Evaluating Environmental Impact in Reduced Risk IPM Apple & Peach Orchards

David Biddinger
Penn State University
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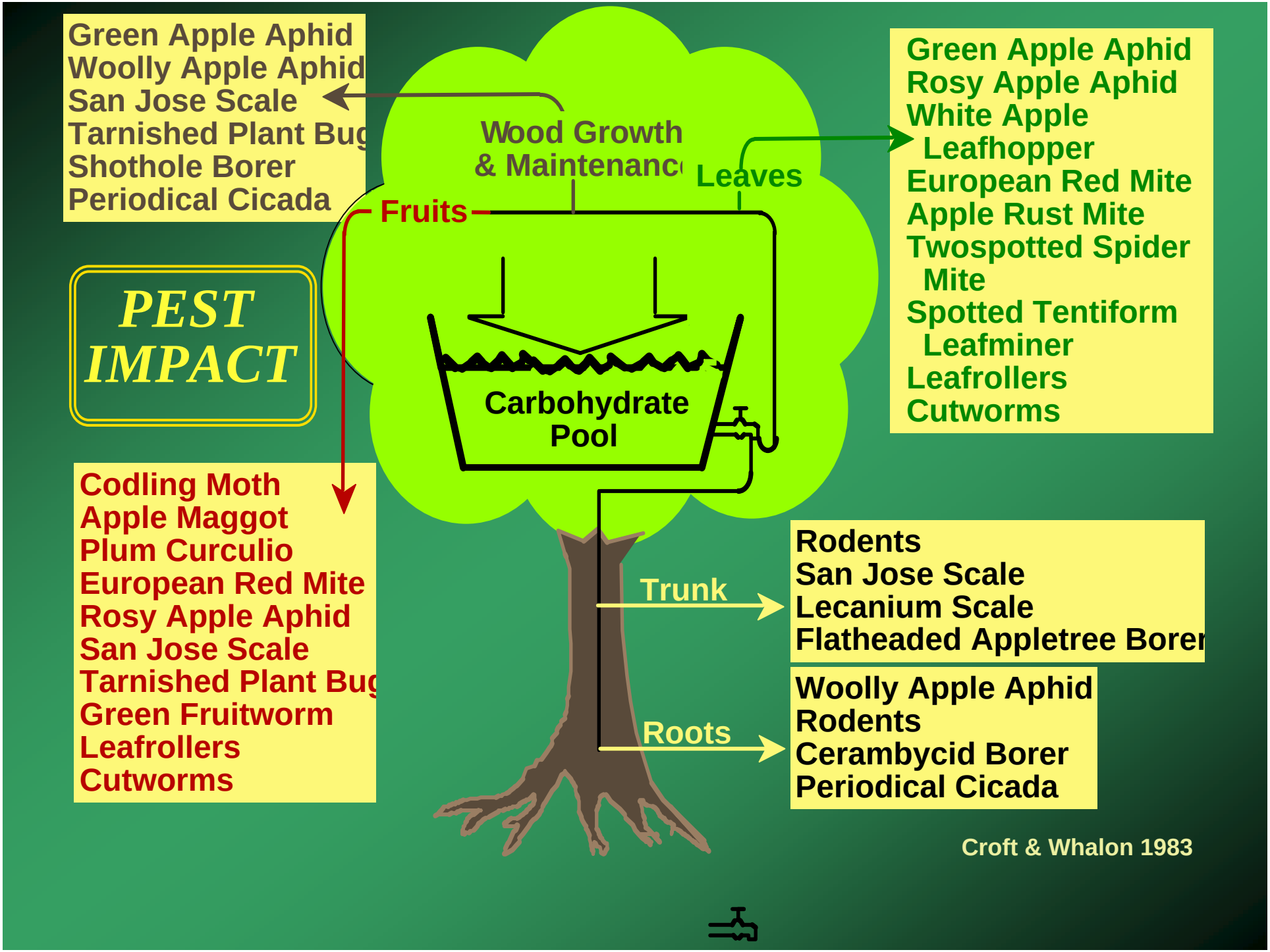
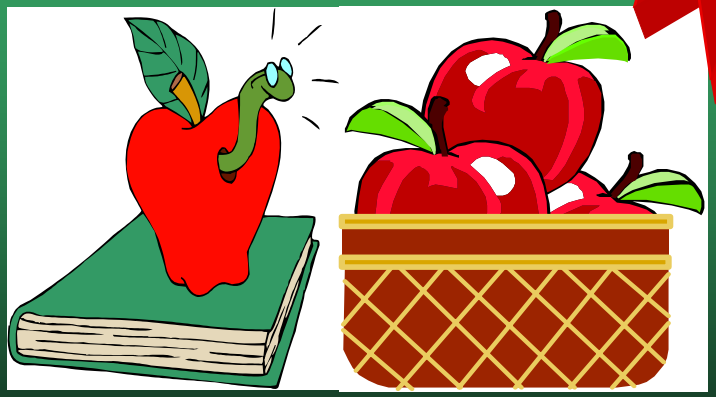

Green Apple Aphid
Woolly Apple Aphid
San Jose Scale
Tarnished Plant Bug
Shothole Borer
Periodical Cicada
PEST IMPACT
Wood Growth & Maintenance
Fruits
Leaves
Carbohydrate Pool
Green Apple Aphid
Rosy Apple Aphid
White Apple Leafhopper
European Red Mite
Apple Rust Mite
Twospotted Spider Mite
Spotted Tentiform Leafminer
Leafrollers
Cutworms
Codling Moth
Apple Maggot
Plum Curculio
European Red Mite
Rosy Apple Aphid
San Jose Scale
Tarnished Plant Bug
Green Fruitworm
Leafrollers
Cutworms
Trunk
Rodents
San Jose Scale
Lecanium Scale
Flatheaded Appletree Borer
Roots
Woolly Apple Aphid
Rodents
Cerambycid Borer
Periodical Cicada
Croft & Whalon 1983

The Good, The Bad, & The Ugly Bugs

PENNSTATE 1855

F = Food
Q = Quality
P = Protection
A = Act

OR



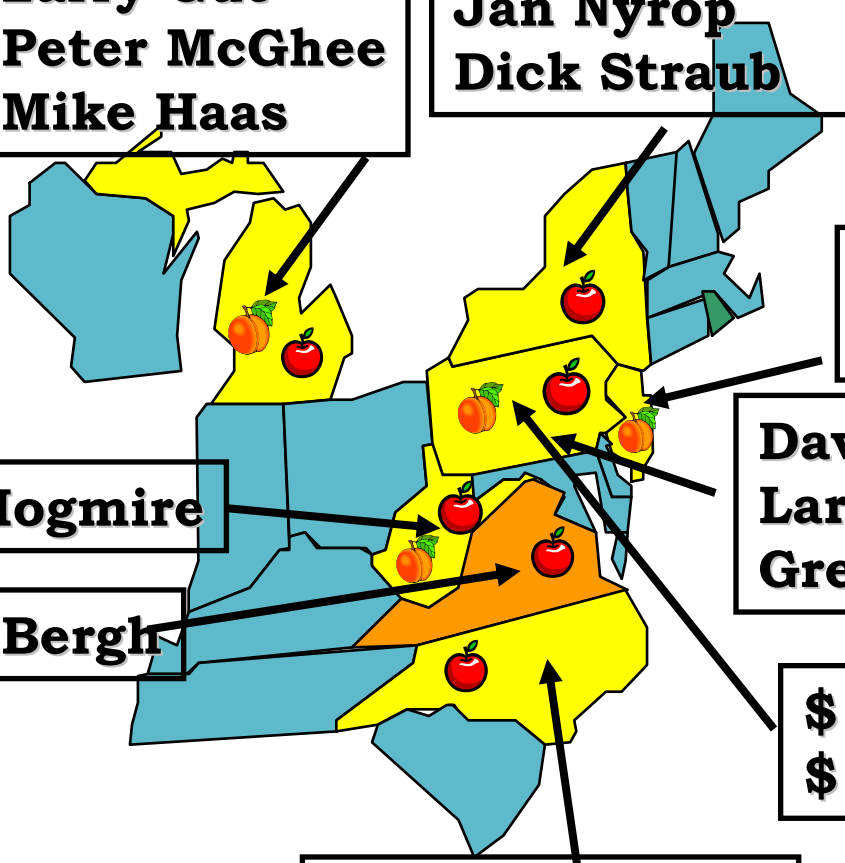
F = Frequent
Q = Questions about
P = Pests without
A = Answers

Organophosphates *Currently Registered* on Tree Fruits

Common Name	Trade Name
~~Azinphosmethyl~~ ?	Guthion®
Chlorpyrifos	Lorsban®
Diazinon	Diazinon
Dimethoate	Dimethoate®
Methidathion	Supracide®
Phosmet	Imidan®
~~Methyl Parathion~~	Penncap M ®

The Future Picture ??

