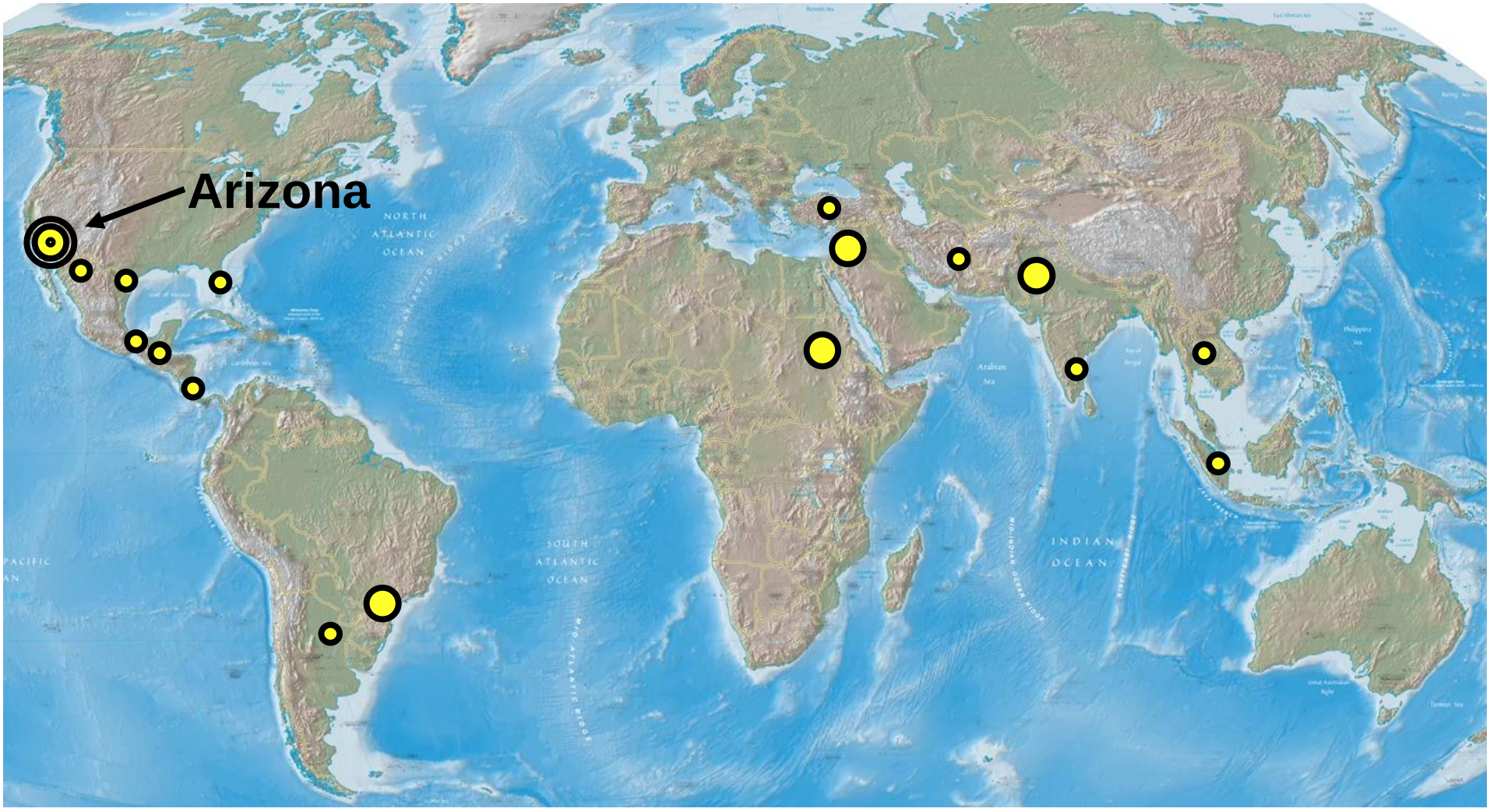
Global Perspectives on **Whitefly Management**

Timothy Dennehy

16 September, 2017

Bayer CropScience

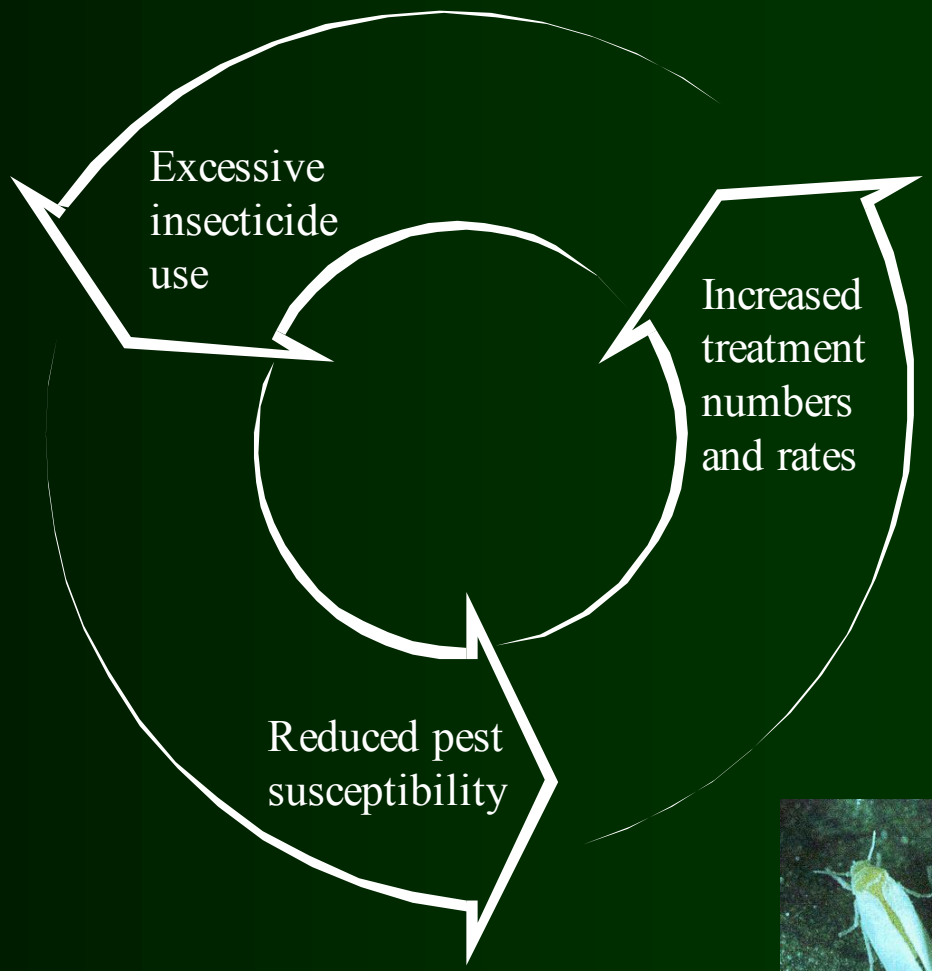
World Distribution of Outbreaks of B. tabaci



