicotinoid Foliar Application

Zacapa Valley, Guatemala 2001

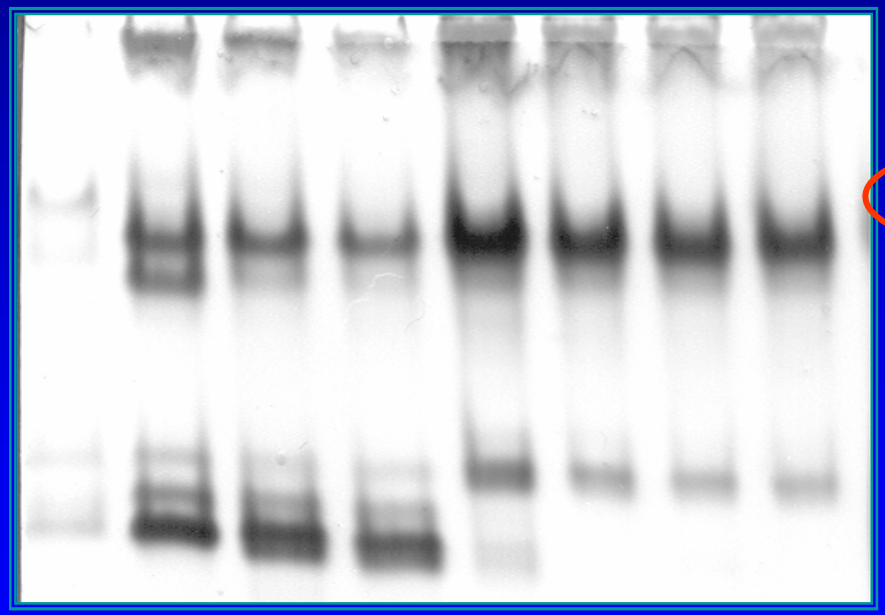
Whitefly Genetics

Bemisia tabaci

Q-type **B-type**

Populations

Spain
Italy
Germany
Israel



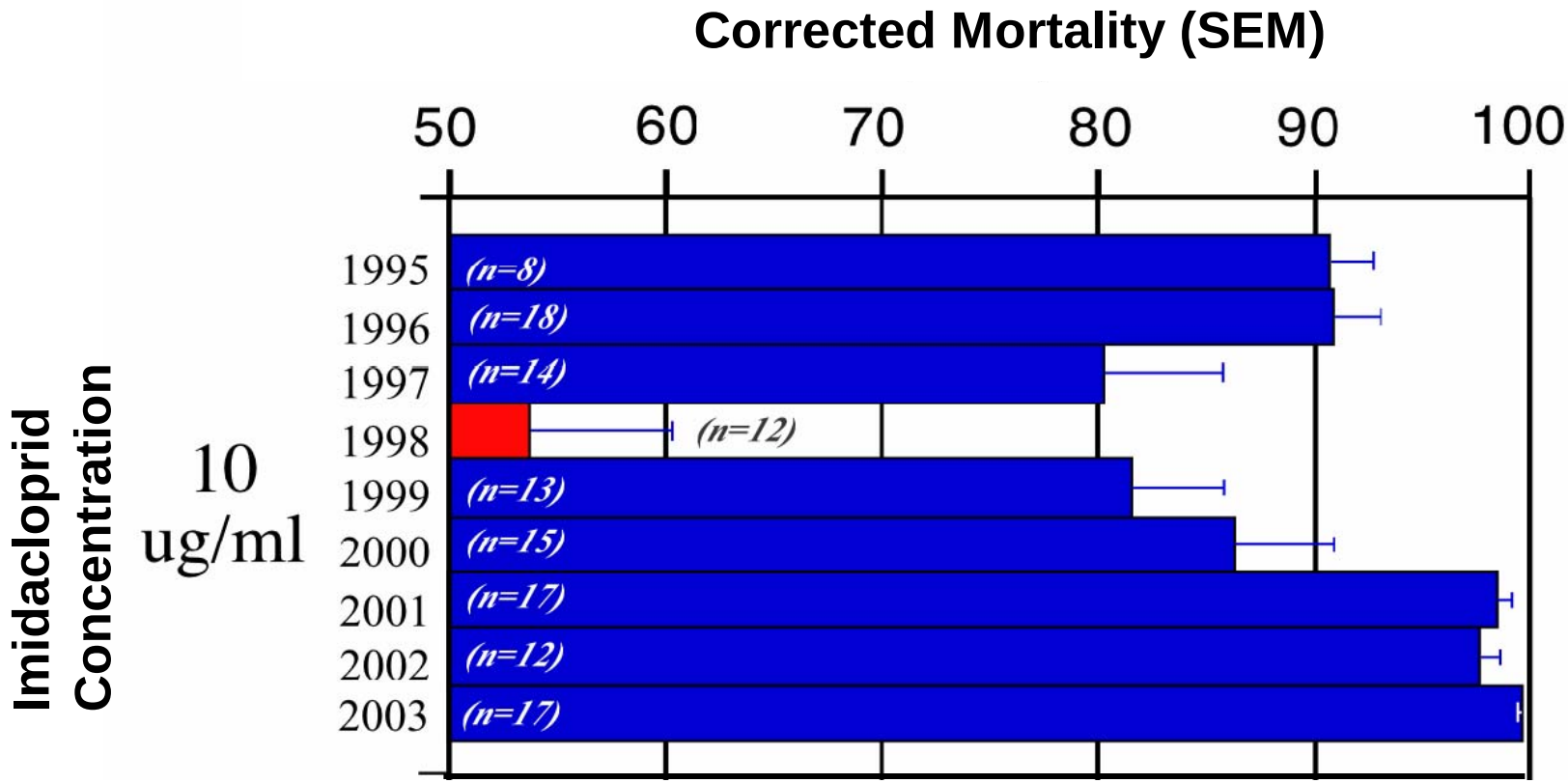
Populations

Guatemala
USA

* **Resistance is stable in Q biotype**