Investigators



Larry Gut
Peter McGhee
Mike Haas

Harvey Reissig
Art Agnello
Jan Nyrop
Dick Straub

Peter Shearer
Atanas Atanassov

David Biddinger
Larry Hull
Greg Krawczyk

Henry Hogmire

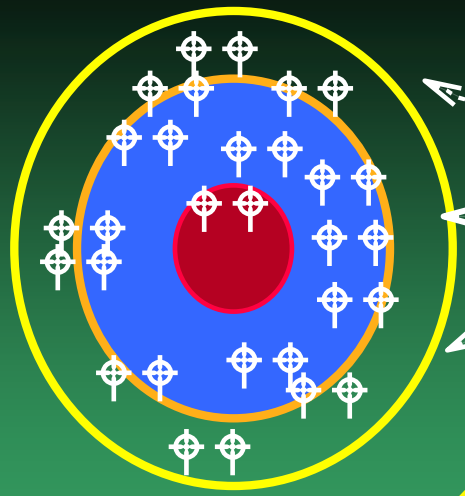
Chris Bergh

$ Jay Harper
$ Lynn Kime

Jim Walgenbach
Raul Villanueva

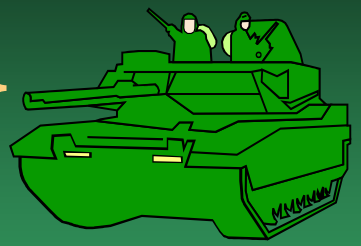
7 States - $1.9 Million over 4 years.

Eastern U.S. Risk Assessment & Mitigation Project



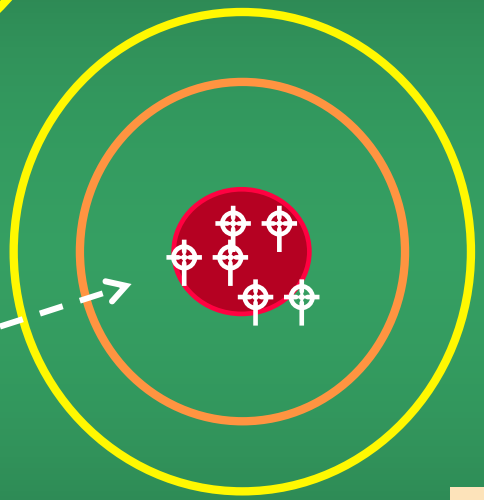
Broad-spectrum Insecticides

PENNSTATE 1855

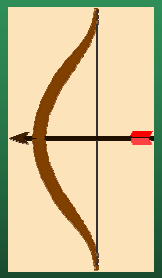


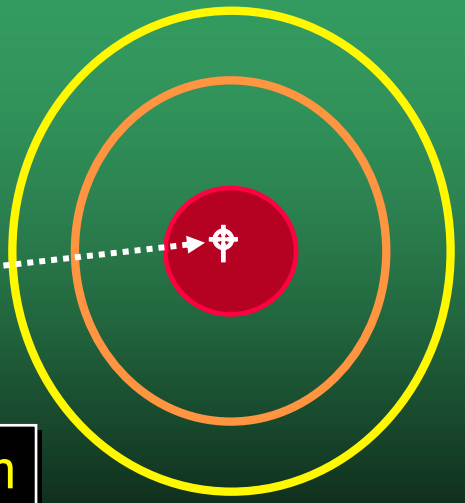
OPs, Carbamates Pyrethroids

Reduced Risk



Avaunt, IGR's Assail, Bts etc.





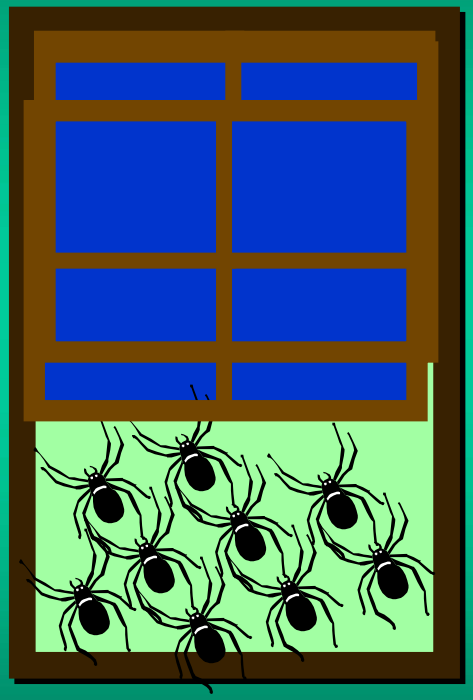
Mating Disruption

⌖ = Species of insect killed.

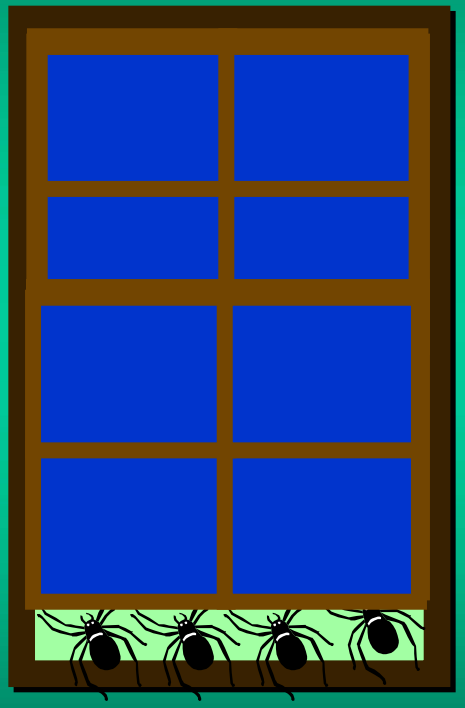
LAH-2003

“Soft” or Selective insecticides

Broad spectrum insecticides



Species of pests and natural enemies not impacted



“Windows of opportunity”

