

Fifth Annual PUR Workgroup

Do Pesticide Use Trends Determine the Potential for Biological Control?

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**Funding: California Department of Food & Agriculture
Office of Pesticide Consultation & Analysis**



Concept

Biological Control is one of the founding principles of Integrated Pest Management

Belief

If more *Biological Controls* are used
than less *Insecticides* will be used

Question

Is there greater use of *Biological Controls*?
If not, what prevents greater adoption?

Study

“Biological Control of Arthropod Pests in California Agriculture: Current Status and Future Potential.”

Goals

- (1) Identify historical, current, and future role of bio-control for key commodities.**
- (2) Identify barriers and opportunities for greater implementation of bio-control.**

Three Parts to Study

Part I. Social & Political Economics

- (a) Bio-control use in light of current trends in commodity policy & economics.**
- (b) Bio-control practice, extension & research as conducted by institutions.**
- (c) Bio-control potential as a commercial practice (insectaries, PCAs, chemicals).**

I. Economics: Almond Research



I. Economics: Citrus Research



I. Economics: Lettuce Research

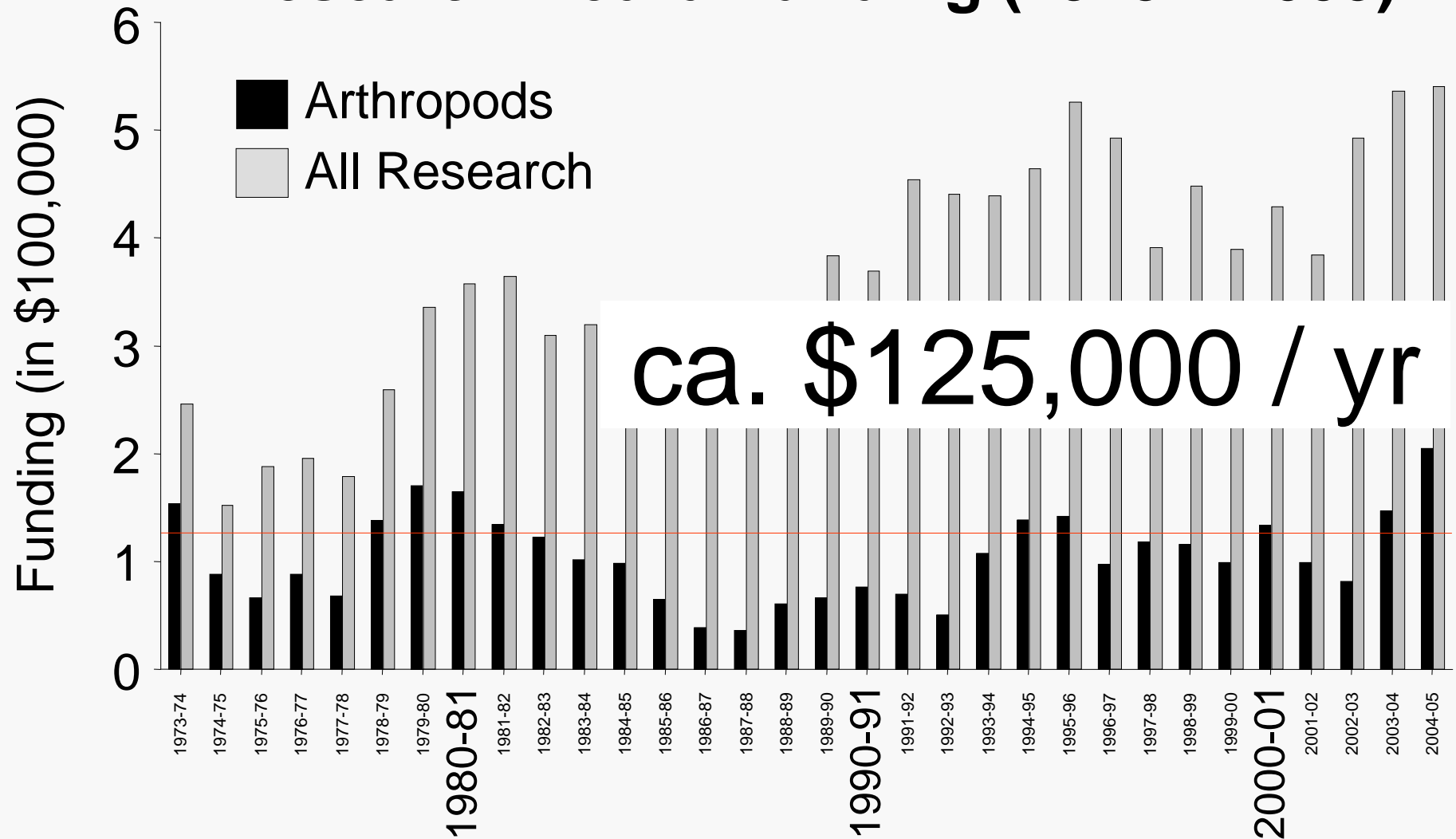


I. Economics: Tomato Research



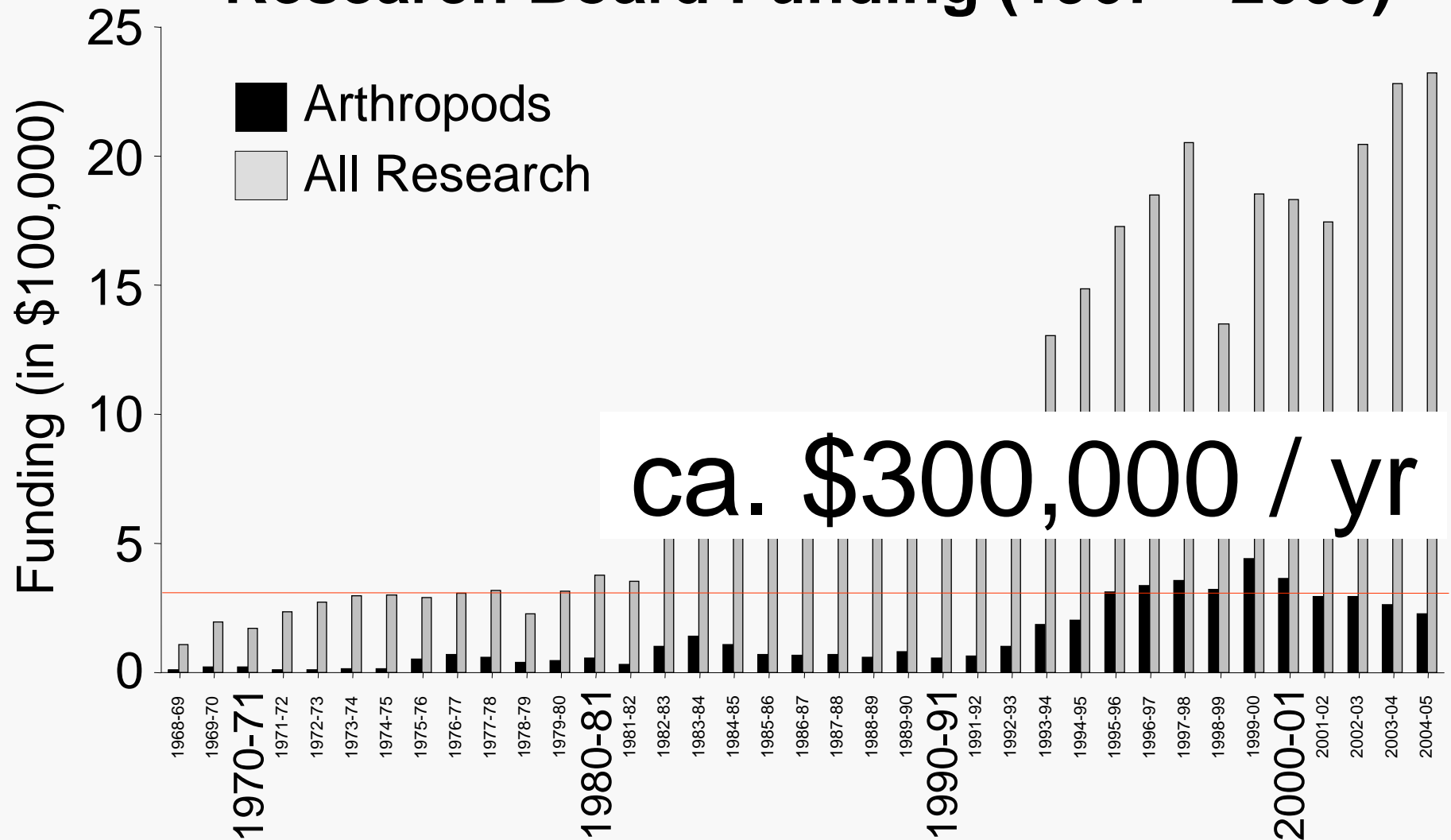
ALMOND

Research Board Funding (1973 – 2005)



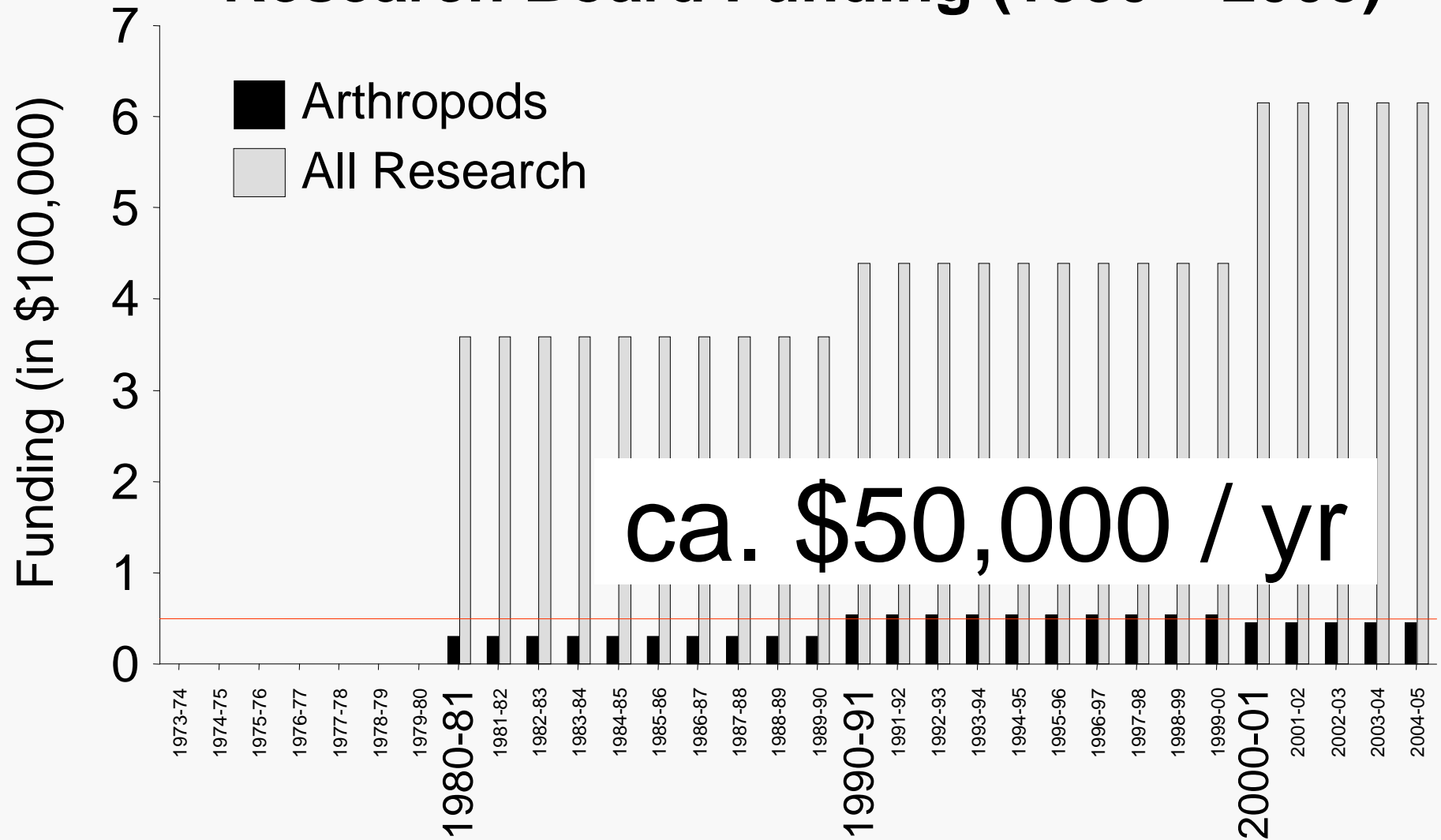
CITRUS

Research Board Funding (1967 – 2005)