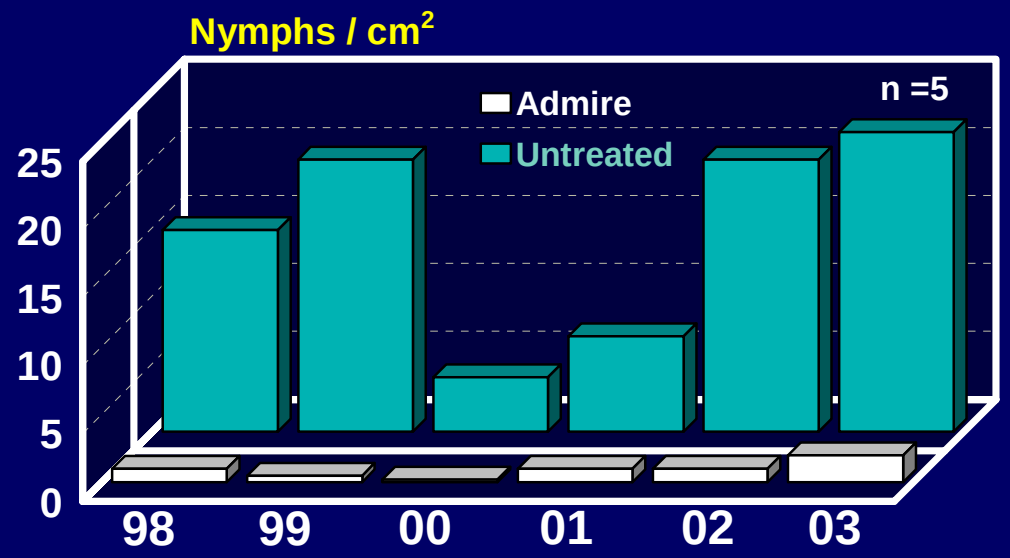
<u>Whiteflies</u> have not affected *Yield or Quality of* vegetables in Yuma where Admire has been used properly for the past 11 years.

Susceptibility to imidacloprid (Admire®/Provado®) of Arizona whiteflies collected from cotton