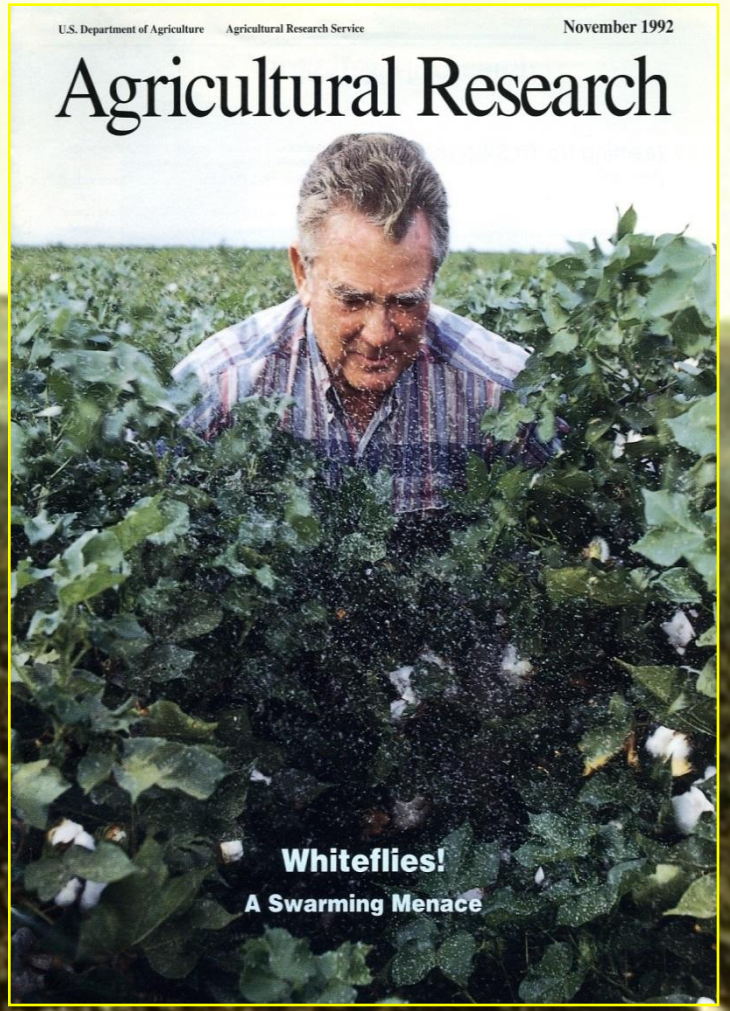
Bemisia tabaci

Pesticide Treadmill

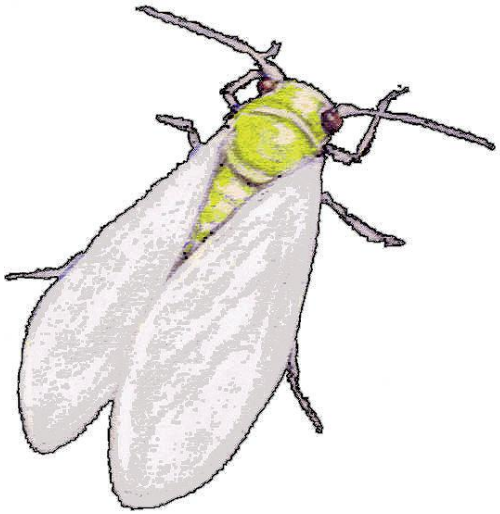
- Resistance
- Resurgence
- 2° pest outbreaks
- Elimination of natural enemies