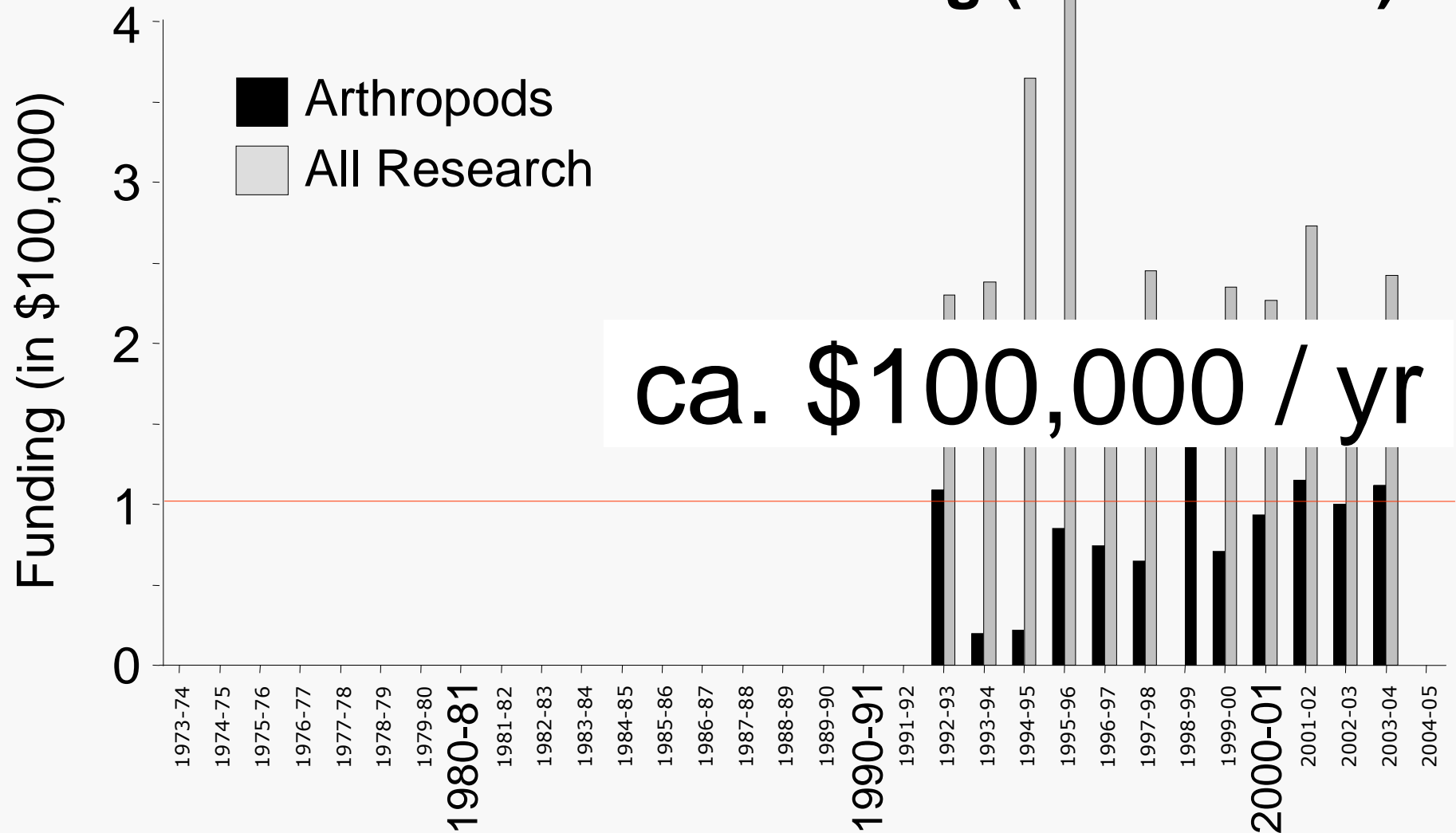
LETTUCE

Research Board Funding (1980 – 2005)

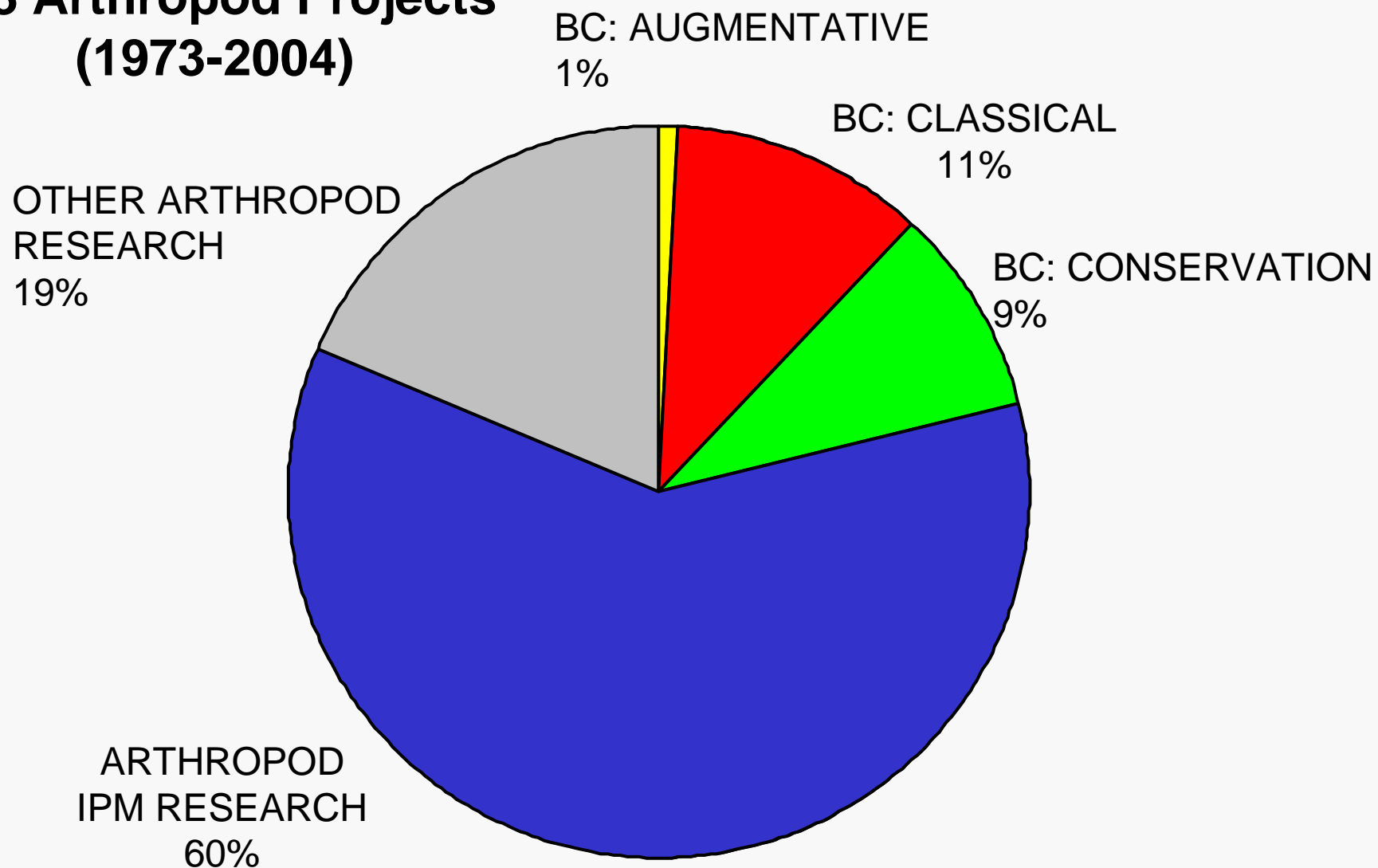


TOMATO

Research Board Funding (1992 – 2004)