Green Stink Bug (*Acrosterum hilare*) - Peach

DJB-2005

Nymph w/ Tachinid Eggs

Hatching Eggs

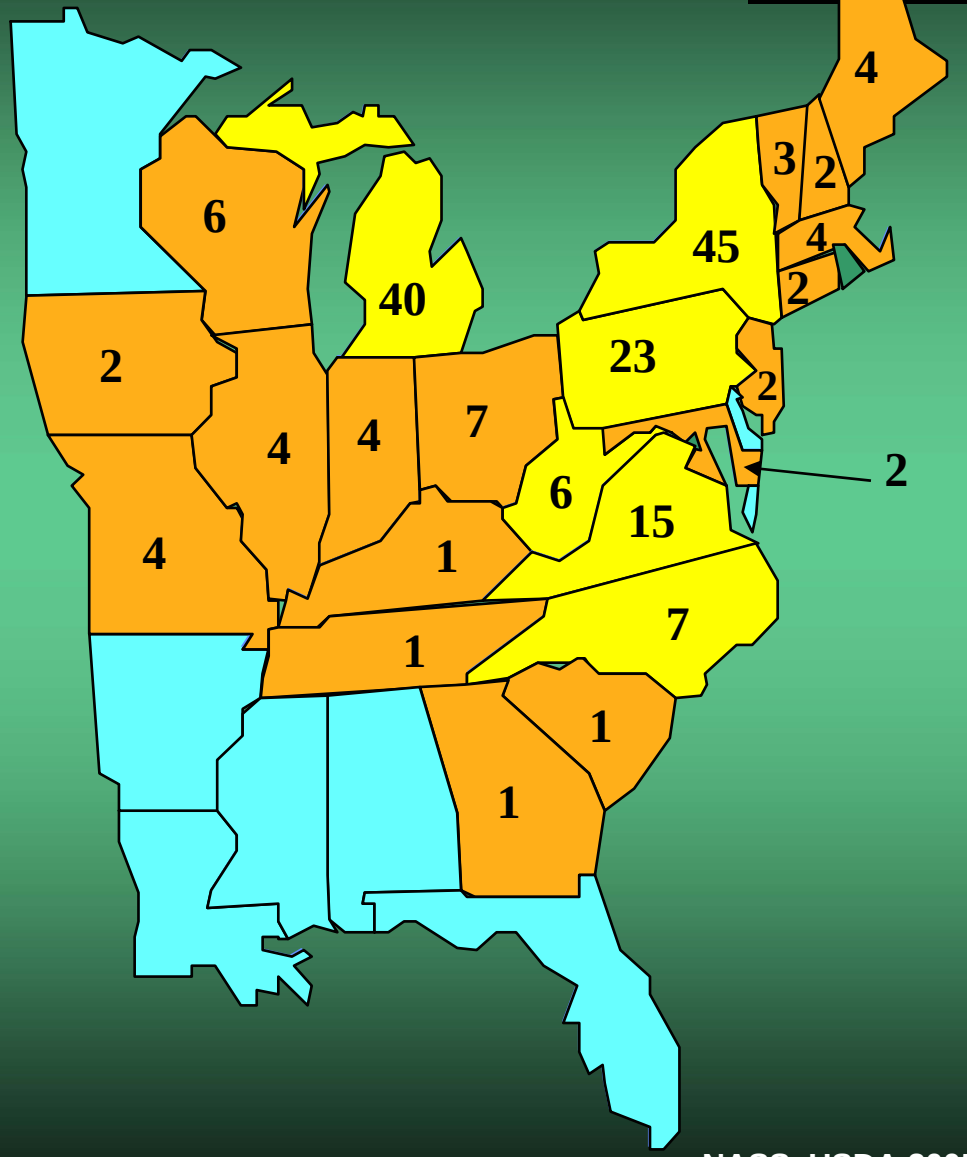
Green SB

Southern Green SB

Fruit Damage

2004 Apple Acres X 1,000

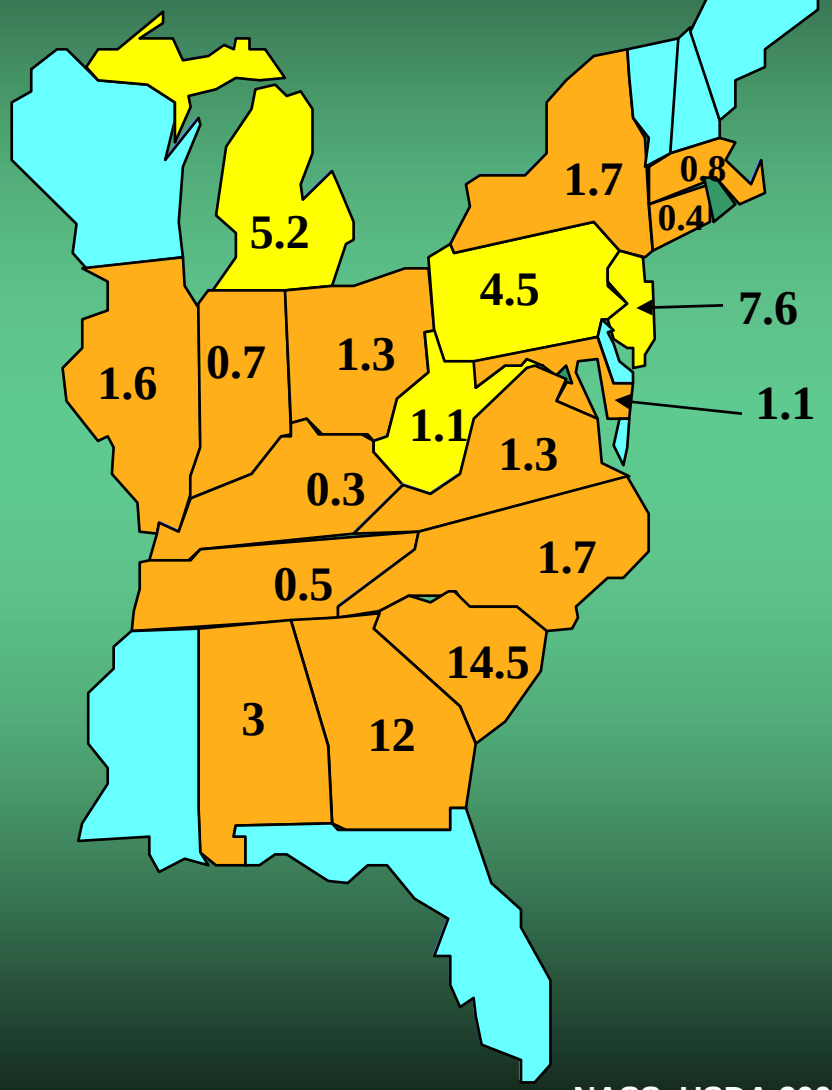
- Represent 73% of 138,000 Eastern apple acres worth $450 million.
- Av. lb ai/A for all states 6.06 lb of which 84% are OPs & 6% are CBs .
- Av. ai/A reduction of 83.1%.
- Total tons ai/A for insecticides /miticides in East – 614 tons.
- Potential ai/A reduction of 381 tons in RAMP states; potentially 513 tons in all Eastern states.



NASS, USDA 2005

2004 Peach Acres X 1,000

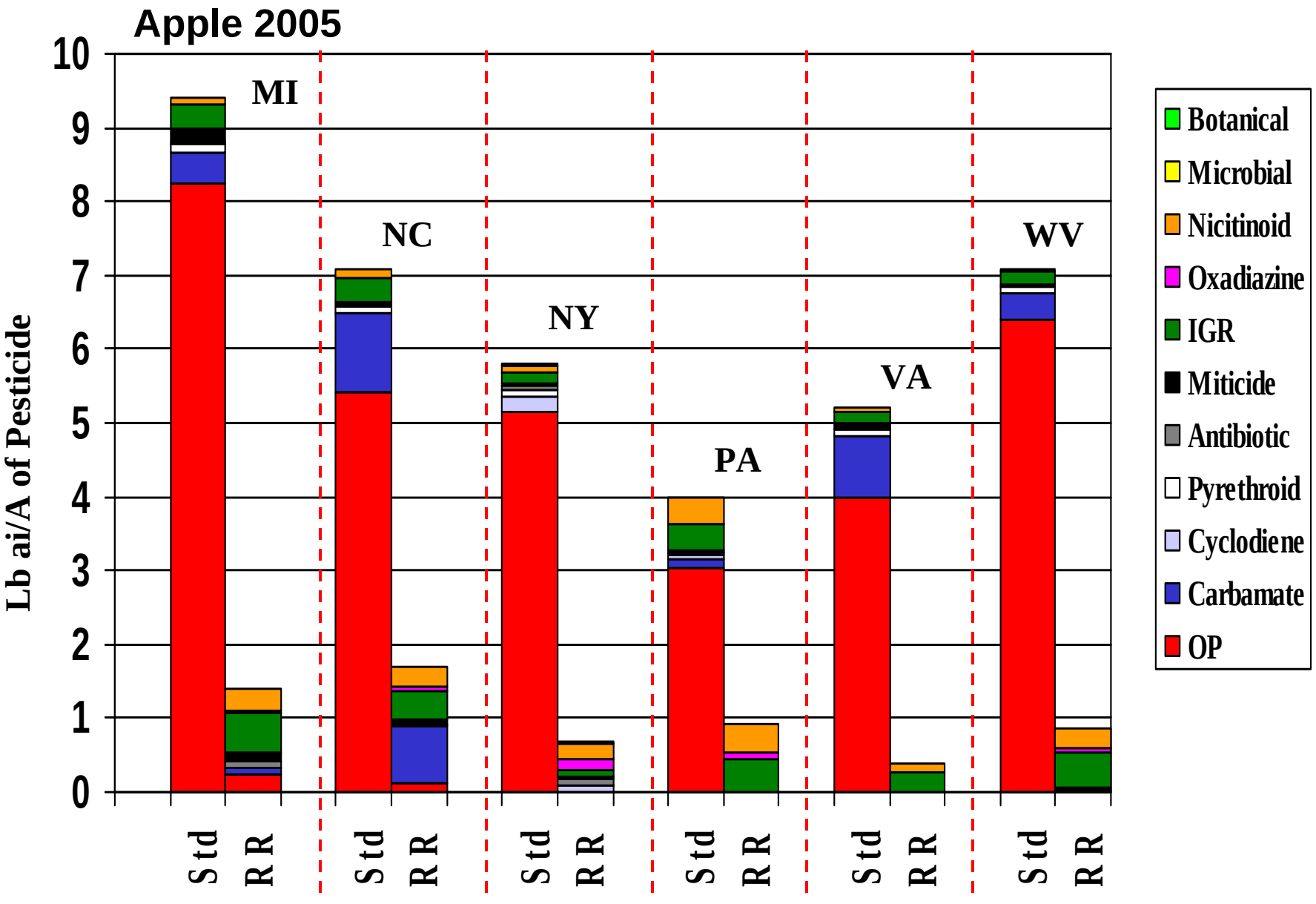
- Represent 30% of 61,000 Eastern peach acres worth $157 million.
- Av. lb ai/A for all states 4.39 lb - 83% are OPs & 13% CBs.
- Av. ai/A reduction of 77.7%.
- Total tons ai/A for insecticides /miticides in East – 128 tons.
- Potential ai/A reduction of 37 tons in RAMP states; potentially 97 tons in all Eastern states.