Slides: Steve Naranjo



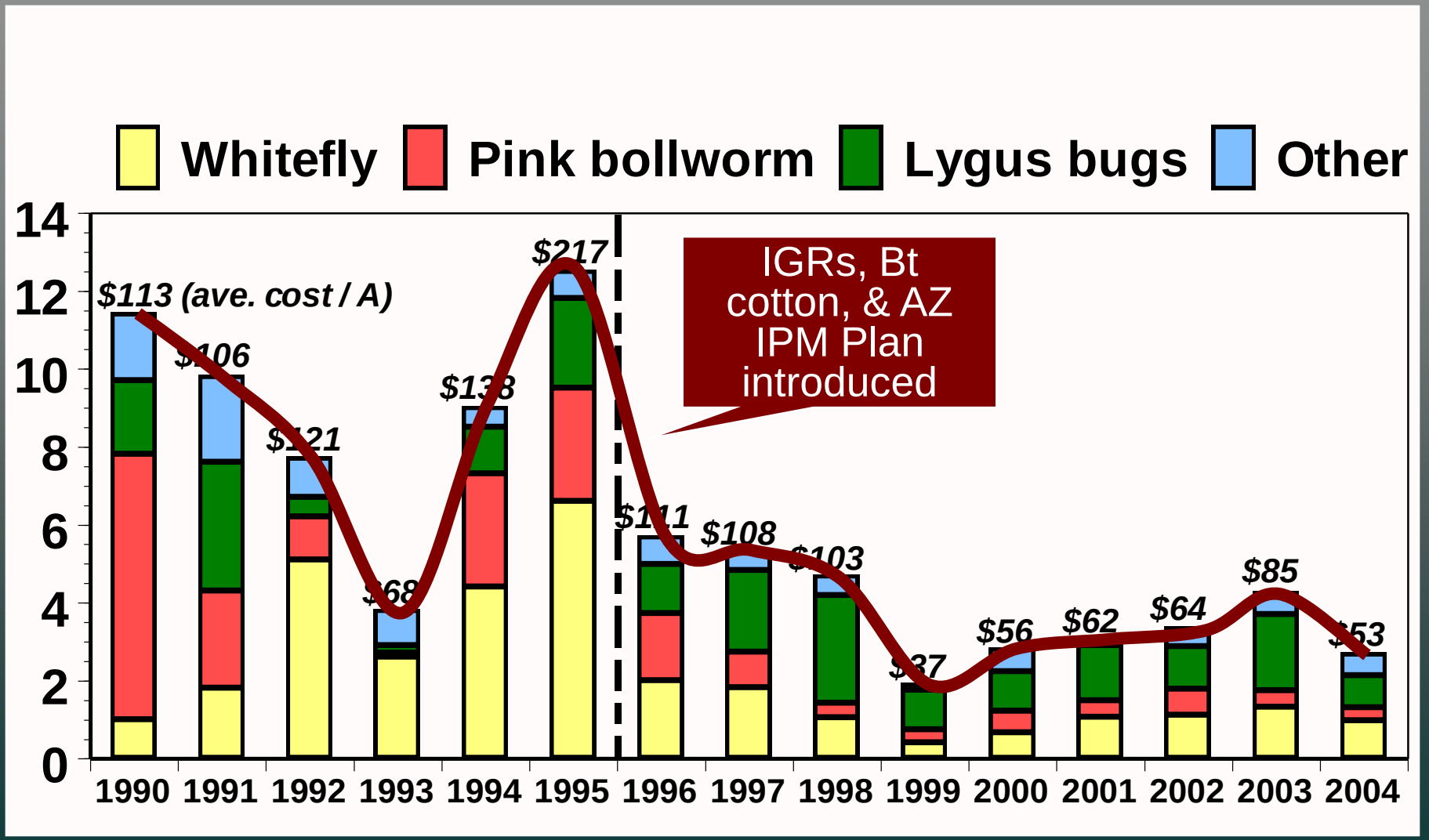
B. tabaci in Arizona



- **Whiteflies (biotype B) invaded Arizona in the early 1990s.**
- **Very severe losses to the agricultural industry.**
- **Honeydew excreted caused sticky cotton that could not be sold at a premium price after outbreaks in 1992 & 1995.**

Ellsworth/UA

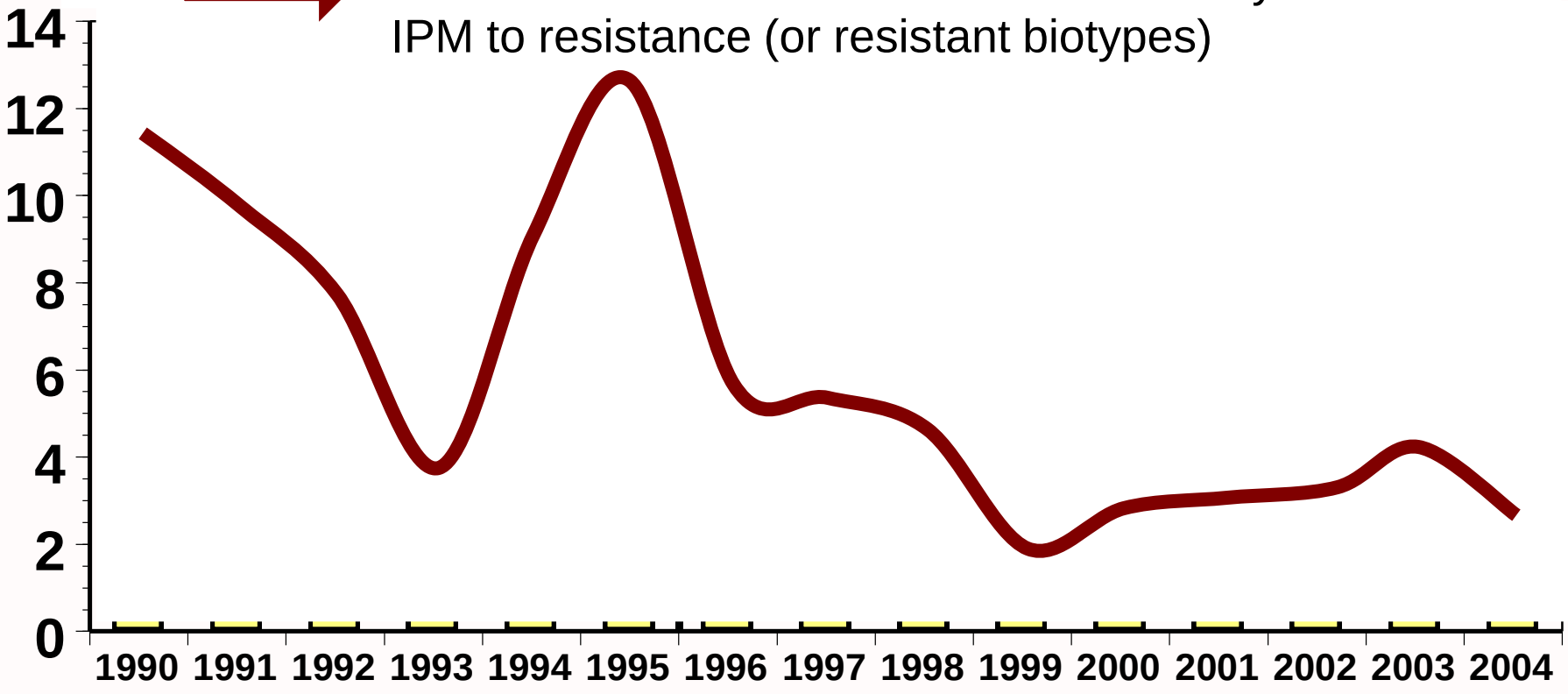
Chemical Control Costs in Arizona Cotton (Ellsworth 2005)



Chemical Control Costs in Arizona Cotton (Ellsworth 2005)

Dramatic demonstration of success of the integrated management paradigm

Dramatic demonstration of the vulnerability of IPM to resistance (or resistant biotypes)