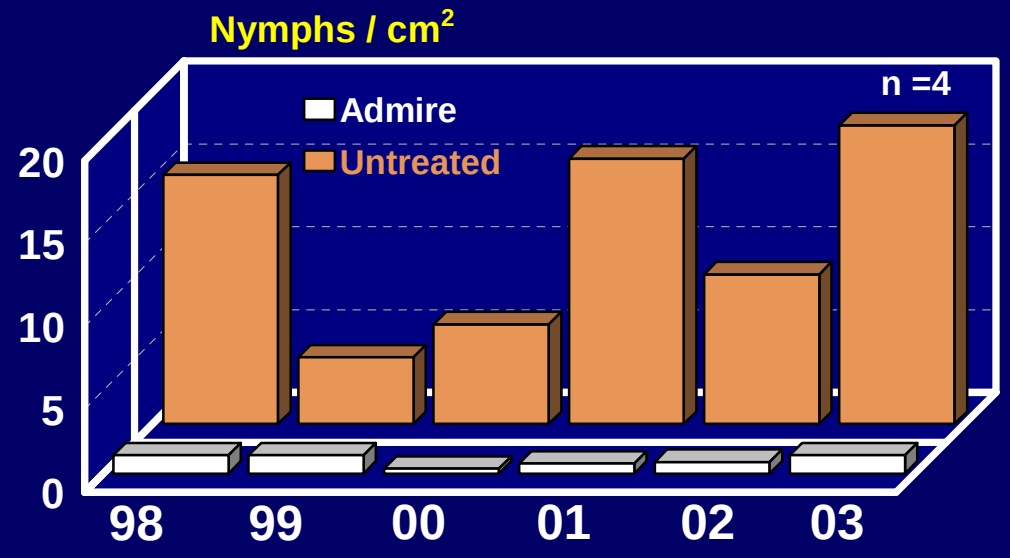


Source: ***Dennehy et al. 2004***


Fall Broccoli


Nymphs / cm2
n =5
Admire
Untreated
25
20
15
10
5
0
98
99
00
01
02
03


Fall Cantaloupes


Nymphs / cm2
n =4
Admire
Untreated
20
15
10
5
0
98
99
00
01
02
03

Thus the question ?

“ Given the situations in Spain & Guatemala, and the extensive use of Admire in Arizona Since 1993”

Why are the neonicotinoids still effective In Desert Cropping Communities?

De facto Resistance Management

- **Cropping systems**
- **IPM practices**
- **Whitefly ecology & biology**

Contributing Factors to the Sustained Efficacy of the Imidacloprid in AZ

- Segregation of neonicotinoids in vegetables and melons / IGRs in cotton
- Limitation of IGR uses (1 /crop) and Imidaclorpid (single soil or foliar use, not both)
- Spatial and Temporal Insecticide Rotations
- Exposure to and alternation with unrelated chemistries used for management of other key pests (ie., Endosulfan, Pyrethroids, Orthene)

Contributing Factors ……

- Untreated host plants serve as refugia for unselected individuals (alfalfa, ornamentals)
- High WF population dispersal and mating to and from key crops - chemistries
- Bio-residual in Cotton with IGR's; and to a lesser extent in melons with Admire.
- Inherent toxicity of soil-applied Imidacloprid

So what's to be concerned about ?

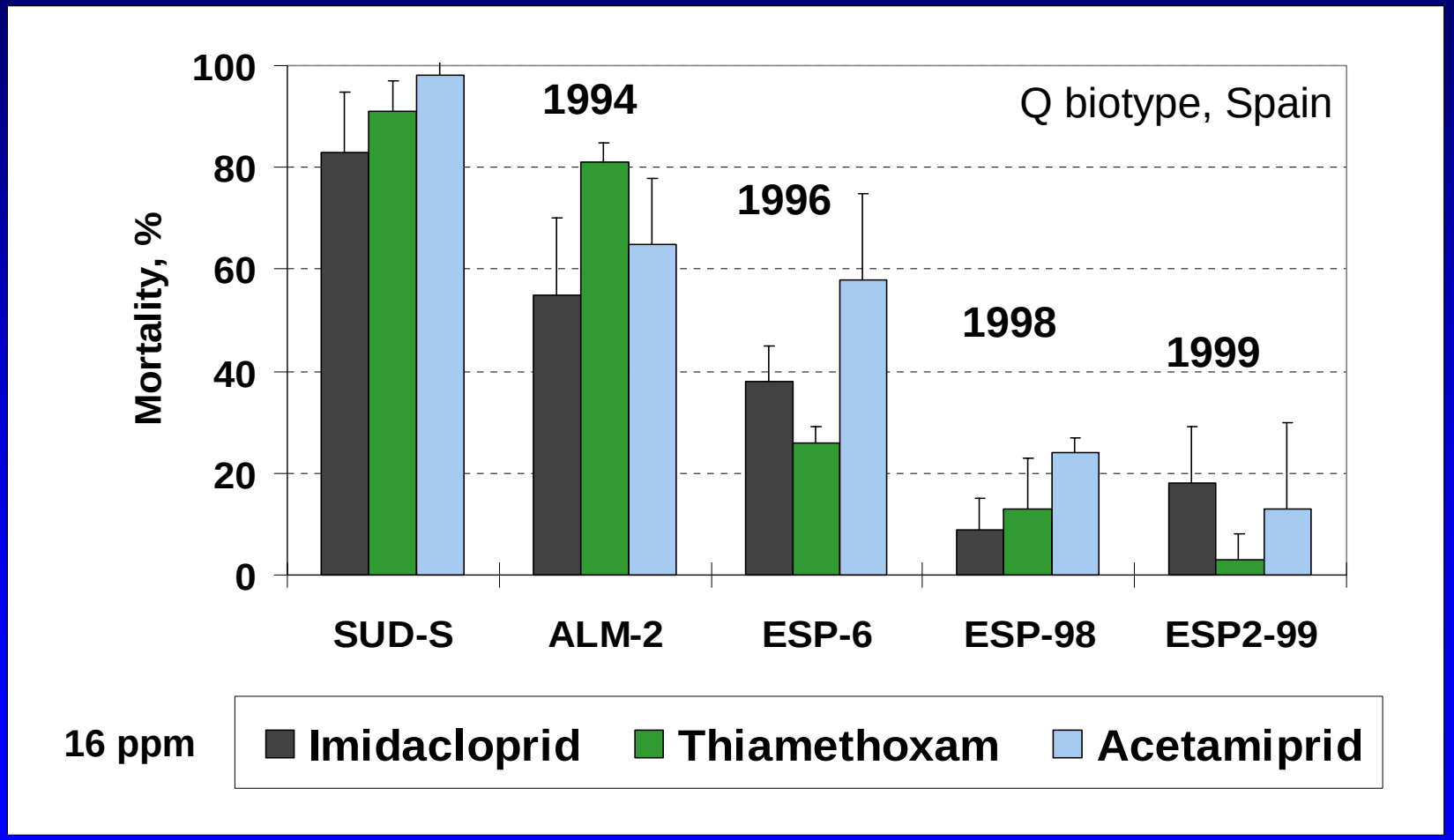
1) **Expanded registrations of neonicotinoids**:

   - Admire/Provado: *melons, leafy vegetables*
   - Centric / Platinum: *cotton, melons*
   - Intruder / Assail: cotton, leafy vegetables
   - Dinotefuron: pending on numerous crops

2) **Multiple applications allowed by labels.**

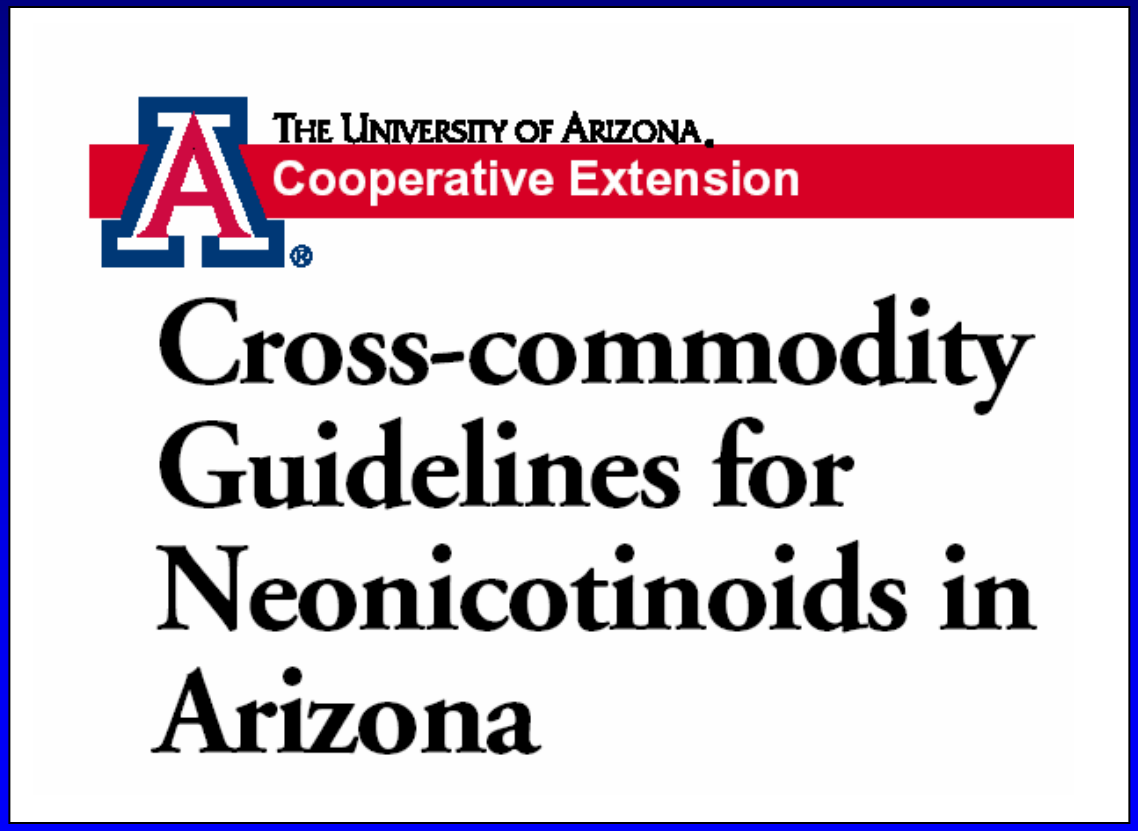
3) **Risk of increased selection pressure on whiteflies**