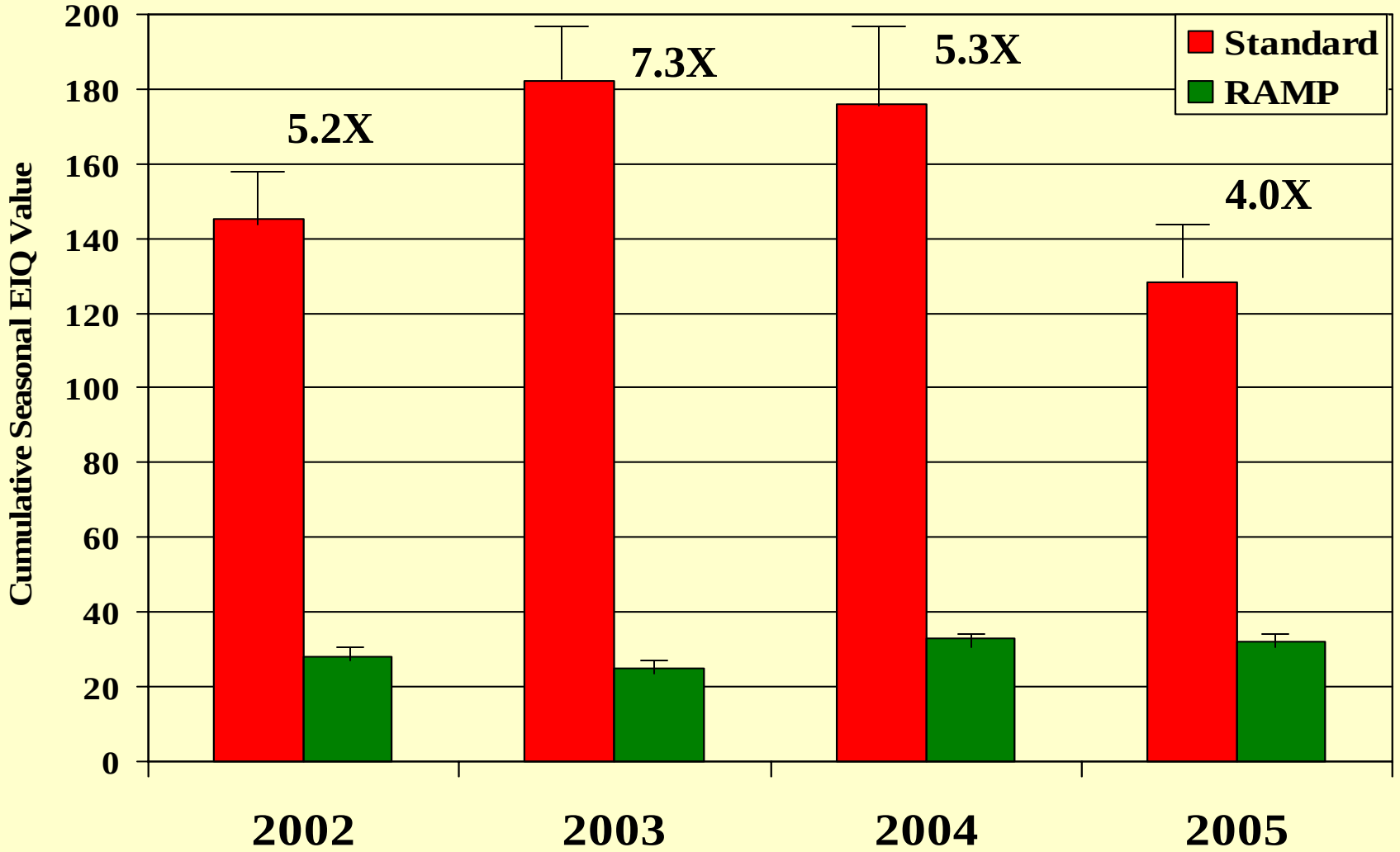
NASS, USDA 2005

Environmental Impact Quotient (EIQ)

- Developed by Cornell to measure environmental benefits from IPM practices that resulted in pesticide reductions.
- Uses toxicity data on potential for ground water contamination, residual half life on plants, human health, impacts on fish, birds, aquatics, bees, and beneficials.
- Takes into account the toxicity of individual pesticides, their field use rates, and number of applications.
- Many problems, but best evaluation currently. Used in IPM labeled food products in NY.

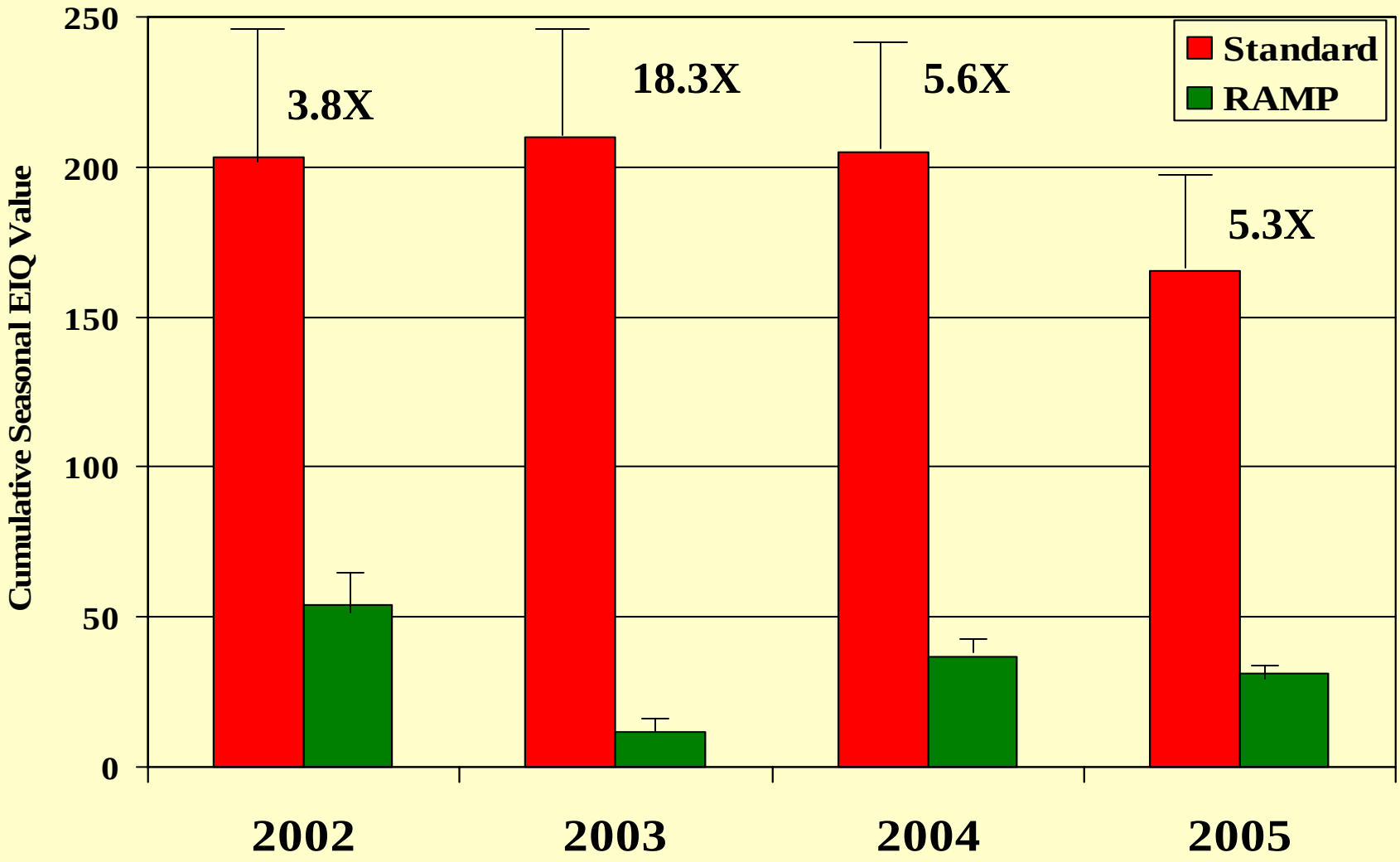

Apple 2005
Lb ai/A of Pesticide
10
9
8
7
6
5
4
3
2
1
0
MI
NC
NY
PA
VA
WV
Std
RR
Botanical
Microbial
Nicitinoid
Oxadiazine
IGR
Miticide
Antibiotic
Pyrethroid
Cyclodiene
Carbamate
OP