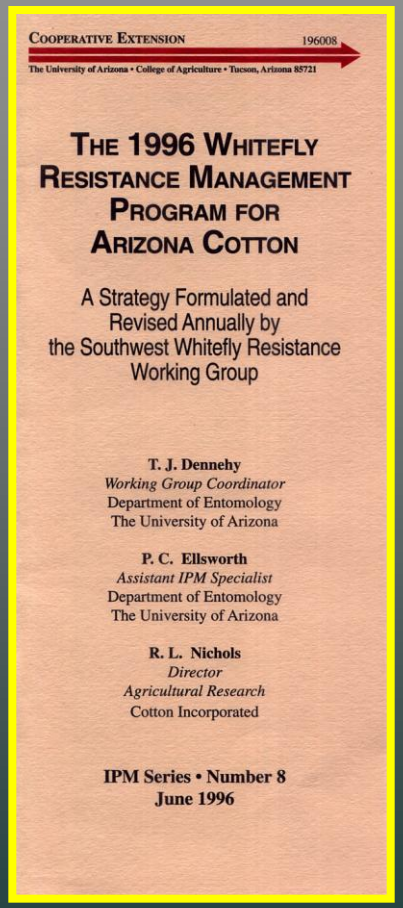


Elements of the Success

--Whitefly Management in Arizona--

- Improved sampling and thresholds
- Emphasis on conserving natural enemies
  - delay use of pyrethroids as much as possible
- 2 IGRs: pyriproxyfen and buprofezin
  - *Use limited to once each per season*

Arizona's IGR-based resistance management strategy



COOPERATIVE EXTENSION 196008

The University of Arizona • College of Agriculture • Tucson, Arizona 85721

THE 1996 WHITEFLY RESISTANCE MANAGEMENT PROGRAM FOR ARIZONA COTTON

A Strategy Formulated and Revised Annually by the Southwest Whitefly Resistance Working Group

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IPM Series • Number 8
June 1996

Stage I: Insect Growth Regulators

Threshold: 0.5–1 large nymph per leaf disk AND 3–5 adults per leaf

Use IGR of choice when whitefly counts exceed threshold

IGR	Use Rate	Restrictions	Mode of Action
Applaud (70WP)	8 oz./A	Use only once per season. Apply no sooner than 21 days after Knack	Chitin synthesis inhibitor; effective against nymphs.
Knack (0.86EC)	8 fl. oz./A	Use only once per season. Apply no sooner than 14 days after Applaud	Juvenoid; sterilizes adults and eggs; prevents adult emergence.

Stage II: Non-Pyrethroids

Threshold: 5 adults per leaf

1. When populations average more than five adults per leaf, use Stage II materials at least once before using Stage III materials, in order to delay the need for pyrethroids.
2. Rotate among classes of insecticides and among different insecticides within classes.
3. Do not use mixtures of more than two compounds.
4. Use no active ingredient more than twice per season.

Stage III: Pyrethroid Mixtures

Threshold: 5 adults per leaf

1. Delay pyrethroid use until the end of the control season approaches (for example, September – October).
2. Plan to use the pyrethroid class no more than twice per season.
3. Rotate the classes of the compounds tank-mixed with the pyrethroid and rotate among pyrethroids.

Ellsworth et al.

THE UNIVERSITY OF ARIZONA
Cooperative Extension
IPM Series No. 18
cals.arizona.edu/pubs/insects/az1404.pdf
AZ1404 – 5/2006

Whitefly Management in Arizona Cotton 2006

absolutely essential to produce high quality cotton. Good stewardship of insecticide efficacy is necessary to sustain whitefly management. Use all available cultural means to avoid whitefly population buildup in individual fields and in communities. A three-stage approach to chemical control is recommended. The basic strategy is to initiate chemical control with highly selective Stage I chemistry in order to reduce the need for broad-spectrum chemistry. Postpone the use of pyrethroid insecticides until they may be needed at the end of the season. Limit the use of insecticide modes of action to no more than two, non-consecutive uses per season. Arizona's substantial gains in lowering insecticide inputs in cotton over the last decade have been due in large part to a shift to selective pest management that conserves natural enemies.

Peter C. Ellsworth[1], John C. Palumbo[1], Steven E. Naranjo[2], Timothy J. Dennehy[1], Robert L. Nichols[3]

[1]University of Arizona, [2]USDA-ARS, [3]Cotton Incorporated

Following these guidelines, especially on a community basis, should result in better management locally and areawide. Effective integrated management depends on implementing pest avoidance practices, in-field sampling, and deployment of effective control technologies.

Crop Management

- Plant and terminate the crop as early as economically feasible. Encourage uniform planting and termination practices within your community. Late-planted and longer-season fields are at greater risk for whitefly problems.
- Minimize moisture stress to reduce whitefly problems and the need for chemical controls.
- Meet the plant's nutritional needs, especially for nitrogen (N), to minimize plant stress. Excesses or deficits of plant-available N can create conditions favorable to whiteflies.
- Select well-adapted varieties. Smooth-leaf varieties are generally less attractive and less suitable for whitefly growth than hairy-leaf varieties.

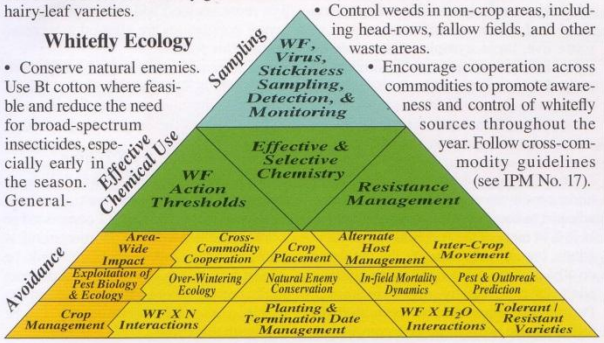
Whitefly Ecology

- Conserve natural enemies. Use Bt cotton where feasible and reduce the need for broad-spectrum insecticides, especially early in the season. Generalist predators are key sources of natural mortality of whiteflies in cotton. Predation, along with physical removal of whiteflies by dust, wind or rain, help extend the utility of selective insecticides (i.e., bioresidual).
- Recognize conditions that can contribute to whitefly outbreaks, such as better than usual weather for over-wintering success and spring development of whiteflies on weeds and other desert hosts. Whiteflies breed year-round on multiple hosts.

Our Goal: Manage whiteflies both locally and area-wide in Arizona to permit the production of high quality cotton and protect the economic interests of growers statewide.

Areawide Impact

- Spatially and temporally arrange crops in your community to break the cycle of whitefly movement among fields. Minimize the direct contact between whitefly-source and whitefly-attracting crops. For example, cotton planted next to spring melons will receive whiteflies from the senescing melons.
- Efficiently manage whiteflies in all host crops. Control whiteflies in spring sources such as melons. Terminate spring vegetable and melon crops as soon as economically possible. Maintain as short a cutting interval as possible for alfalfa.
- Promptly harvest all host crops and destroy crop residues. Prevent regrowth after disking, especially in post-harvest melons, and after defoliation in cotton.
- Control weeds in non-crop areas, including head-rows, fallow fields, and other waste areas.
- Encourage cooperation across commodities to promote awareness and control of whitefly sources throughout the year. Follow cross-commodity guidelines (see IPM No. 17).