Strong evidence for cross-resistance among neonicotinoids has been documented



Source: Elbert & Nauen (2000)

Pro-active Resistance Management



Insecticide Resistance Action Committee

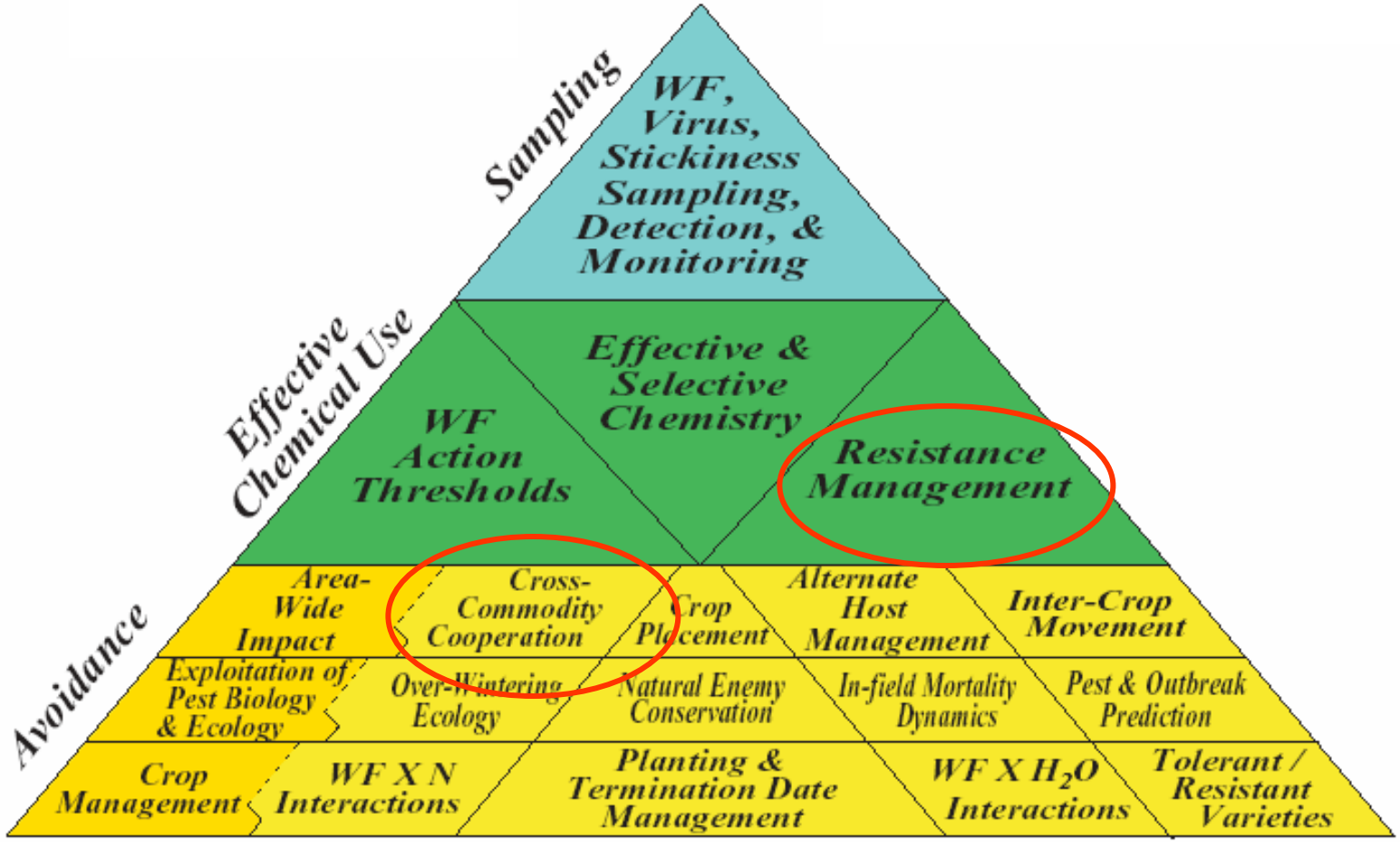
IRAC Mode of Action Classification v 3.3

Revised and re-issued, October 2003

http://www.irac-online.org/documents/moa/moa.pdf

1. Based on IPM Principles

- Avoid Problems through Cultural Controls
- Scouting, Sampling and Detection
- Ensure Effective Chemical Use



