*Advances in Understanding Insect Dispersal to Improve Pest Management in Vegetable Crops*

# Successful Management Adapted to a Mobile, Polyphagous Whitefly Pest in a Diverse Cropping System

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**University of Arizona**

*Section F Symposium, ESA, December 20, 2005*

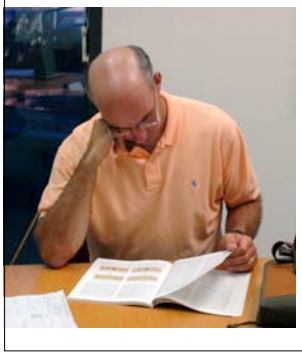


## What Am I Doing Here?

- Vegetables?
- Dispersal?



## What Am I Doing Here?





## Bemisia tabaci, Biotype B

- 33 µg
- > 600 hosts
- Mobile adult form
- Introduced to U.S. in late 1980's and AZ in early 1990's
- Reduces yields, contaminates with honeydew & vectors viruses



## Dispersal and IPM

- Description of System
  - Damage potential & economic impact
  - Intercrop interactions
- Bemisia movement
- IPM System
  - Impact of dispersal
  - Cross-commodity management



## Veggie Losses

- Reduced Yields
  - Leaf necrosis
  - Fruit size
  - Plant vigor
  - Maturity
- Reduced Quality
  - Chlorosis
  - Low sugars
  - Sooty mold

## Biological Defoliation (UTC, 1992)

**Yield Loss**

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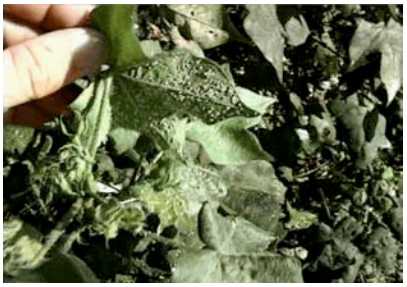
## Damage to Cotton: Direct, Yield Loss



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## Excreted Sugars Host Sooty Molds

**Quality Loss**

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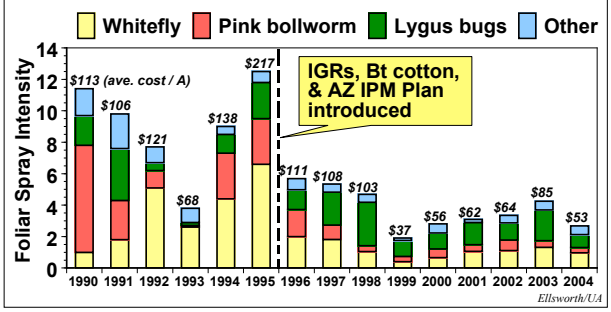
## $100M Problem

**Sticky cotton could not be sold at a premium price after outbreaks in 1992 & 1995.**



## Arizona Cotton Insect Losses

**(1990–2004)**

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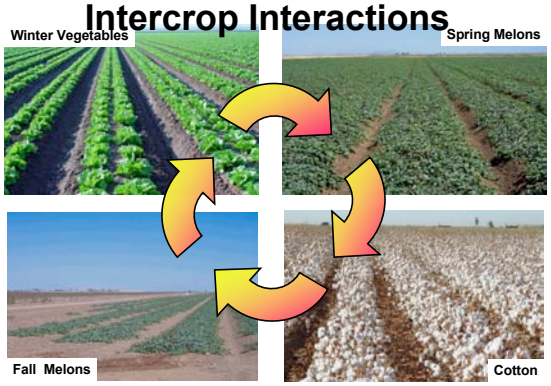
## Intercrop Interactions