Relative Ecological Toxicity (EIQ)
In RAMP Apple Programs
PA 7 Orchard Average



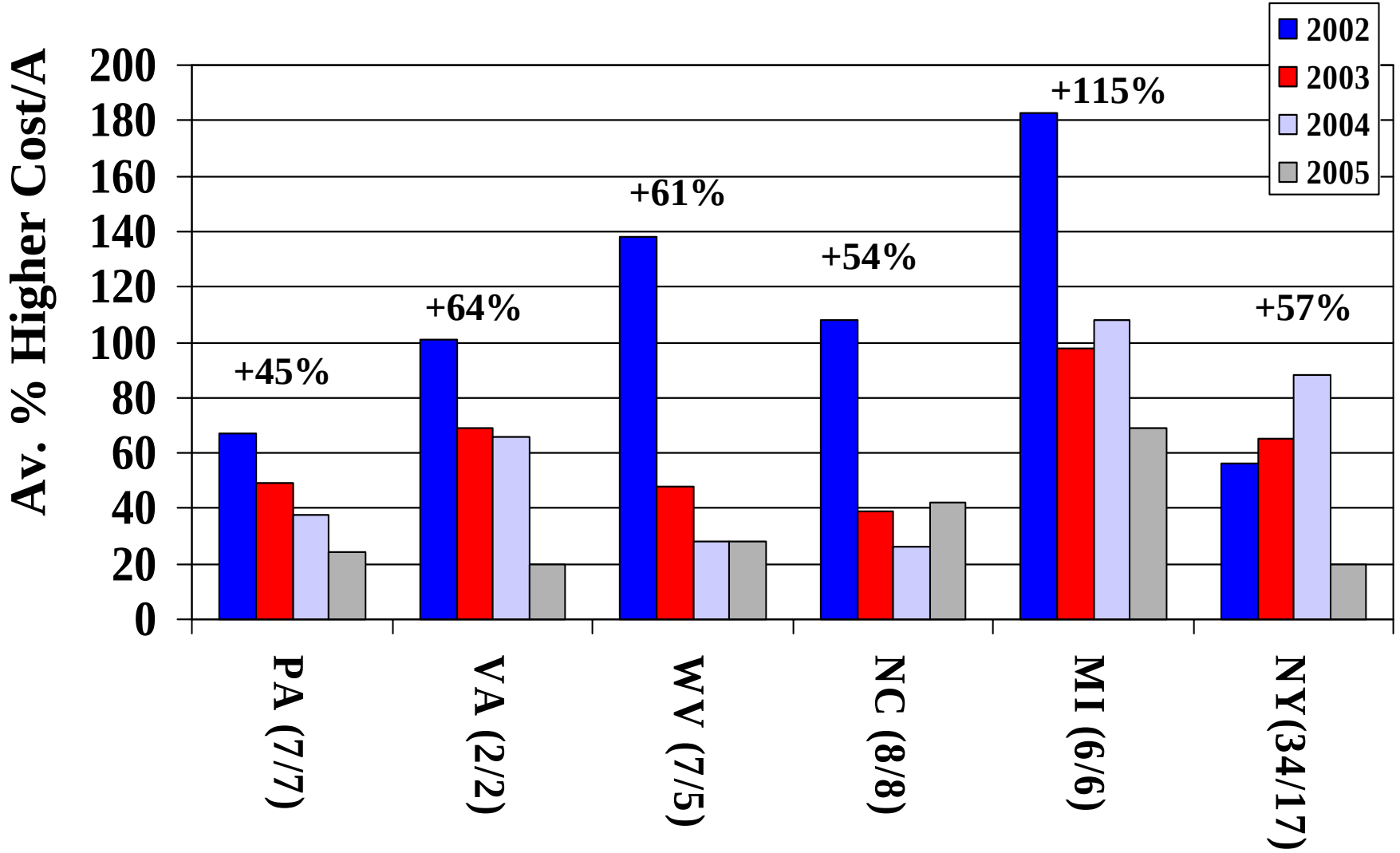
Relative Ecological Toxicity (EIQ) In RAMP Peach Programs

PA 5 Orchard Average



Multi-State Apple RAMP 2002-5

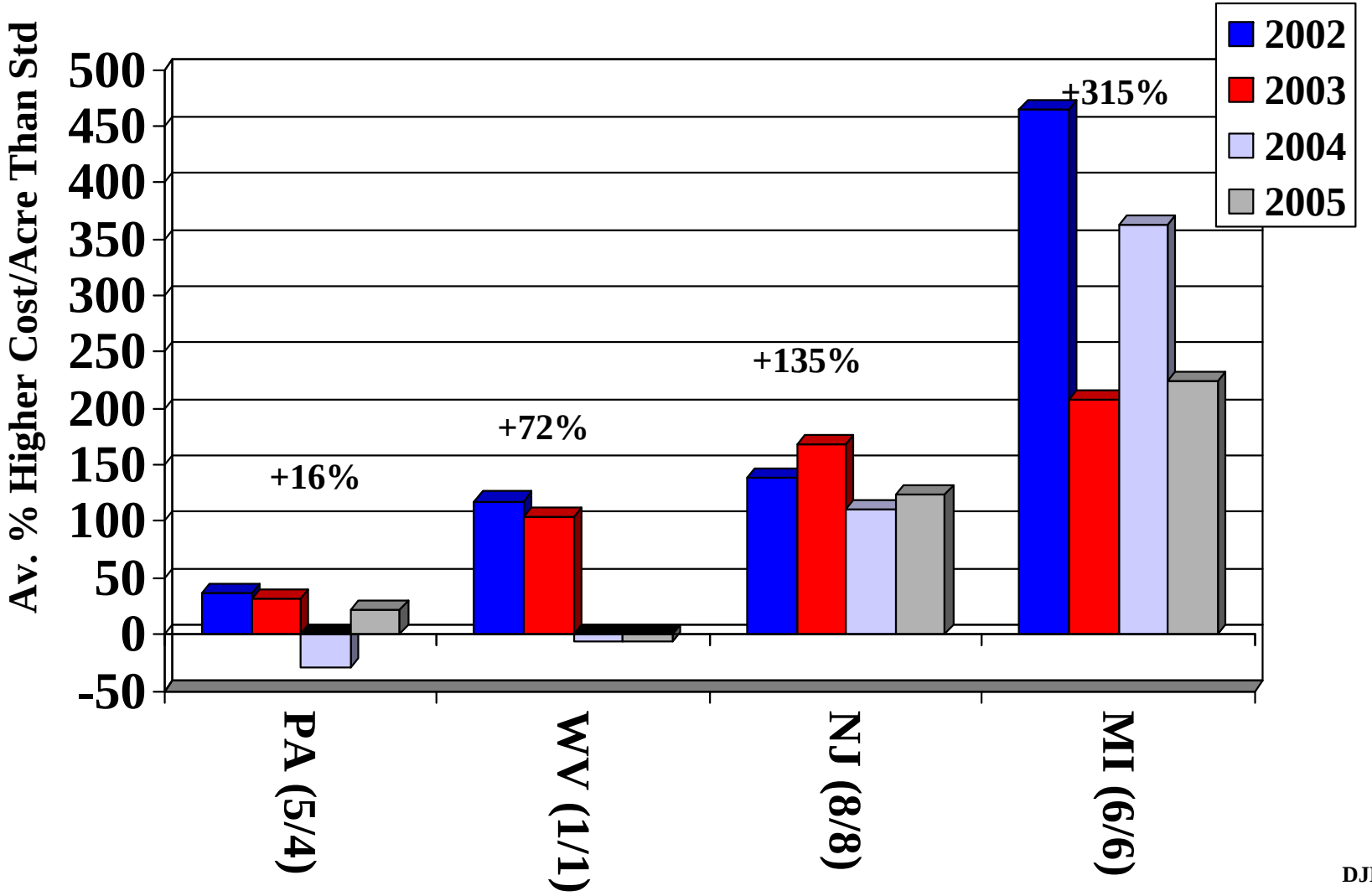
Insecticide/Miticide/Pheromone Disruption Costs ($/A)



DJB 05

Multi-State Peach RAMP 2002-5

Insecticide/Miticide/Pheromone Disruption Costs ($/A)



DJB 04

NRCS – Agricultural Management Assistance (EQUIP)