Developed in collaboration with and endorsed by

Arizona Cotton Growers Association
Arizona Cotton Research & Protection Council
Arizona Crop Protection Association
Arizona Pest Management Center
Cotton Incorporated

Funding for the printing of this bulletin was provided by the University of Arizona's Arizona Pest Management Center (APMC) funded in part by grants from USDA-CSREES Western IPM Center and the Arizona Cotton Growers Association State Support Committee.

This and other documents of interest relating to crop production / protection are available on the Arizona Crop Information Site at *http://cals.arizona.edu/crops*

Palumbo et al.

THE UNIVERSITY OF ARIZONA
Cooperative Extension
IPM Series No. 17
cals.arizona.edu/pubs/insects/az1319.pdf
AZ1319 – 5/2003

Cross-commodity Guidelines for Neonicotinoid Insecticides in Arizona

SUMMARY

Arizona enjoys a sustained recovery from the devastating whitefly outbreaks of the early 1990's. This success is built on an IPM strategy that includes the use of selective and effective chemistry. Admire® has been a key soil insecticide protecting vegetables and produce throughout Arizona and is the first member of a burgeoning class of chemistry known as the neonicotinoids. New members of this valuable, reduced-risk, class of chemistry are now available to agricultural producers, placing a burden on users of these compounds to adopt science-based plans for sustaining their efficacy. This consensus document represents our best efforts to share this chemistry among different agricultural interests. Our goal is to preserve the long-term efficacy of the neonicotinoids and protect growers' interests in sustainable and economical whitefly management. Through identification of crop communities (i.e., 'multi-crop', 'cotton-intensive', and 'cotton / melon') common to Arizona agriculture, we have designed sensible plans of use that should allow access to this valuable chemistry for everyone, while protecting it from resistance.

John C. Palumbo[1], Peter C. Ellsworth[1], Timothy J. Dennehy[2], Robert L. Nichels[2]
[1]University of Arizona, [2]Cotton Incorporated

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Arizona Crop Protection Association
Arizona Cotton Growers Association
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Western Growers Association

Neonicotinoids & Whitefly Management

During the past decade, the silverleaf whitefly (*Bemisa tabaci*, Biotype B) has been relegated to a managed pest in Arizona. This was achieved through the development, adoption and implementation of management programs in a partnership between the University and growers. Growers are quick to adopt new guidelines that have been developed in response to pest crises and other significant events.

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.

The recent registration of several new neonicotinoid compounds on cotton, melons and vegetables has expanded the number of compounds available for whitefly control on these crops. Admire® (imidacloprid), the first compound registered within this class of chemistry, has been used effectively in melons and vegetables for whitefly and aphid control since 1993. The sustained efficacy of Admire over the past 10 years exceeds the expectations of many who speculated that whiteflies would quickly evolve resistance. However, no field failures have been reported so far, in part perhaps, because imidacloprid has been used sparingly in cotton and other summer crops. The recent registration of new members of this class of chemistry, Intruder® (acetamiprid) and Centric® (thiamethoxam), may lead to much greater use of this class in cotton against whiteflies. If not used judiciously, successive whitefly generations could be exposed to several neonicotinoid compounds on a variety of different crops throughout the year. Such a scenario places increased selection pressure on exposed whitefly populations and thereby increases the risk of resistance.

All interested parties including agrochemical industry, University researchers, growers, and pest control advisors (PCAs) have worked together to outline below some common-sense guidelines that take into account the use patterns of neonicotinoids for whitefly control and the cropping communities in which they will be used.

The objective of these guidelines is to optimize frequency of insecticide use (e.g., number of applications / season or year) to avoid sequential exposure of multiple generations of whiteflies across commodities. Ideally, these strategies will enhance whitefly management and maximize the longevity of all compounds used for their control. We recognize in certain situations these management practices may be difficult to implement and even occasionally run counter to strictly short-term interests; however, more disciplined use will now be necessary to accommodate new products and contribute to long-term sustainability of the neonicotinoid chemistry on desert crops.

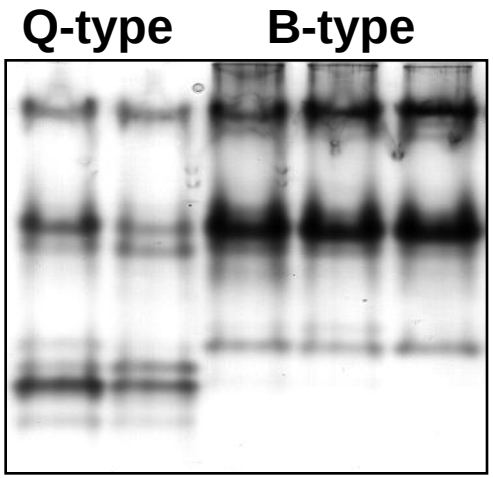
Suggested Minimum Rates & Crop Uses for Neonicotinoid Insecticides Registered in AZ

Active Ingredient	Product Name	Type of Application	Minimum Rate	Control Interval	Registered Crops
acetamiprid	Intruder	Foliar	2 oz	14–28 d	Cotton
imidacloprid	Admire	Soil	16–20 oz	45–60 d	Melons, Lettuce, Cole
imidacloprid	Provado	Foliar	3.75 oz	7–10 d	Lettuce, Cole (aphids)
thiamethoxam	Actara	Foliar	4 oz	7–14 d	Lettuce, Cole
thiamethoxam	Centric	Foliar	2 oz	7–14 d	Cotton
thiamethoxam	Platinum	Soil	8 oz	45–60 d	Melons, Lettuce, Cole

Biotypes of *Bemisia tabaci*

Bemisia tabaci
(sweetpotato whitefly)