2. Limit insecticide use

*** No more than 2 uses per year**

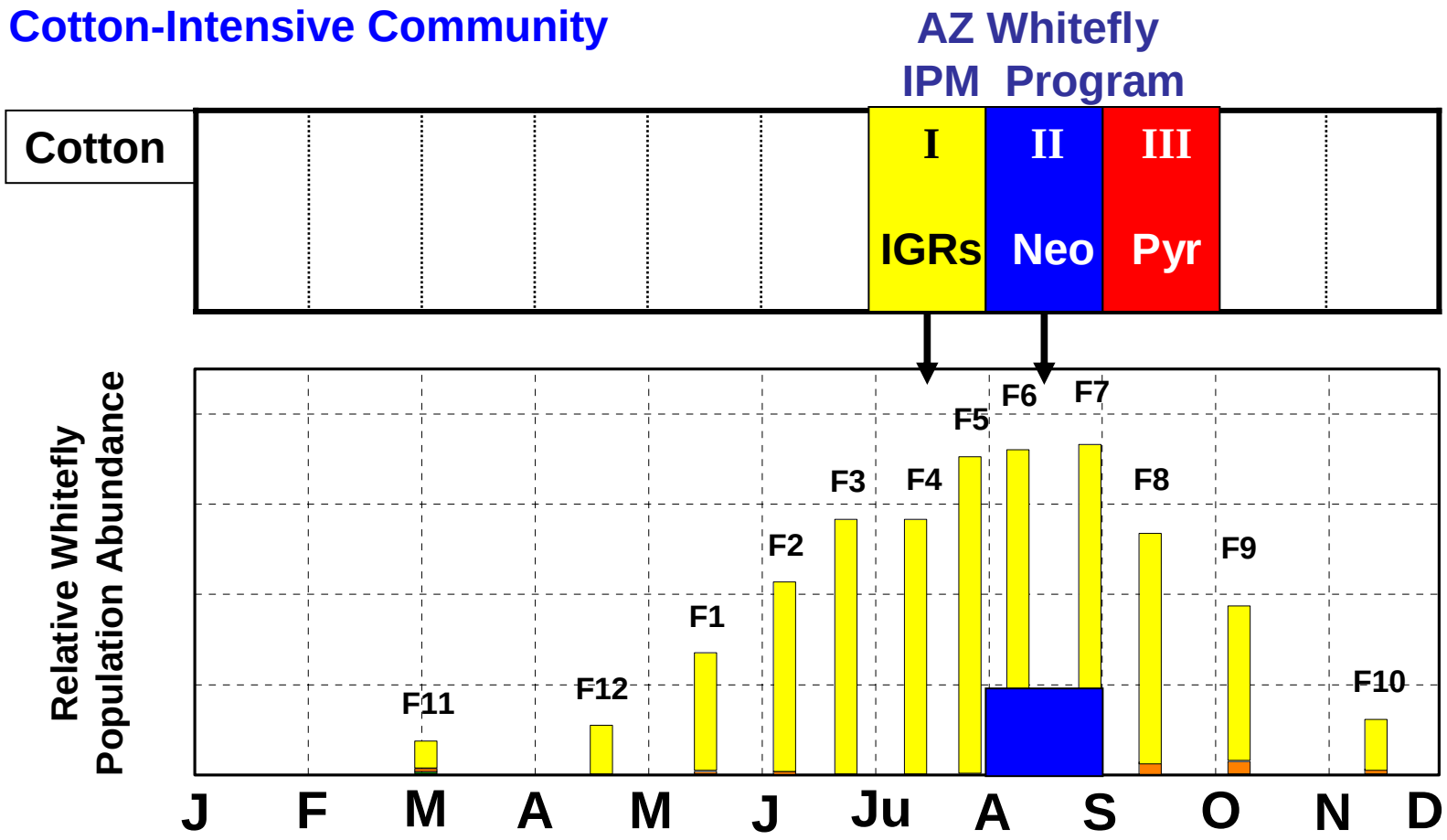
***Summary Guidelines**: Maximum number of uses per crop season for neonicotinoids in three different cropping communities.*