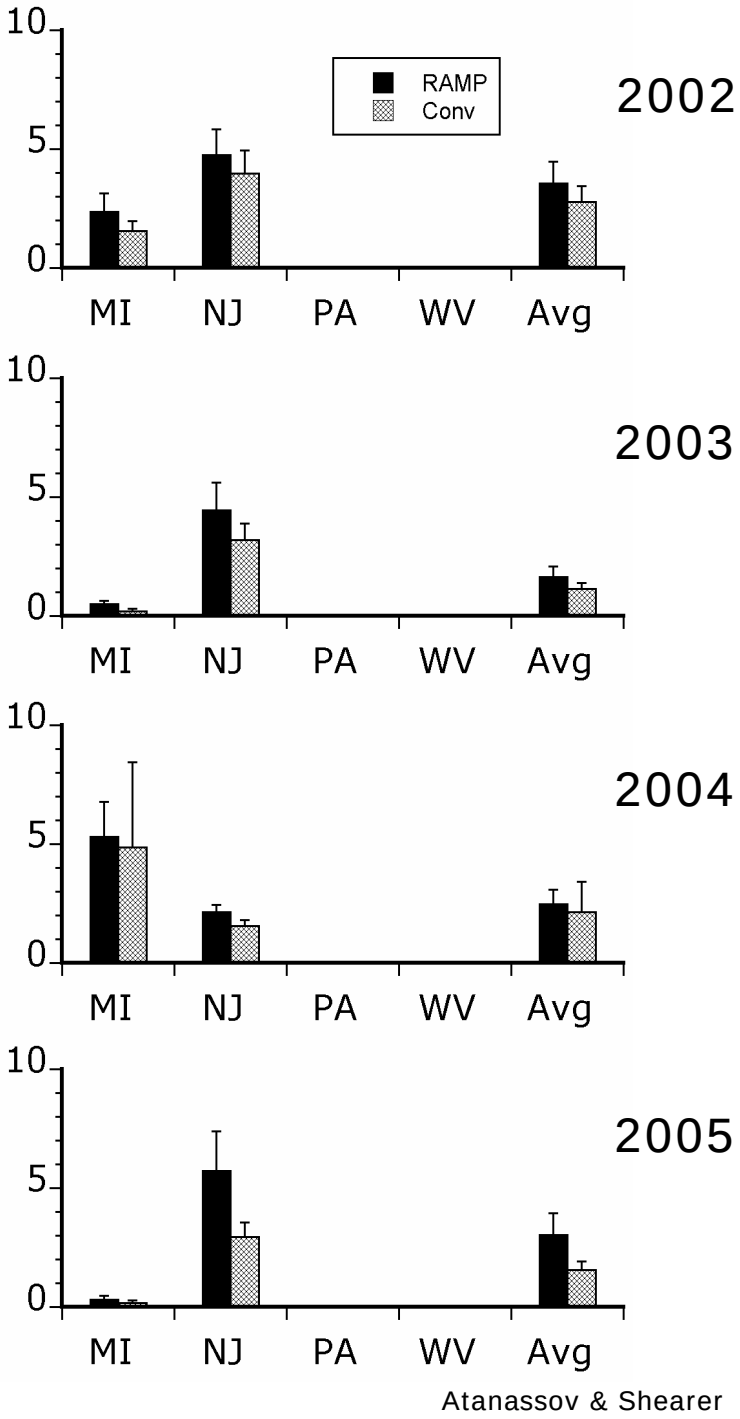
Barry Frantz

Practice	Comp Units	Comp Cost	Cost-Share Type	Cost-Share Rate
	Correlated Practices -			
Pest Management	**Correlated Practices -**			
Adv PM Tree Fruit-area-wide mating disruption 1-spe	Ac.	$38.00	FR	100
Adv PM Tree Fruit-area-wide mating disruption 2-spe	Ac.	$90.00	FR	100
Adv PM Tree Fruit-intensive disease monitoring	Ac.	$23.00	FR	100
Adv PM Tree Fruit-intensive insect monitoring&trappi	Ac.	$45.00	FR	100
Adv PM Tree Fruit-reduced risk pesticides	Ac.	$56.00	FR	100
Avoidance techniques-plant resistant varieties, trap	Ac.	$15.00	FR	100
Basic Pest Management for Tree Fruit	Ac.	$35.00	FR	100
Field Crops	Ac.	$8.00	FR	100
Nonchemical control methods-increase beneficial ins	Ac.	$6.00	FR	100
Use of precision application technology	Ac.	$15.00	FR	100
Weather and Growing Degree Days Monitoring	No.	$375.00	FR	100
Weather plus use of Pedictive Models (per season)	No.	$394.00	FR	100

Natural Enemy Abundance: Peach (All states):

- No real differences in NE levels despite different IPM programs.

NJ AGRICULTURAL EXPERIMENT STATIO
RUTGERS
COOPERATIVE RESEARCH & EXTENSIO



Atanassov & Shearer

Secondary Pests

Aphids




Leafminers



Leafhoppers



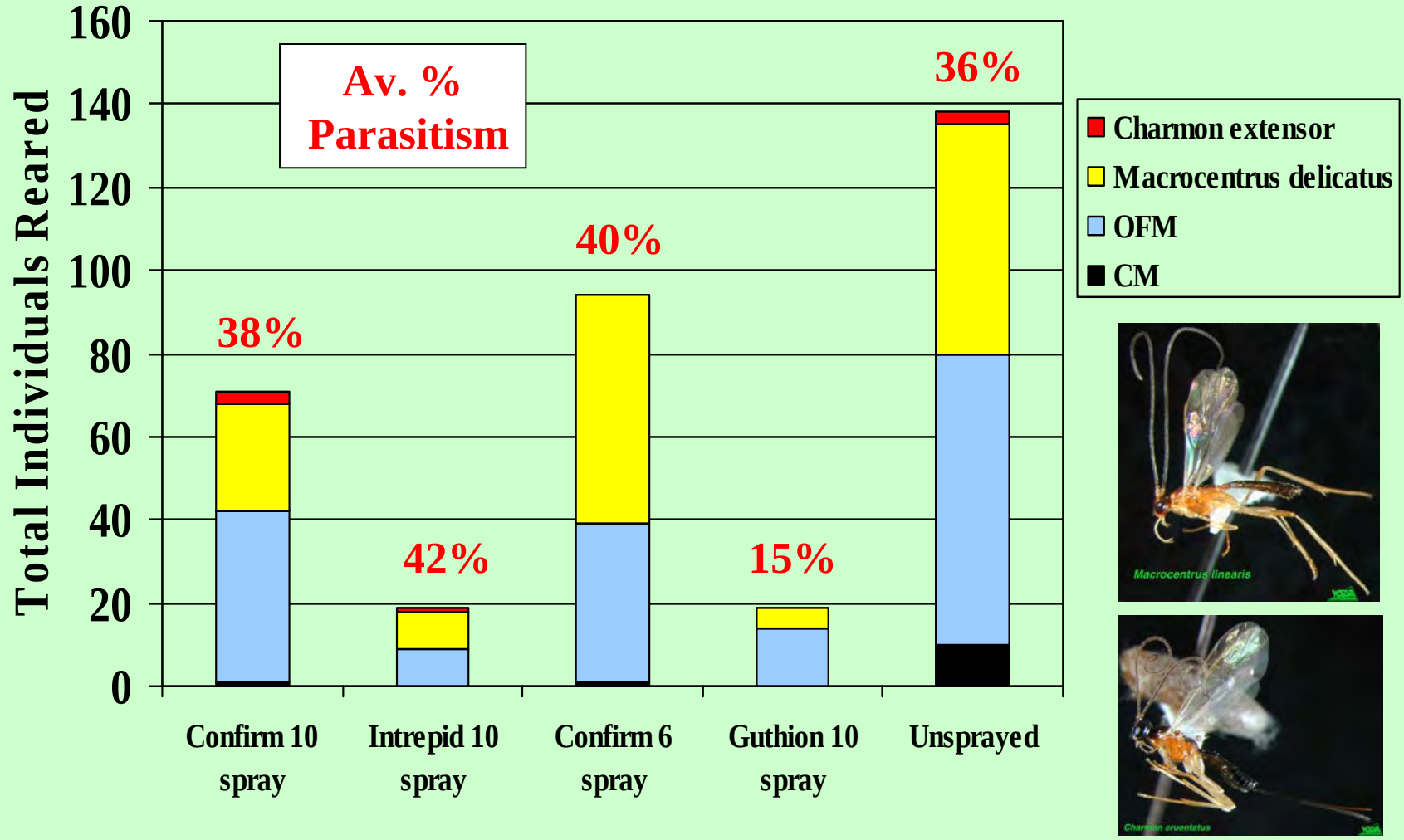

DJB 2005

Conservation & Augmentation of the Predatory Mite, *T. pyri*, in Pennsylvani Apple Orchards