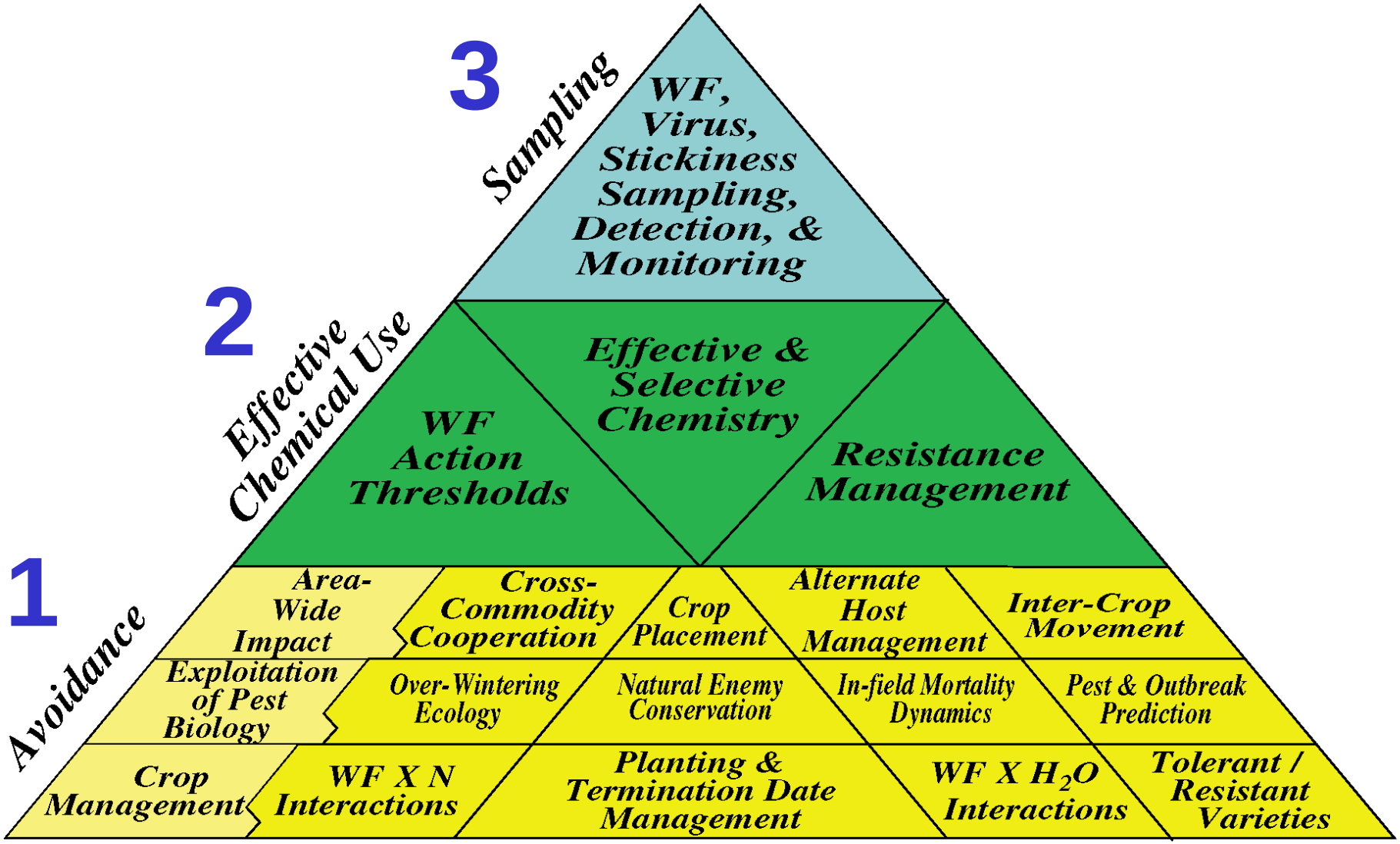
Two important biotypes are B- and Q-types. The most dominant biotype world-wide is B, whereas Q is to a greater or lesser extent restricted to the Mediterranean basin (*e.g.* Almeria Spain).



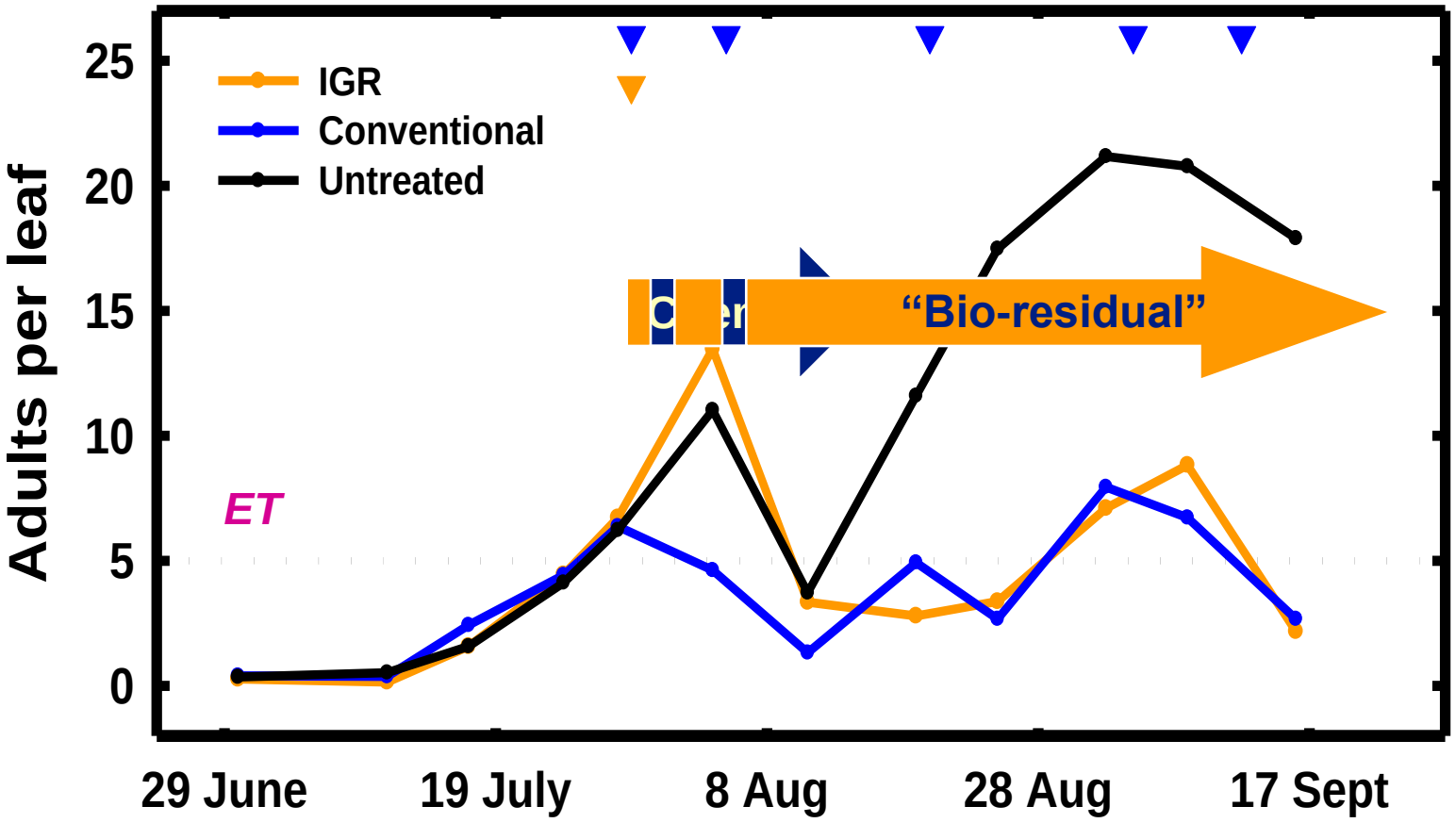
Esterase banding pattern to differentiate biotypes