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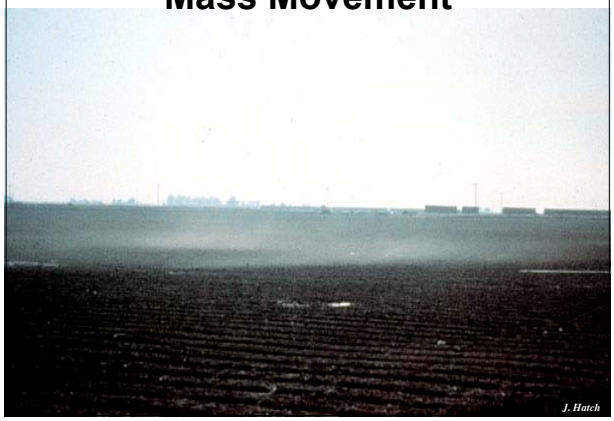
## Mass Movement



J. Hatch

## One Man's White-Fly…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## Whitefly Movement & Dispersal

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## What Do We Know?

*From Byrne, Blackmer et al.*

- Longer flights during morning hours in females, though flight is possible all day
- Females have greater rates of climb

D. Byrne

- < 1 d old or > 7 d. old, flight muscles not adequately developed for flight
- Longer duration flights at 3 – 5 d of age
- Gravid females do fly, though > 4 eggs inhibits long-duration flights

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## Short-Range Migration

*From Byrne, Blackmer et al.*

- < 5% have sustained flights > 2 hrs
- Ca. 6% exhibit behaviors consistent with migration
- After which, sustained flight (> 15 min.) required to respond to visual cues

J. Hatch

- Heavily dependent on wind direction
- Mark / recapture of individuals up to 2.7 km
- Bimodal distribution with majority near source ("trivial" flyers) & some at ca. 2.2 km ("migrators")

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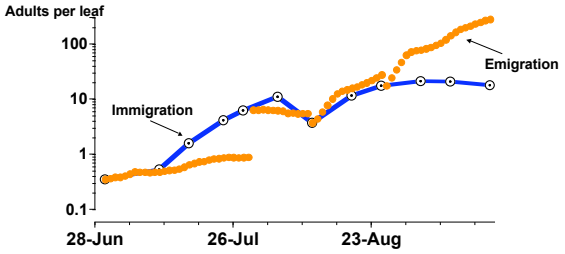
## Adult Population Dynamics

Cotton




1997

*From Naranjo & Ellsworth, 2005*

## Adult Population Dynamics

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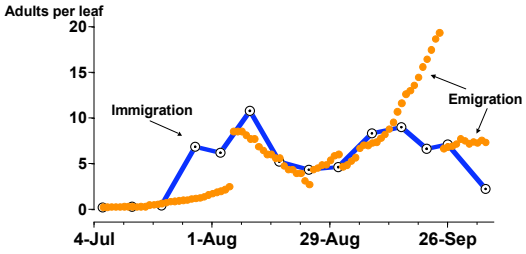


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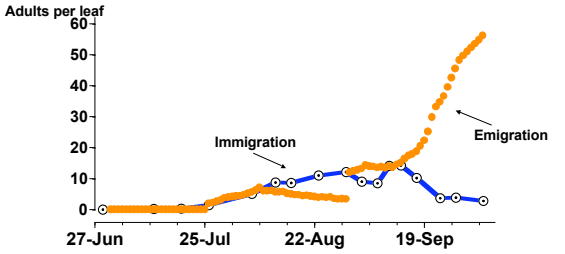