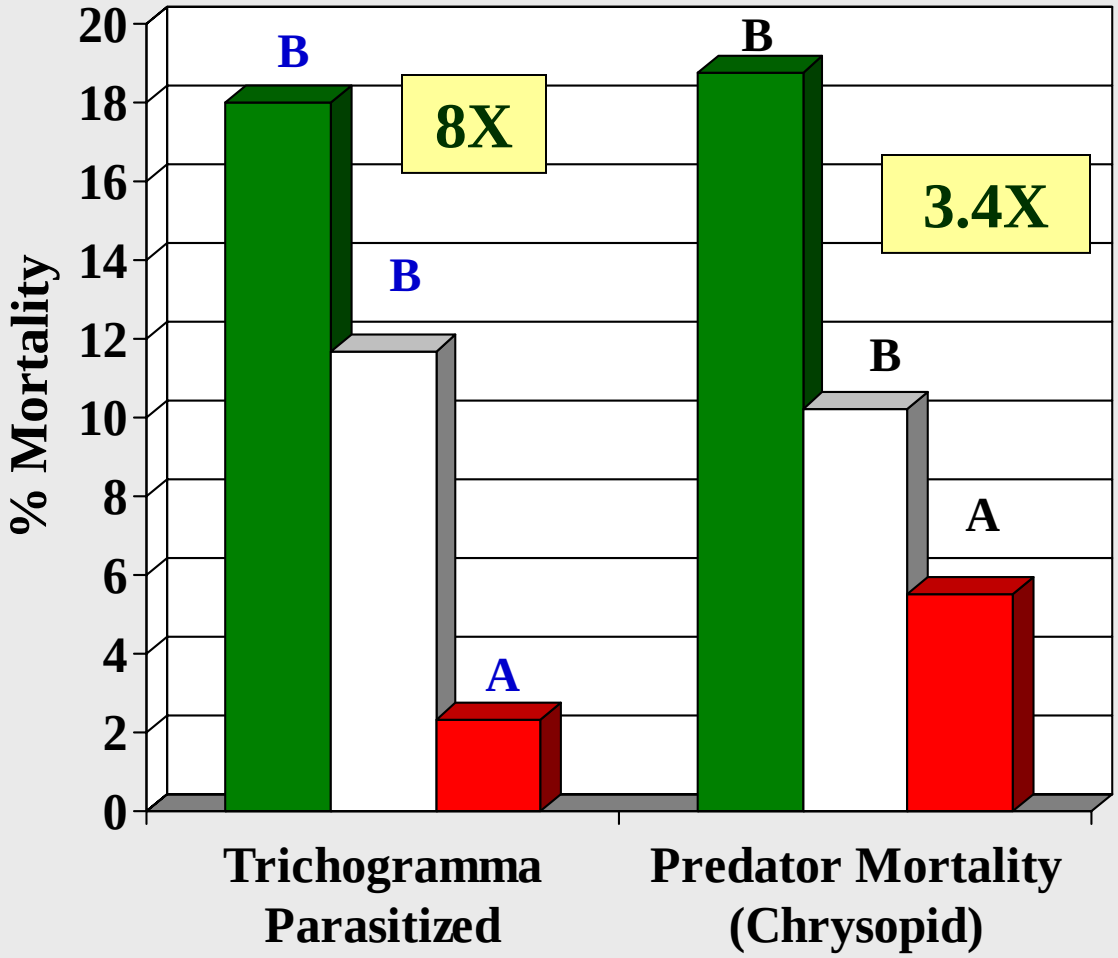
PARASITOIDS

Confirm & Intrepid Internal Lep Spray Trials In Apple

Hull & Biddinger & Hull 1994



Mortality of Sentinel Leafroller Egg Masses To *Trichogramma* In 2003 Apple Ramp Trials



Reduced Risk (RAMP)
Untreated
Grower Standard

*Replicated 4 times by orchard location and over 2 different dates: (8/15 & 8/20/03. A total of 128 TABM/OBLR egg masses were placed in each treatment.

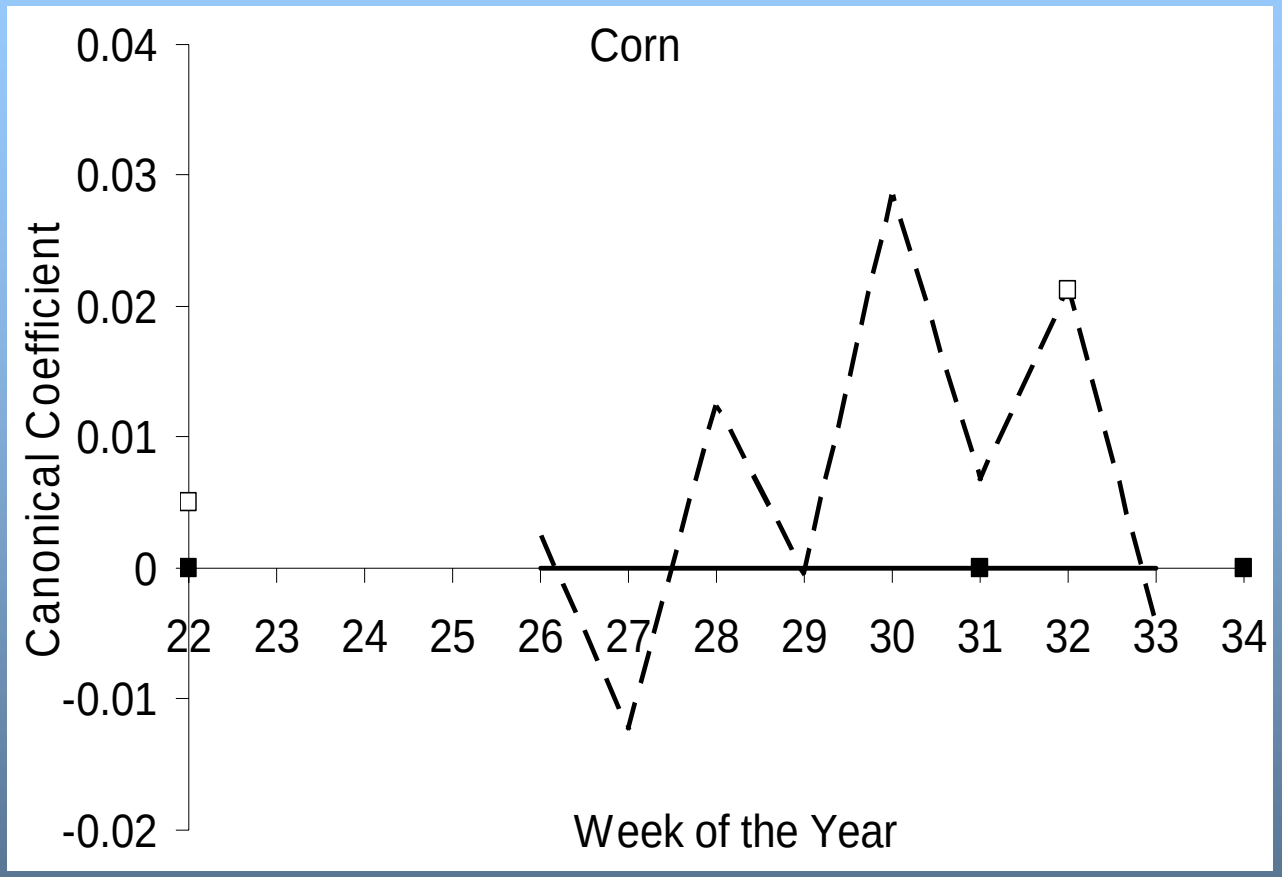
Biodiversity Assessment In Agro-Ecosystems

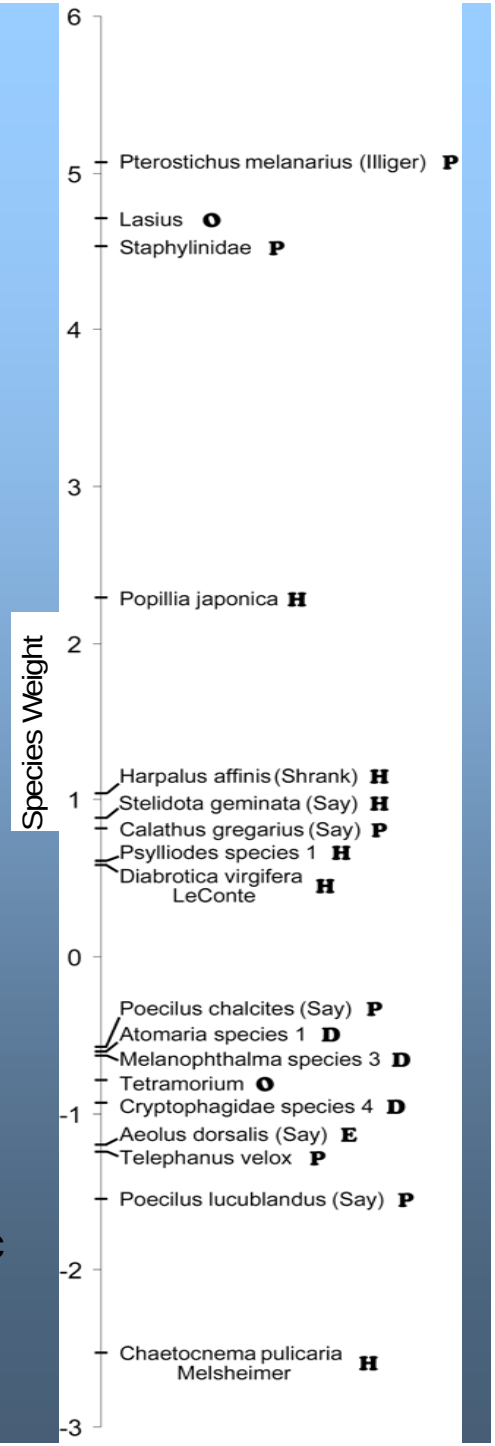
- **In general, much simpler systems w/ fewer plant & animal species than natural systems.**
  - **Pest and beneficial species often better known than in natural systems – non-targets??**
  - **Provides a baseline for future assessment of changes brought about by future IPM practices.**
  - **Always changing with different pesticides use patterns, cultural controls, cultivars, and introduction of exotic pest species.**