Whitefly IPM…

…depends on 3 basic keys



Selective Insecticides



Naranjo & Ellsworth Biol. Control 200

Bioresidual

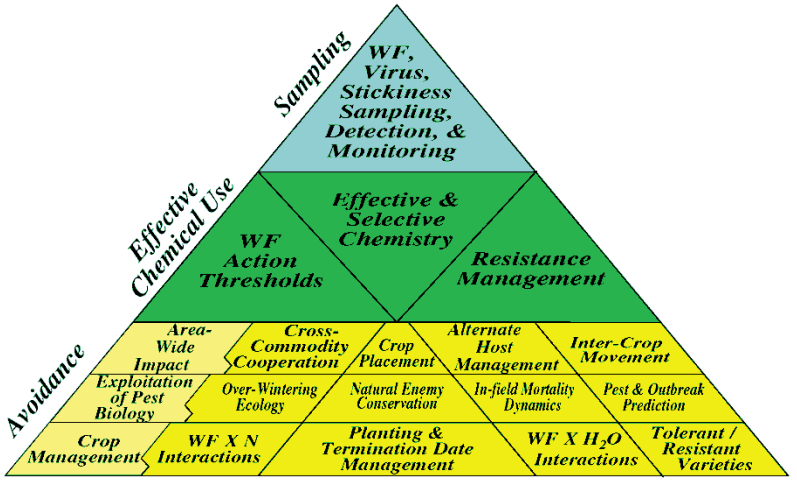
Overall killing power of an insect control technology, including the direct effects of the technology (i.e., chemical residual) and the associated natural biological mortality.

Ellsworth & Martinez-Carrillo, 2001

Ellsworth/UA

Conclusions

AZ Cotton IPM Plan

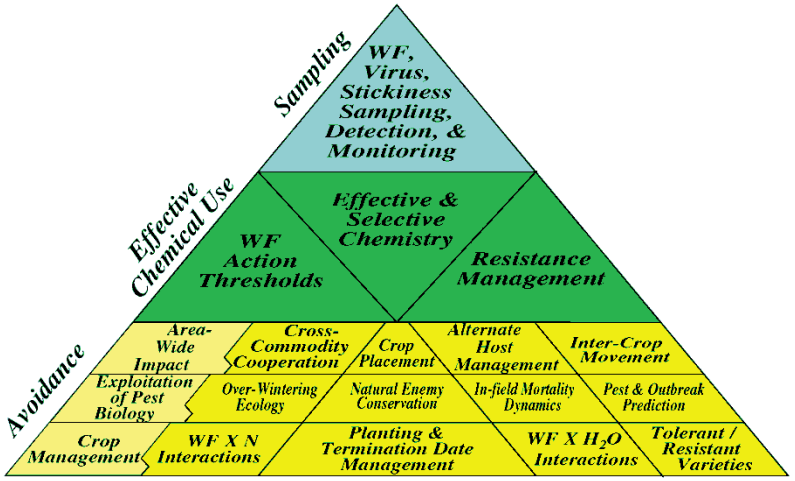


- **Whitefly sprays have been reduced by 71% to around 1 spray per season**
  - **saved > $100 million in control costs and yield savings in its first 5 years.**

- **Multiple elements**
  - **sampling**
  - **effective chemical use**
  - **foundation of avoidance**

Ellsworth/UA

Conclusions



- **Success has been based on:**
  - **Research and extension team working together with Industry**
  - **Research-based guidelines for sampling & thresholds,**
  - **Access to effective, selective insecticides**
    - **Long bio-residual activity**
  - **A comprehensive educational outreach campaign**