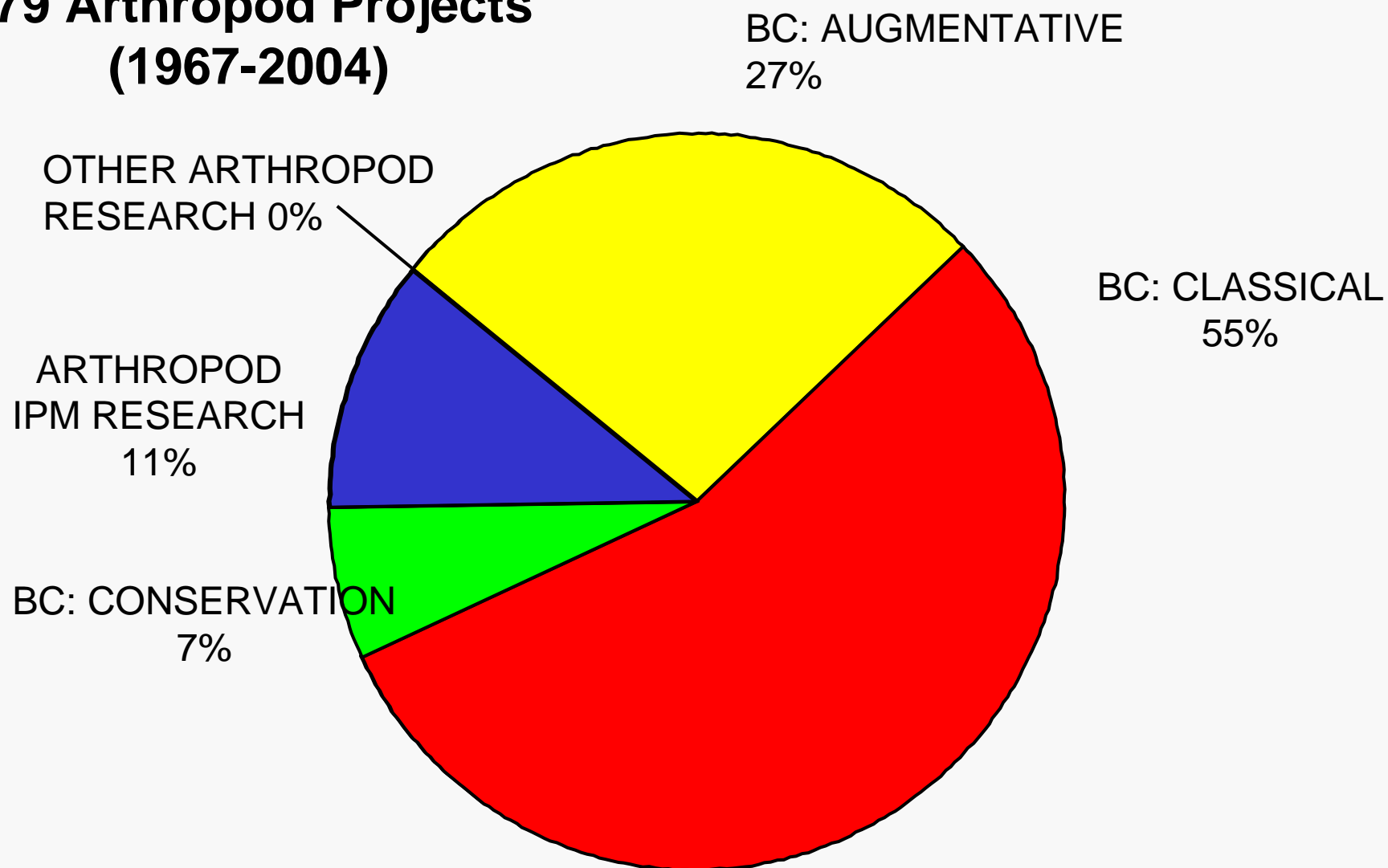


ALMOND
208 Arthropod Projects
(1973-2004)