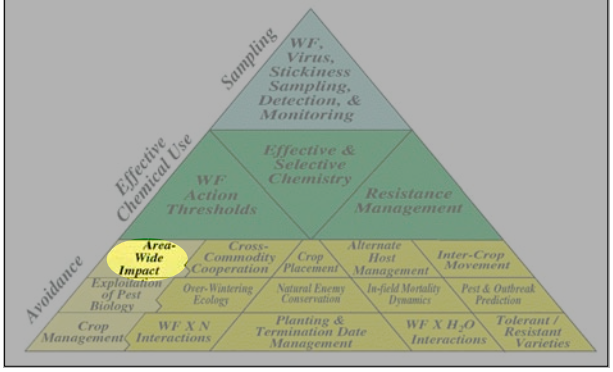

1999

*From Naranjo & Ellsworth, 2005*

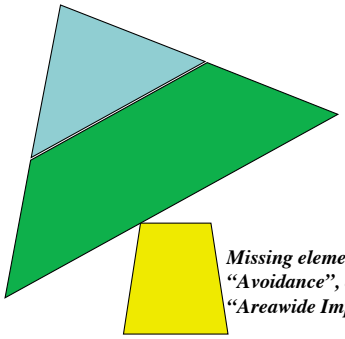
## Whitefly IPM…

…depends on 3 basic keys


## Whitefly IPM




## Unstable



*Missing elements of "Avoidance", e.g., "Areawide Impact"*

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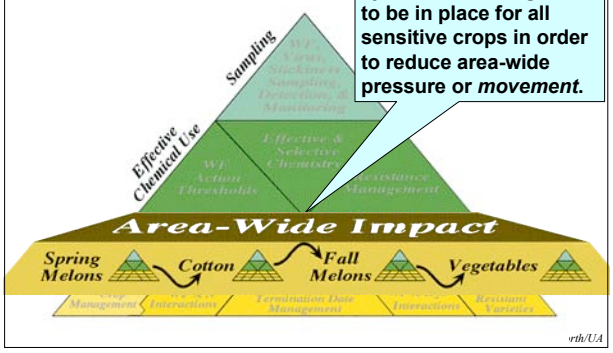
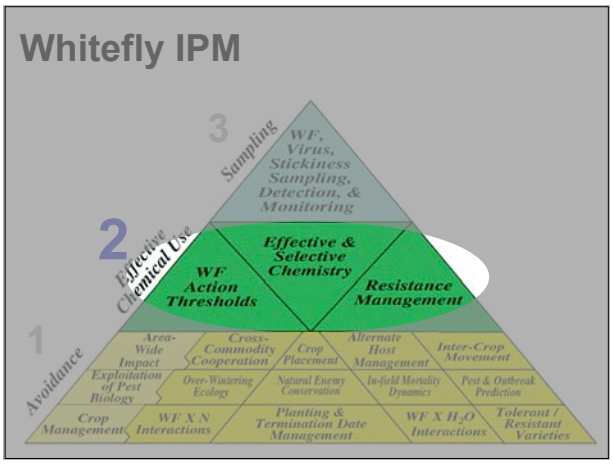
## Areawide Impact

…depends on stable systems of management to be in place for all sensitive crops in order to reduce area-wide pressure or *movement*.

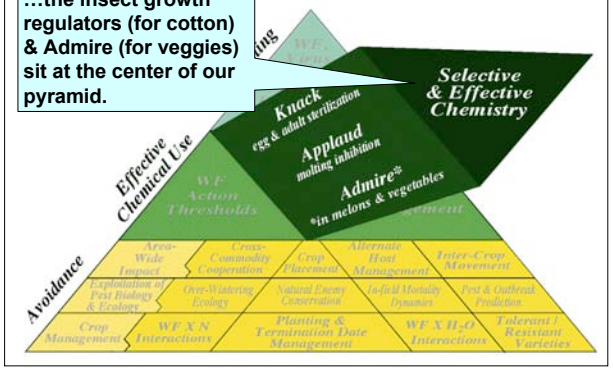



## Whitefly IPM




## Selective & Effective Chemistry

…the insect growth regulators (for cotton) & Admire (for veggies) sit at the center of our pyramid.