Ecotoxicology of Trangenic Maize in Northeastern Agroecosystems

S. Fleischer, C. Mullin, D. Biddinger & P. Blum

Community Analysis



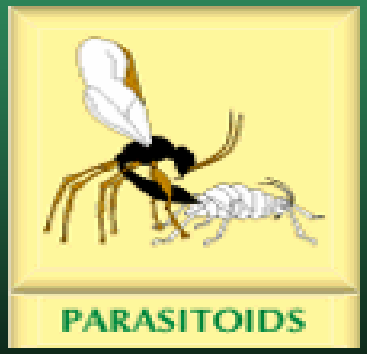


Isoline — **Insecticide Treatment on Isoline**

Transgenic — **Insecticide Treatment on Transgenic**

P = predator, H = herbivore, D = detritivore, O = omnivore

Biological Control & Indicator Species



Parasitic Hymenoptera

Ground Beetles

Ants

Spiders

PA RAMP Peach Ecotoxicology –2002

- 5 RAMP sites and 4 standards sampled 6 times from June-August.
- 10 trees sampled from each block. A sample collected from the canopy of each tree & from ground cover adjacent to tree.
- Ramp – 5 sites x 6 dates x 10 trees x 2 samples/tree = 600 samples.
- Standard -_4 sites x 6 dates x 10 trees x 2 samples/tree = 480 samples.
- 1,080 vials!

RAMP Peach Ecotoxicology –2002

Seasonal Average of Non-Target Insects/Site (+/- SE)

Treatment	*A. aphidimyza* adults	Spiders	Ants	Ichneumonoidea	Chalcidoidea	Lacewings
RAMP	51.4 (20.0)	23.0 (5.1)	40.6 (13.6)	15.4 (3.6)	9.2 (1.9)	6.8 (2.7)
Standard	34.5 (17.4)	12.3 (3.3)	12.0 (5.5)	4.5 (0.9)	4.5 (1.9)	2.0 (0.9)
	1.5X	1.9X*	3.4X*	3.4X *	2.1X*	3.4X*

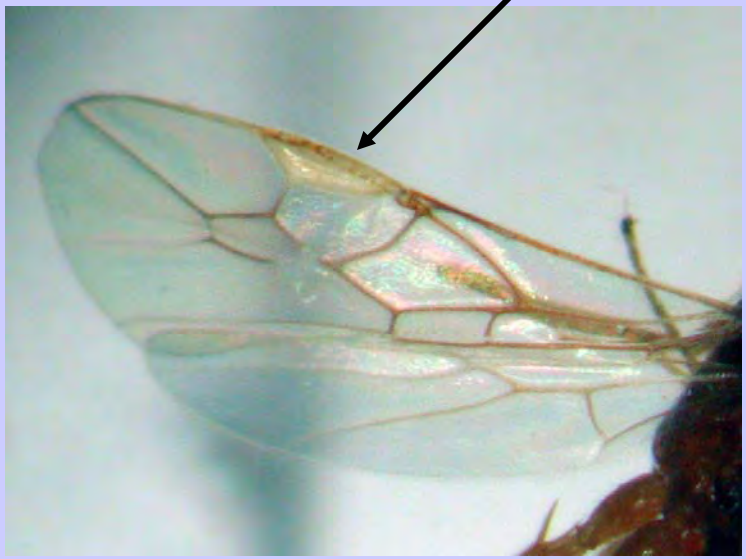
***Increase of 2-3 fold in first season.**

DJB-03

Macrocentrus ancylivorus vs. *Macrocentrus delicatus*

Stigma not uniformly pale yellow

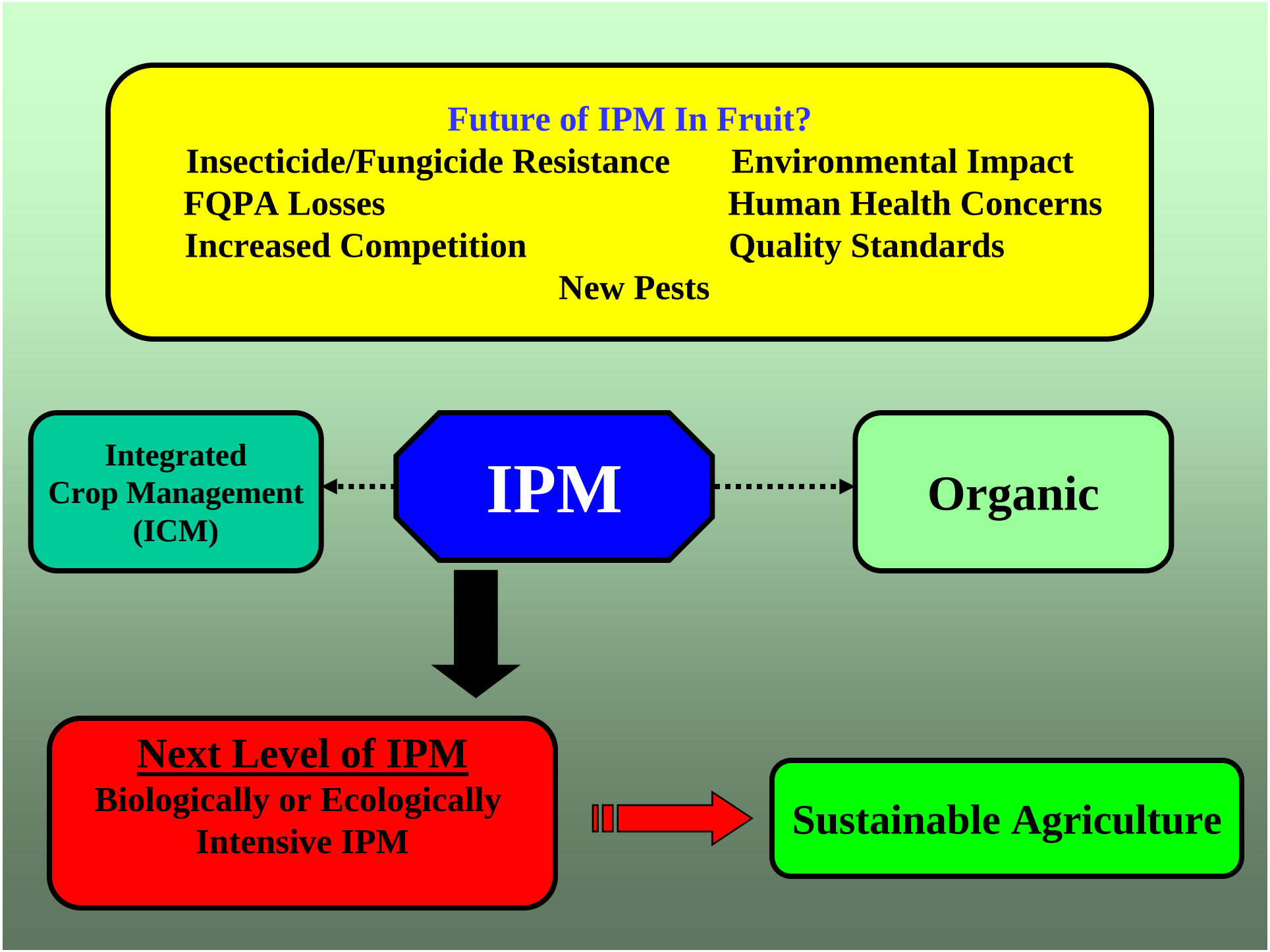
Stigma uniformly pale yellow



Ascogaster quadridentata

Colpoclypeus florus - Eulophidae

- New larval ecto-parasitoid of leafrollers in Pennsylvania.
- Introduced into Canada in 1968, disappeared until about 13 years ago to show up in WA.
- Found in MI, NY & PA in the last 2-3 years.
- Very effective in controlling OBLR & TABM.
- Susceptible to most insecticides.


Future of IPM In Fruit?
Insecticide/Fungicide Resistance
Environmental Impact
FQPA Losses
Human Health Concerns
Increased Competition
Quality Standards
New Pests
Integrated Crop Management (ICM)
IPM
Organic
Next Level of IPM
Biologically or Ecologically Intensive IPM
Sustainable Agriculture