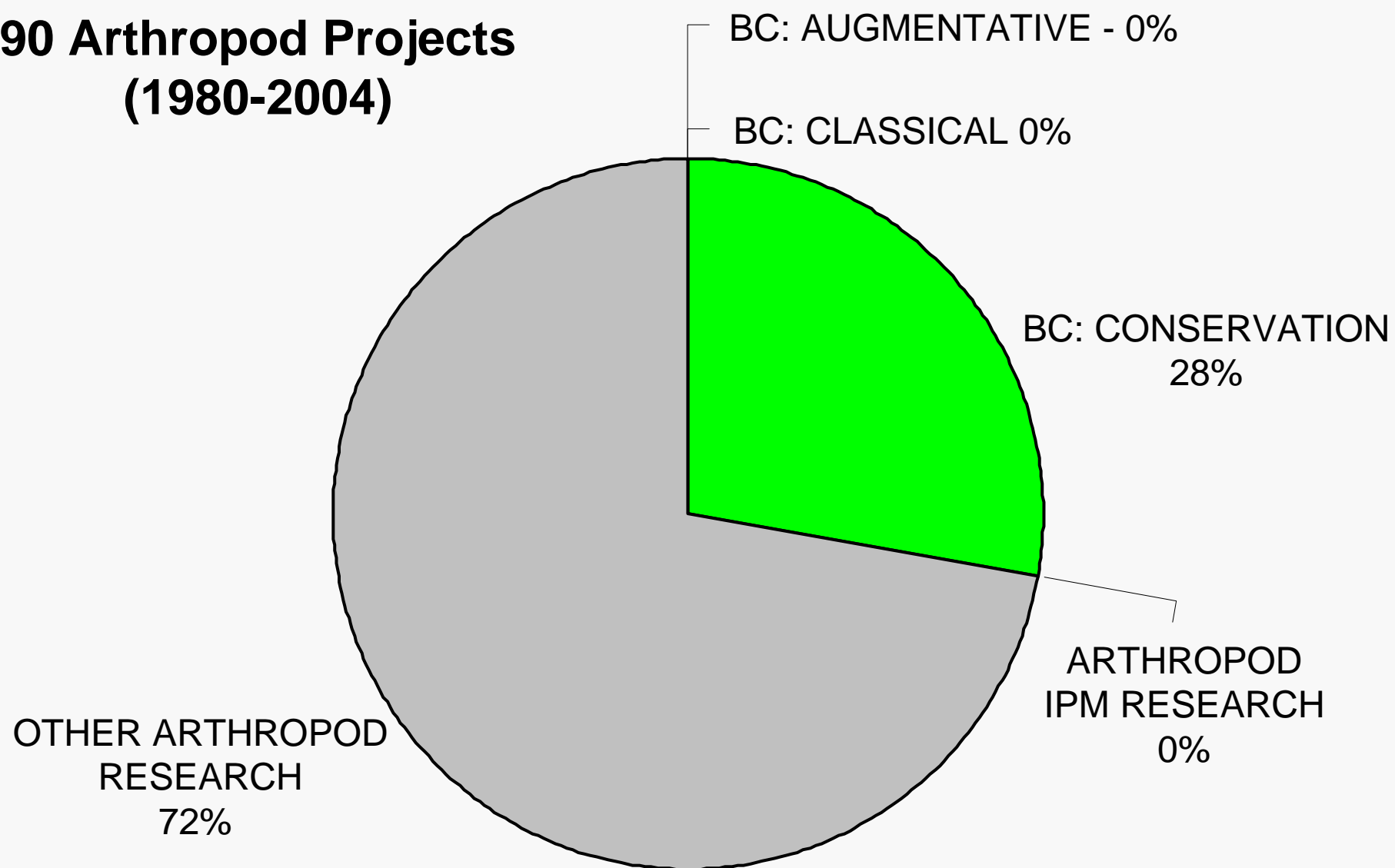


CITRUS

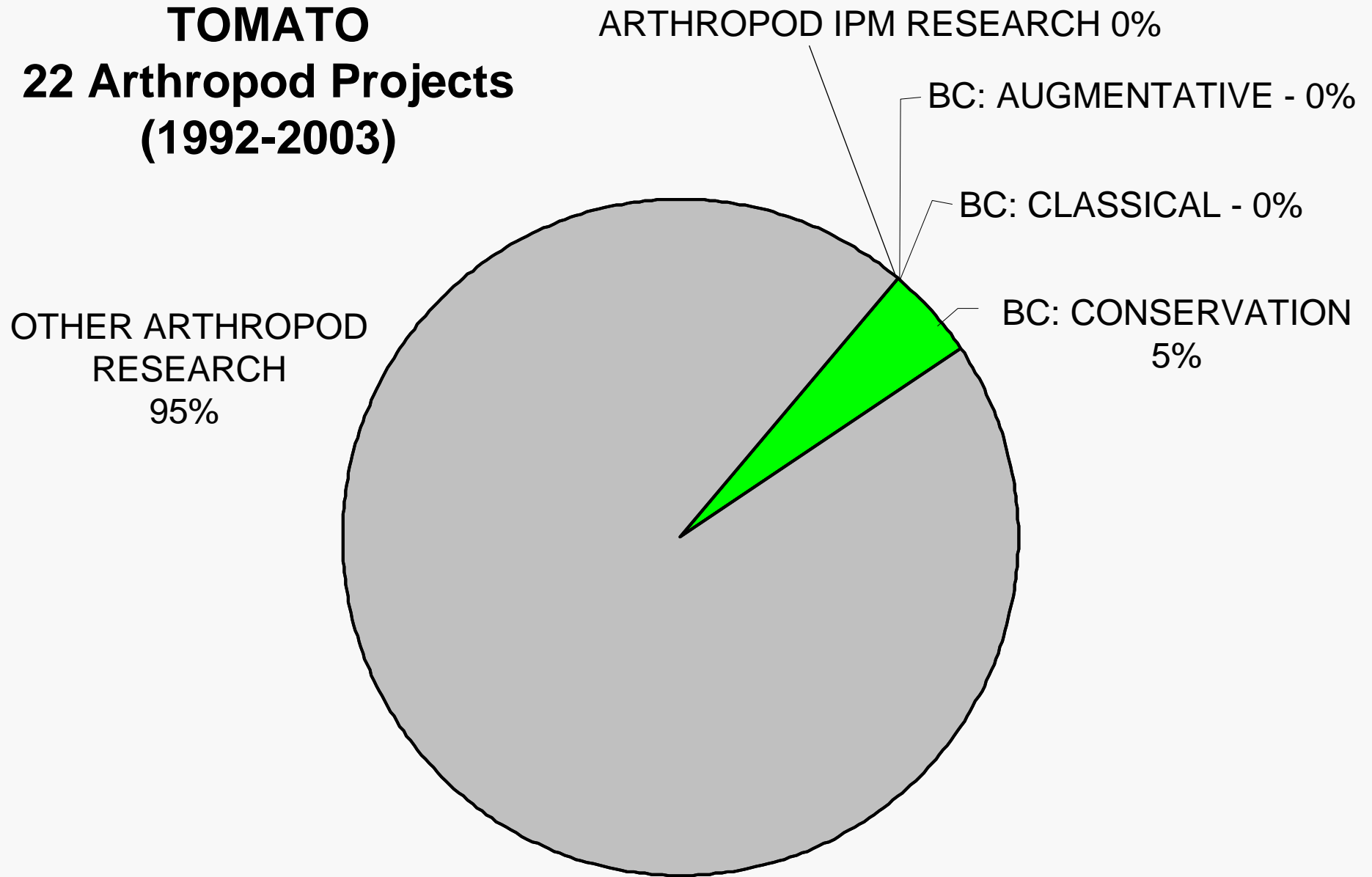
179 Arthropod Projects (1967-2004)



LETTUCE
90 Arthropod Projects
(1980-2004)



TOMATO
22 Arthropod Projects
(1992-2003)