## Overwhelming Pressure

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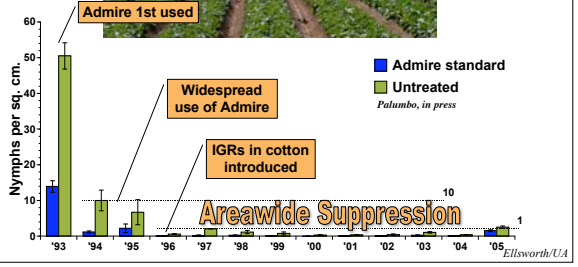
## Areawide Pressure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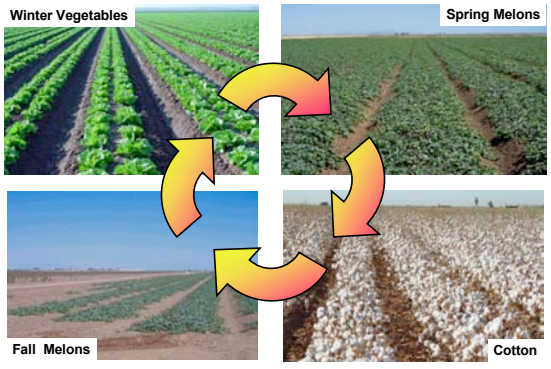


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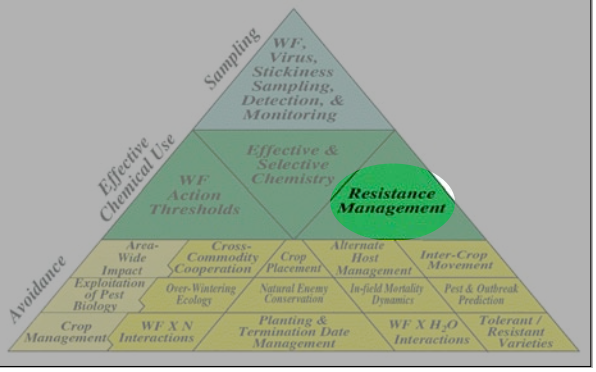
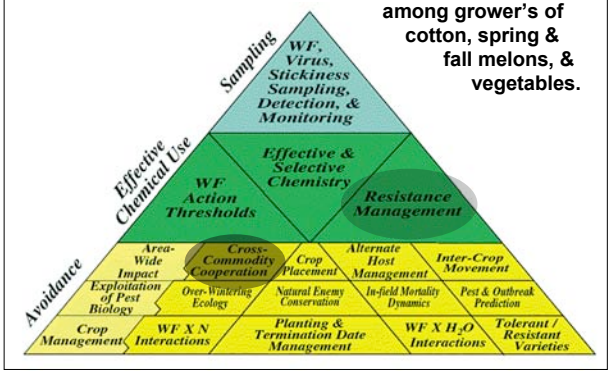
## Whitefly IPM




## Whitefly X-IPM…

…depends on cooperation among grower's of cotton, spring & fall melons, & vegetables.




## Neonicotinoids: A Major Class

| A.I. | Product | Application | Crops Uses |
|---|---|---|---|
| Acetamiprid | Assail | Foliar | Lettuce, Cole |
| Acetamiprid | Intruder | Foliar | Cotton |
| Dinotefuran | Venom | Foliar, Soil | All |
| Imidacloprid | Admire, etc. | Soil | Melons, Lettuce, Cole |
| Imidacloprid | Gaucho, etc. | Seed | Cotton |
| Imidacloprid | Provado, etc. | Foliar | Lettuce, Cole (Cotton) |
| Thiamethoxam | Centric | Foliar | Cotton |
| Thiamethoxam | Cruiser | Seed | Cotton |
| Thiamethoxam | Platinum | Soil | Melons |
| Clothianidin | Clutch/Poncho | various | ? |
| Thiacloprid | Calypso | Foliar | ? |

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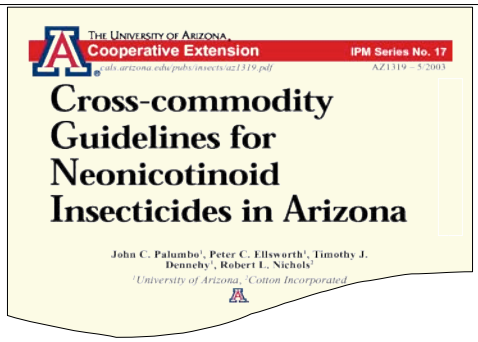