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

**Soil only; **Soil or Foliar*

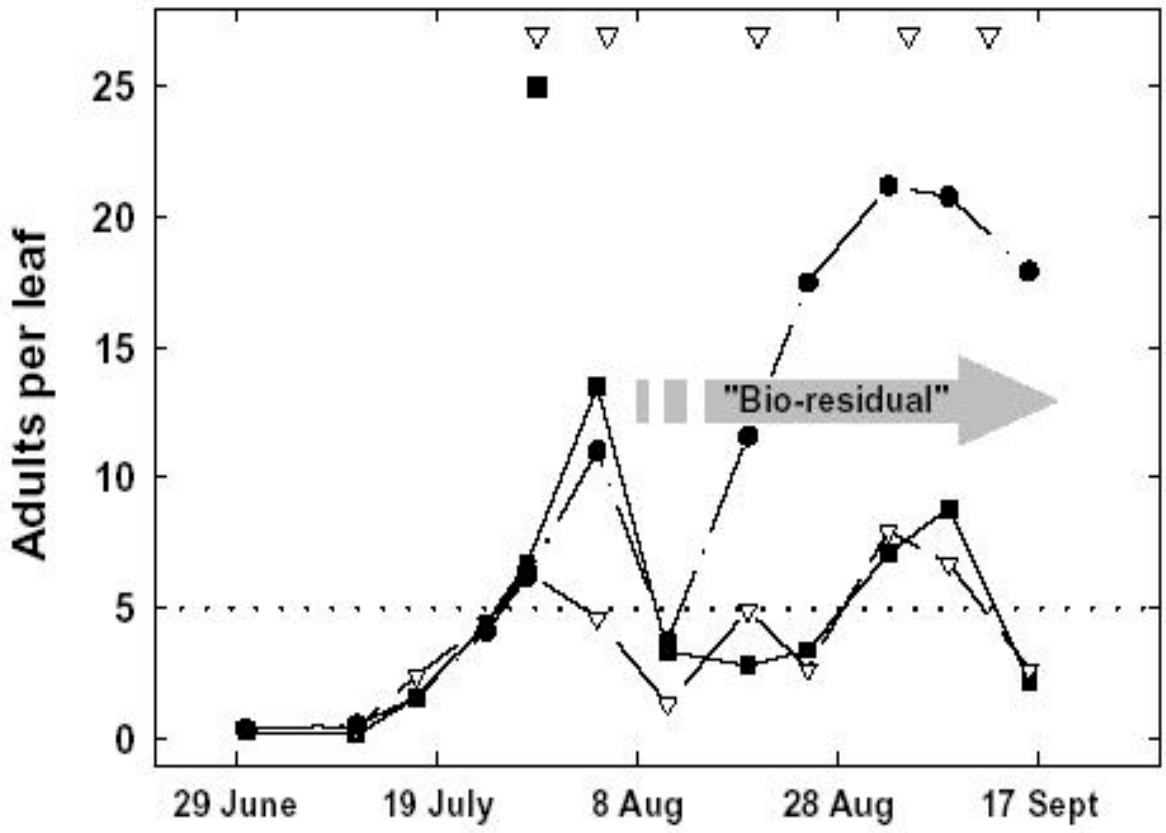
Resistance in Spain and Europe occurred where foliar sprays used in addition to soil drenches.