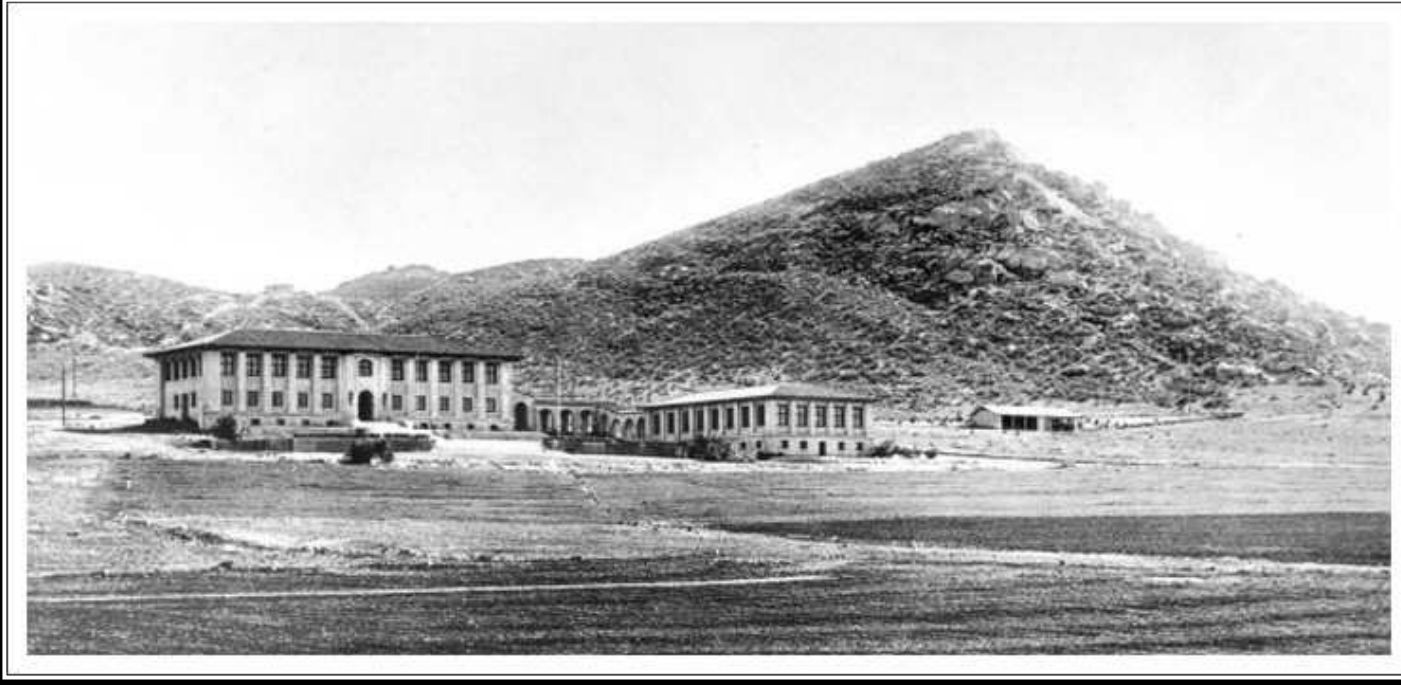


I. Economics: Institutional Support



I. Economics: Institutional Support

Citrus Experimental Station
Riverside, CA circa 1914

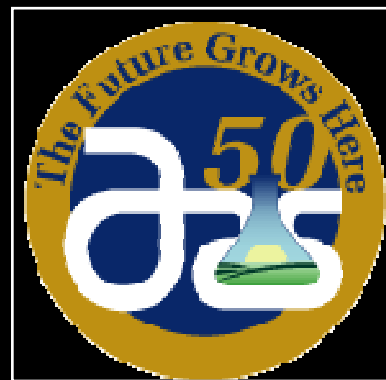
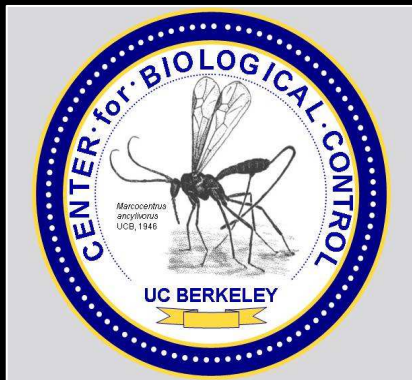
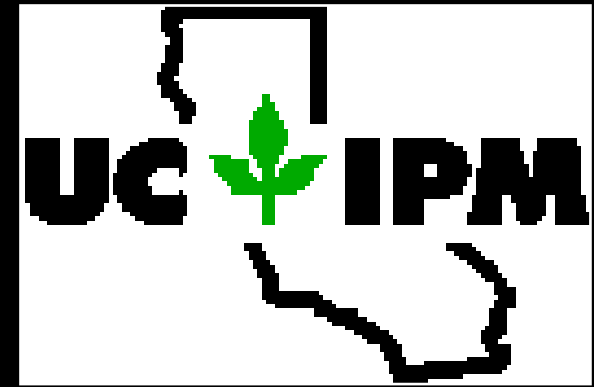


Citrus industry threatened
by Cottony Cushion scale

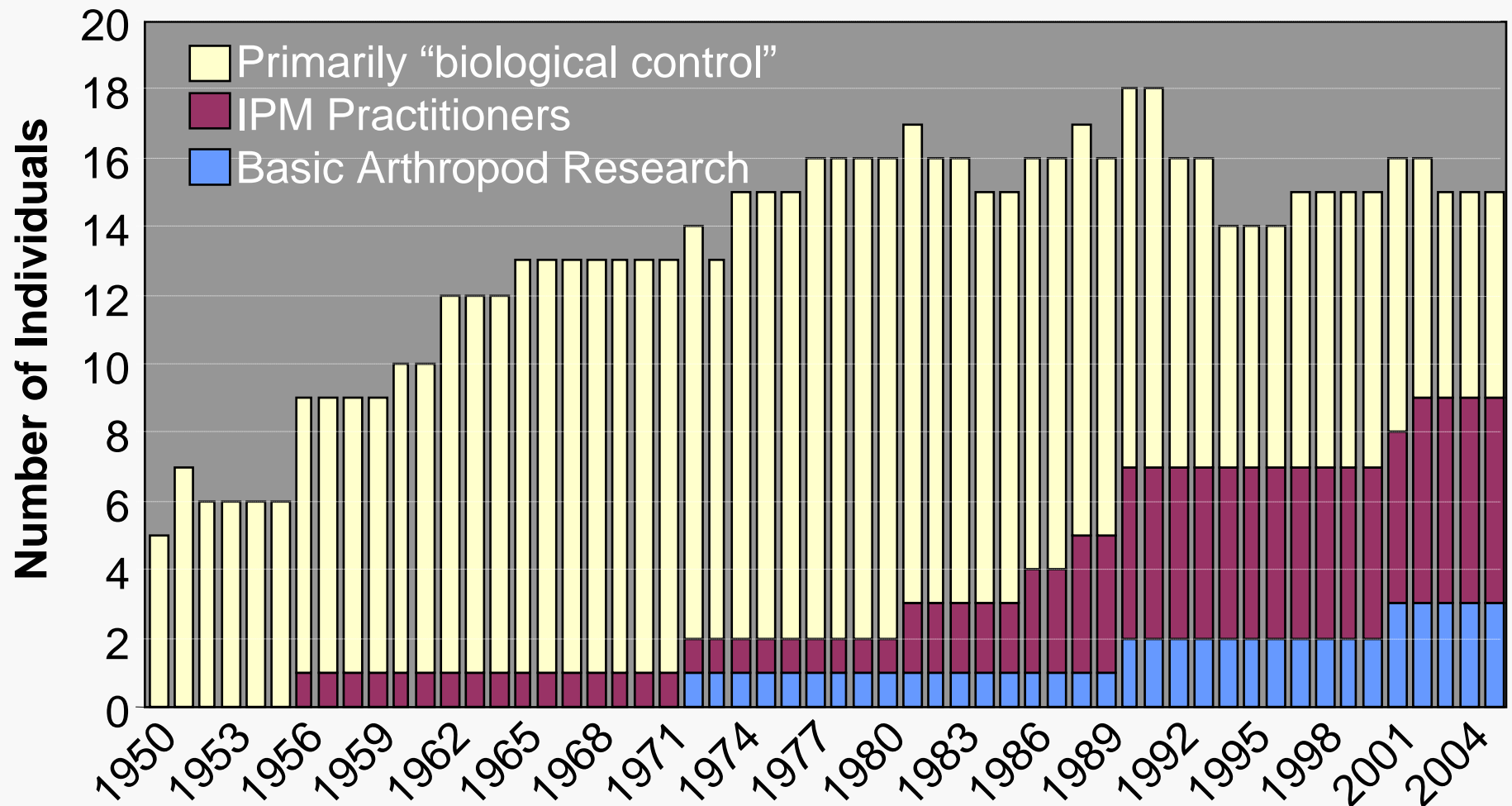


Vedalia beetle. C. Riley (USDA) sent A. Koebele (USDA) and citrus growers to Australia in 1988-89 (\$1,500). Project shows importance of joint efforts and institutional funding