IRAC Symposium • Saturday at 9:30A
Paper 0722 – John C. Palumbo
*"Grower Initiated Model for Sustaining Neonicotinoid Efficacy Across Commodities"*

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## Risks by Community

"Multi-Crop"

- Complex cropping system
- 3 major whitefly host crops
- 4 major production windows
  - Winter vegetables
  - Spring melons
  - Summer cotton
  - Fall melons

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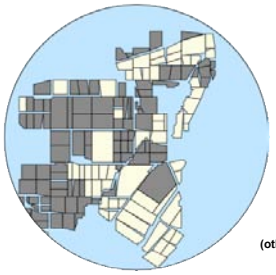
## Risks by Community



- Simple cropping system
- 1 major whitefly host crop
- 1 production window
  - Summer cotton

(other crops grown but not major hosts for whiteflies: alfalfa, wheat, barley, sudan grass, corn)

"Cotton-Intensive"

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## Three Common Communities

- Cotton-Intensive, Multi-Crop, and Cotton / Melon

"Cotton-Intensive" "Multi-Crop"

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## Spatial Considerations

- Whiteflies residential in-season
- Opportunity for 3 – 4 "transfers" per year
- 2.2 km range for < 5% of population, annual range of 6.6 – 8.8 km
- Whitefly "communities" = all those sensitive host crops grown within a 2-mile radius annually


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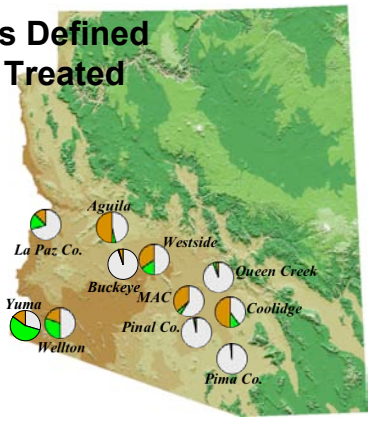
## Communities Defined by Principal Treated WF Hosts

Cotton n Melons

- Cotton
- Vegetables
- Melons

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## Sharing Neonicotinoids

***Neonicotinoid* Limitations:***

***Maximum usage by crop per season***

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

**Seed, Soil, or Foliar*

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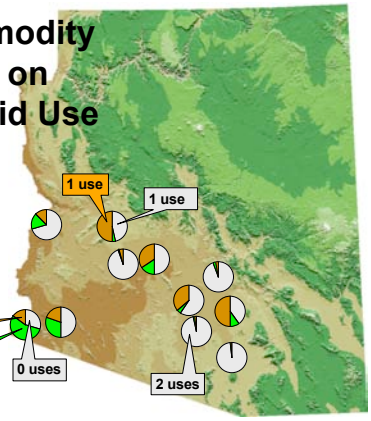
## Cross-Commodity Agreements on Neonicotinoid Use

- Cotton
- Vegetables
- Melons




*Palumbo et al. 2003*

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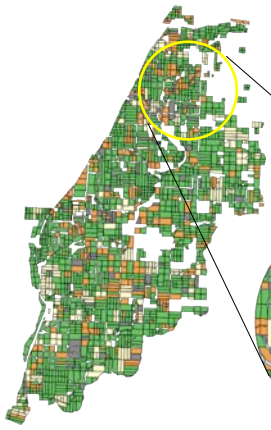

## Group Adoption

- Section level pesticide records (1 mile square)
- Measure temporal & spatial changes in adoption
- E.g., neonicotinoid usage

In cotton,
CI: 2
CM: 1
MC: 0

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## Dispersal & Mgt. of Bemisia

- While ostensibly a sedentary insect through most of its life cycle, whiteflies can and do effectively move through our agroecosystem.
- Careful consideration of the consequences of this movement by stakeholders and researchers has led to the development of a refined IPM strategy.
- These refinements consider the spatial risks (e.g., for outbreak conditions & for resistance) and should help sustain cross-commodity management of this pest areawide.

*Ellsworth/UA*

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*Ellsworth/UA*

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*Ellsworth/UA*