Ellsworth/UA

Let Not The Whitefly See Red

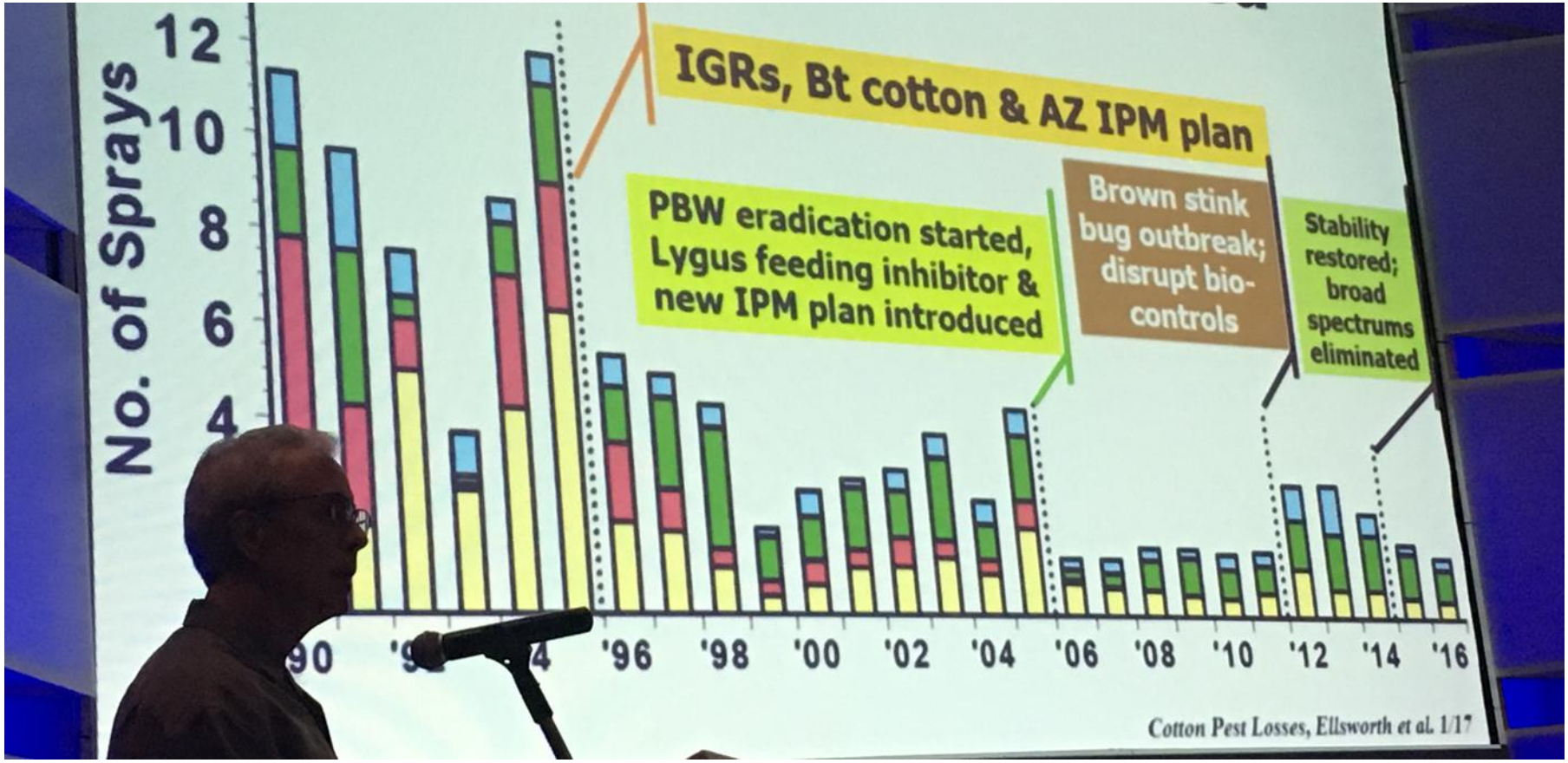
EXPERT's Column

Dr. K.R. Kranthi

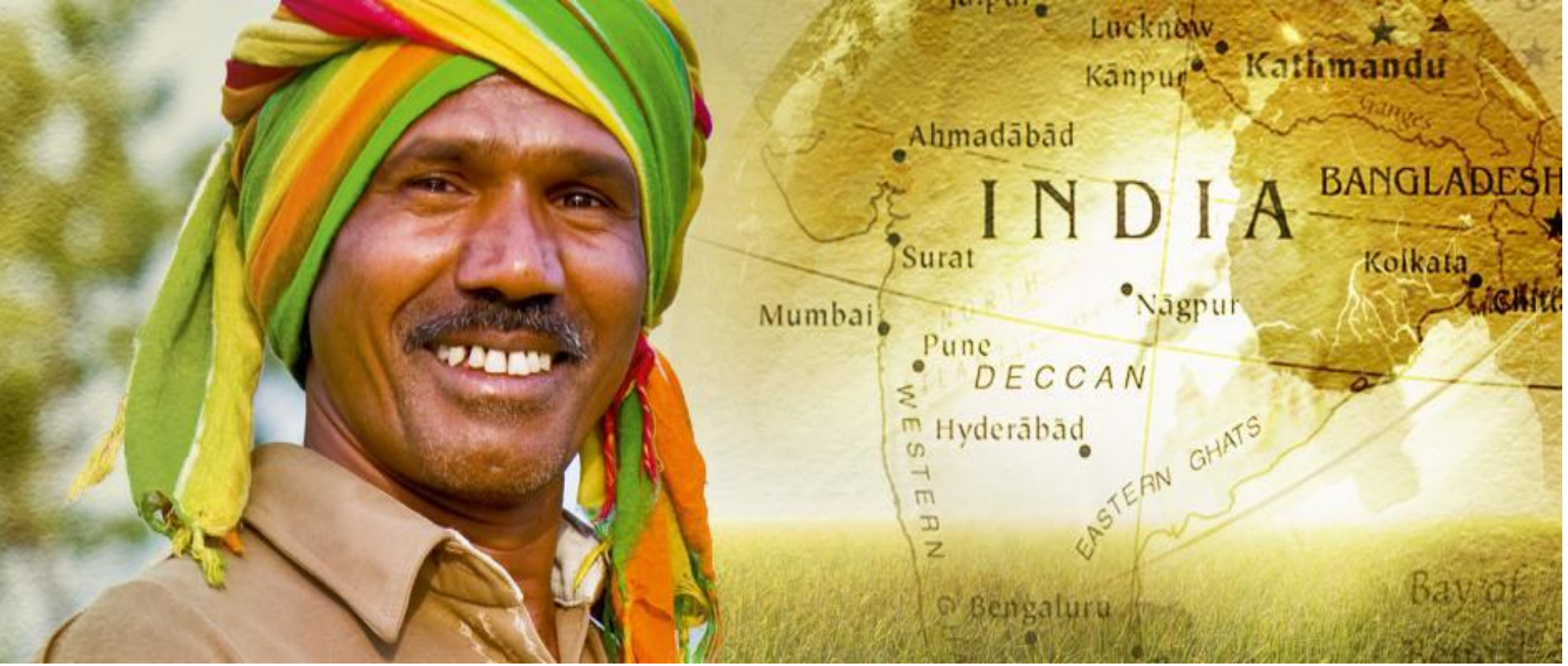
Recommendations:

- Selective insecticides
- No excessive urea
- Monitor w/ stick traps
- Sowing before end of April
- Appropriate spray methods--undersurface
- Weed control
- Neem/castor oils, soaps, etc.
- NPK Split doses
- Vacuum suction traps
- Desi cotton or WF- and CLCuV-tolerant varieties / hybrids
- Robust policy for rigorous screening of varieties/hybrids for insect and virus tolerance

20 Years of Sustainable Management of Cotton Pests in AZ



Dr. Peter Ellsworth, ISBGMO 2017



Exceptional Technology….

Requires Exceptional Stewardship

Thank you