I. Economics: Institutional Support



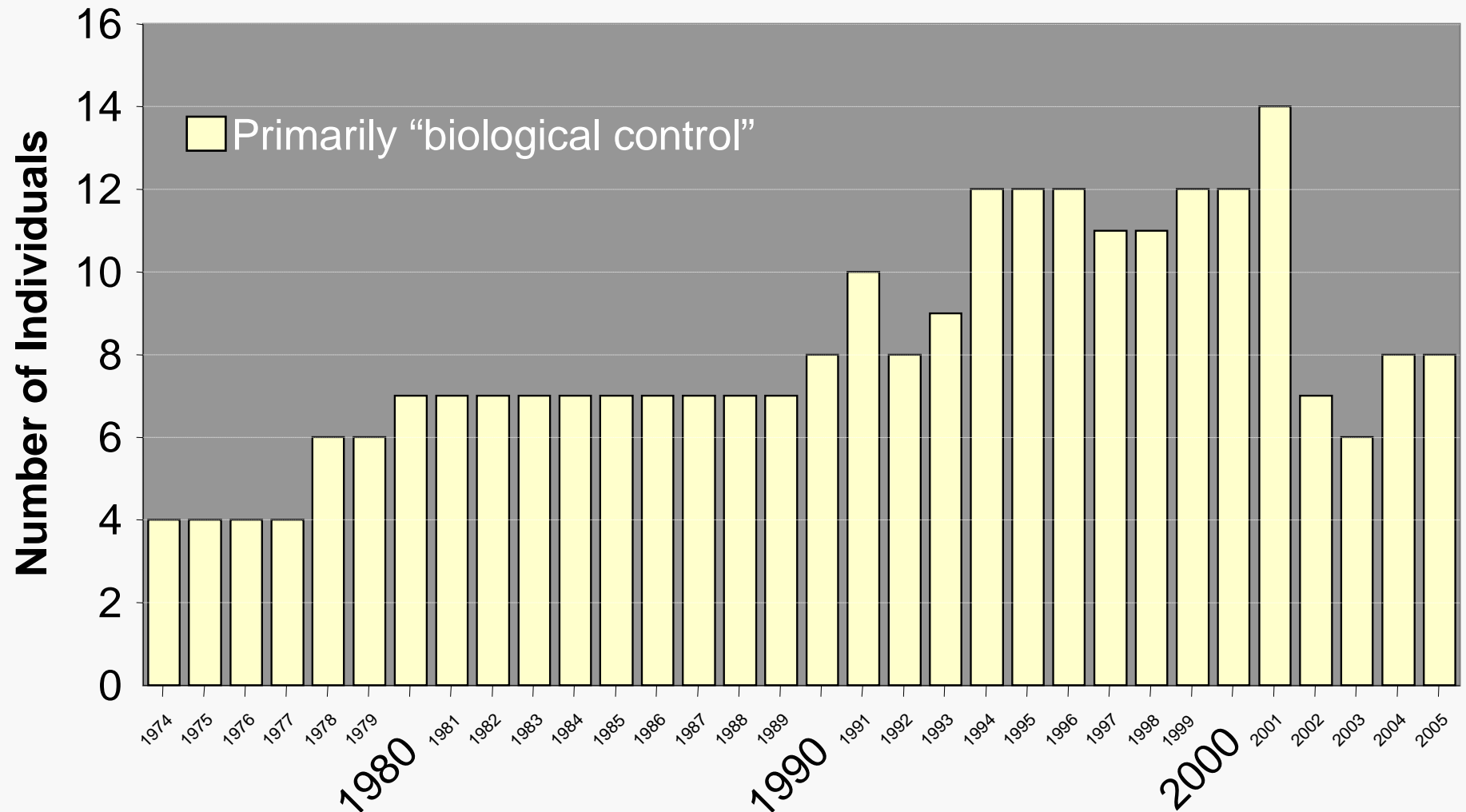
UC Riverside “Department of Entomology” “Bio-Control” Faculty (1950 – 2005)



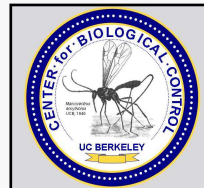
Very Subjective Categorization – who decides what is BioControl or Who Qualifies as 100%
 BC: Hired specifically for biocontrol research. Classical BC is program thrust.; PM: Faculty with applied BC output, but emphasis on IPM.;
 Basic: Faculty working on fundamental biological control issues. Long-term applications.

CDFA's "Biological Control Program"

"Bio-Control" Faculty (1975 – 2005)