3. Diversify Chemical Use
* Alternation of chemistries



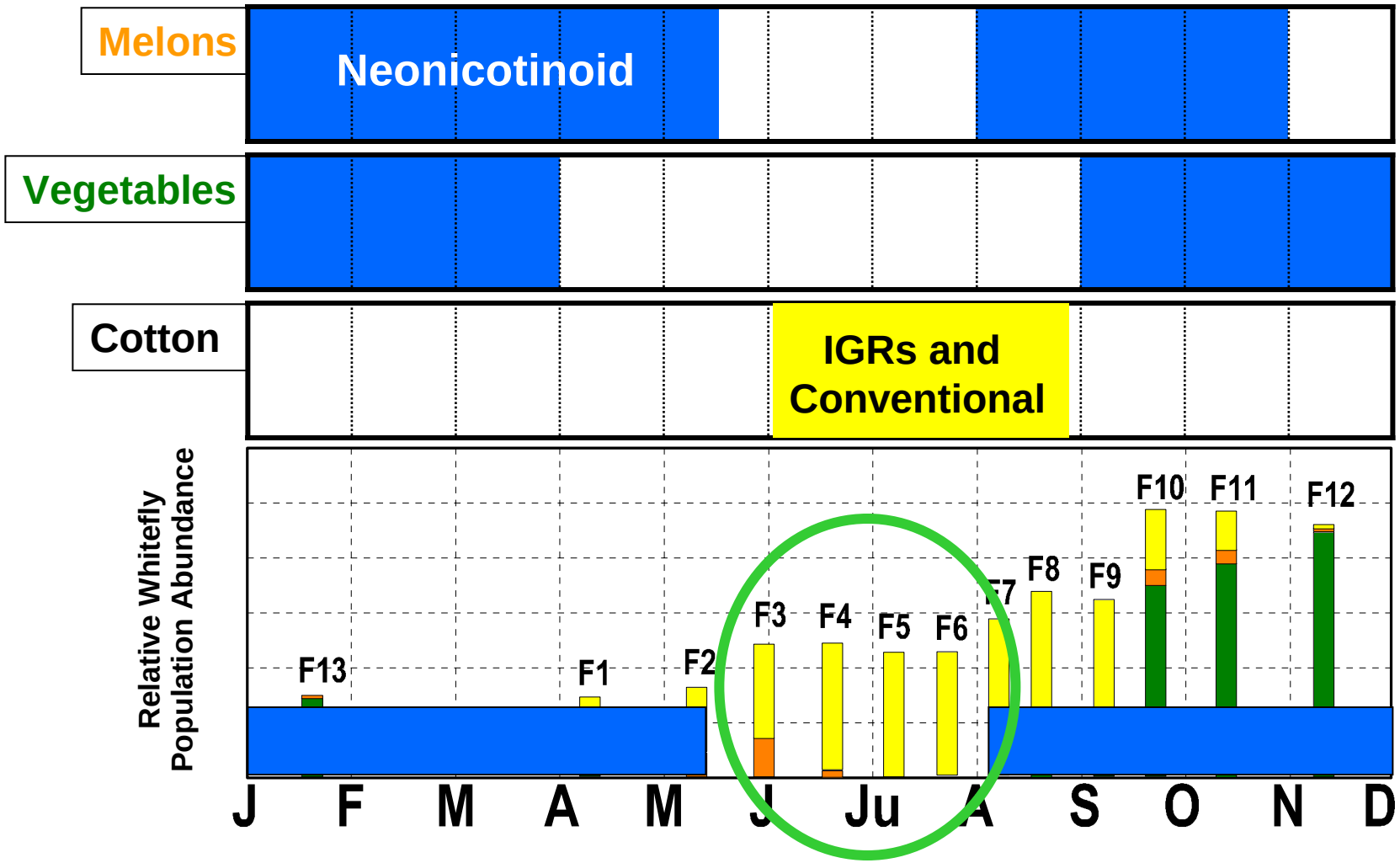
IGRs

Conservation of natural enemies
BioResidual



Naranjo, 2001

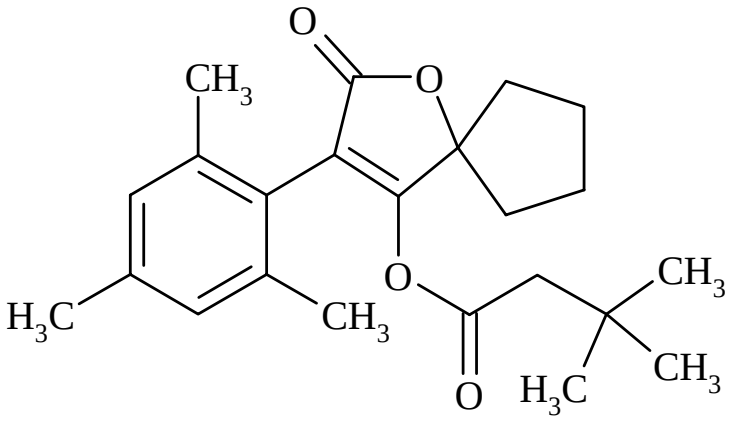
3. Diversify Chemical Use
* Exclusion (Neonicotinoid–Free Period)



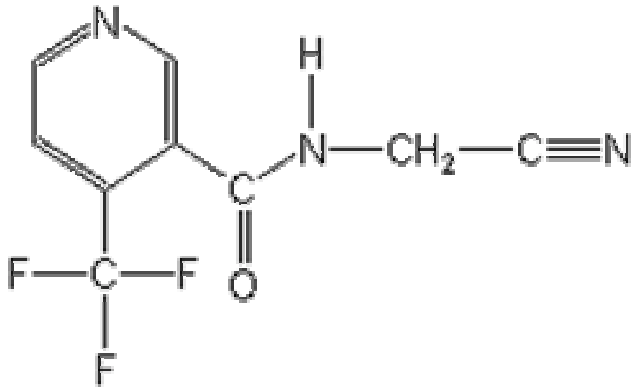
3. Diversify Chemical Use

* New chemistries in the near future

Oberon (spiromesifen)



Flonicamid



- **There are several other promising chemistries in the pipeline**

Will Following the Cross-commodity Guidelines

Passive "*defacto*" IRM

Pro-Active IRM

Sustained long-term efficacy of *Neonicotinoids & IGRs* in our complex cropping communities

Is This Pro-active Approach Important to Arizona Growers ?

If so, how do we measure Success ?