I. Economics: Initial Summary

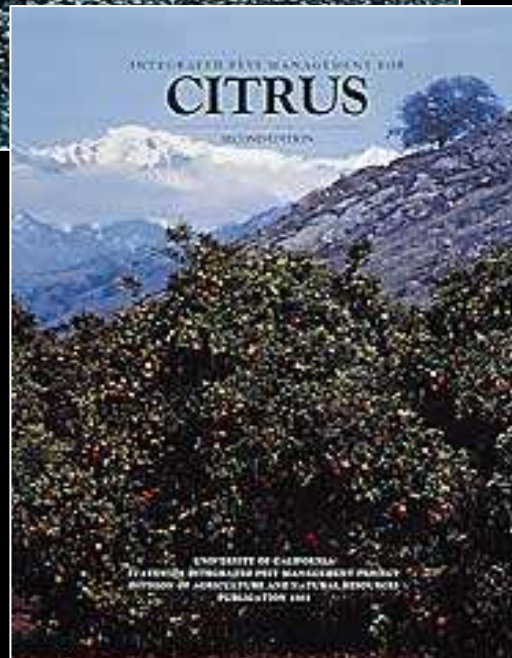
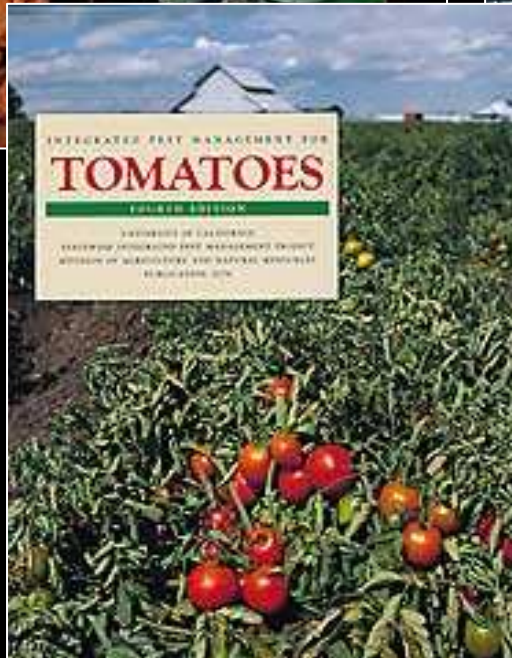
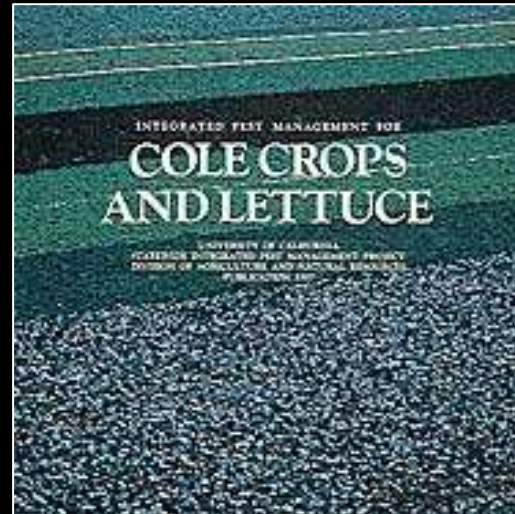
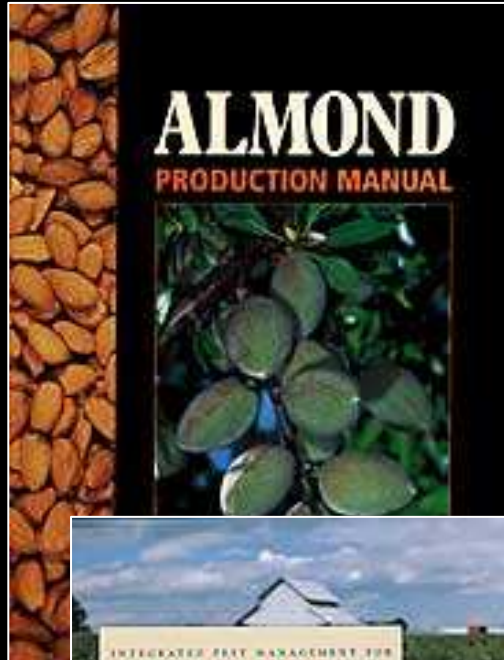


Three Parts to Study

Part II. Bio-Control *Theory & Practice*

- (a) Description of past and current bio-control and IPM in key California crop systems**
- (b) Verify actual practice and effect of bio-control in commercial crop systems.**
- (c) Determine what factors limit or promote bio-control in each crop system.**

II. Bio-Control *Theory & Practice*



How often are
bio-controls
used? Is the
advice correct?

II. Bio-Control Theory & Practice

(a) *Catalog* past and current efforts in key crop systems
(literature review) and then verify their use and effectiveness

Perennial

Annual

Other

Pear / Apple

Broccoli

Alfalfa

Almond

Lettuce

Glasshouse

Citrus

Rice

Grape

Tomato

Stone Fruit

Walnuts



Insecticide use impact on bio-control

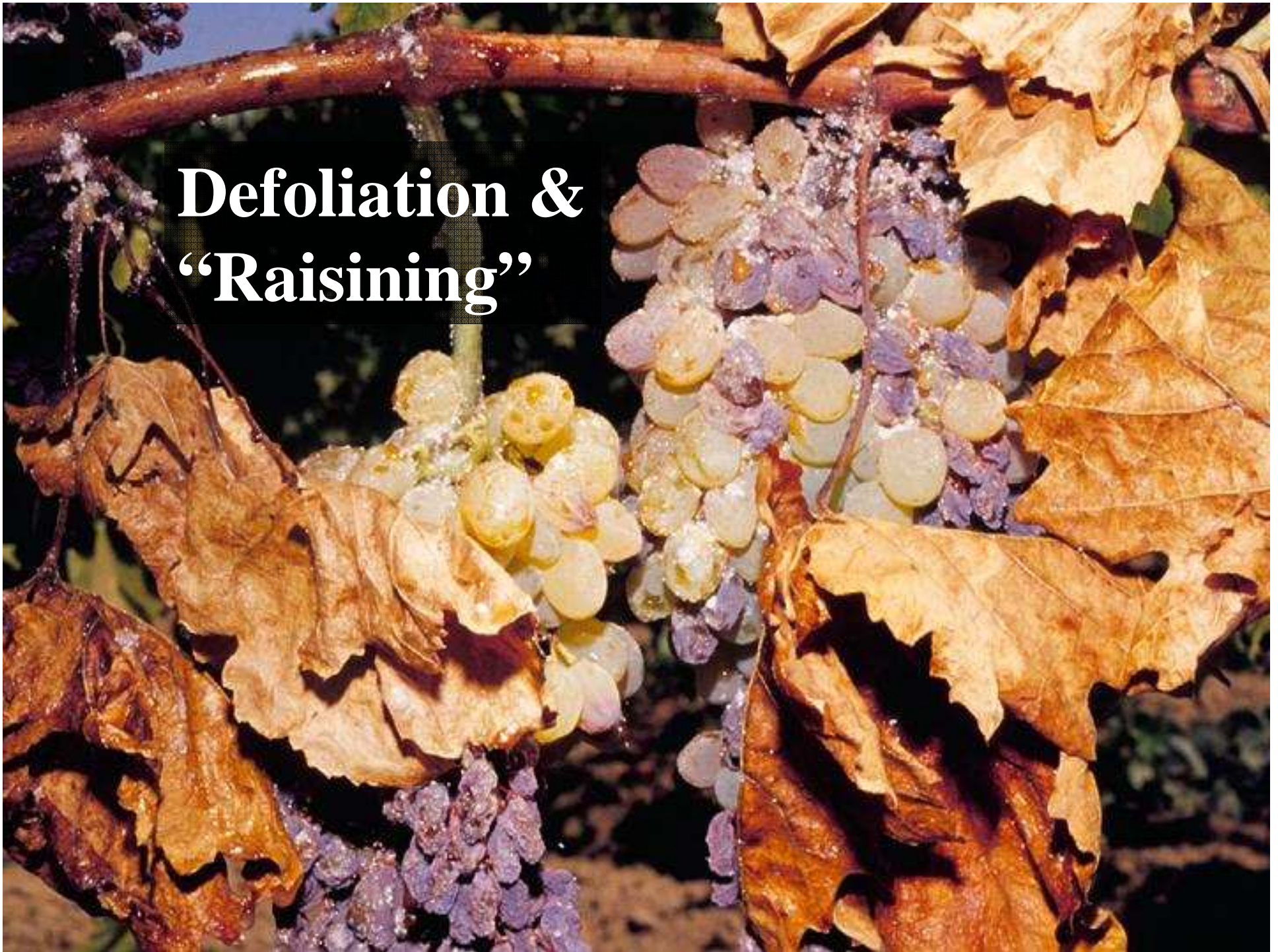
-or-

Insect pests impact insecticide use

**Vine mealybug –
an invasive species**



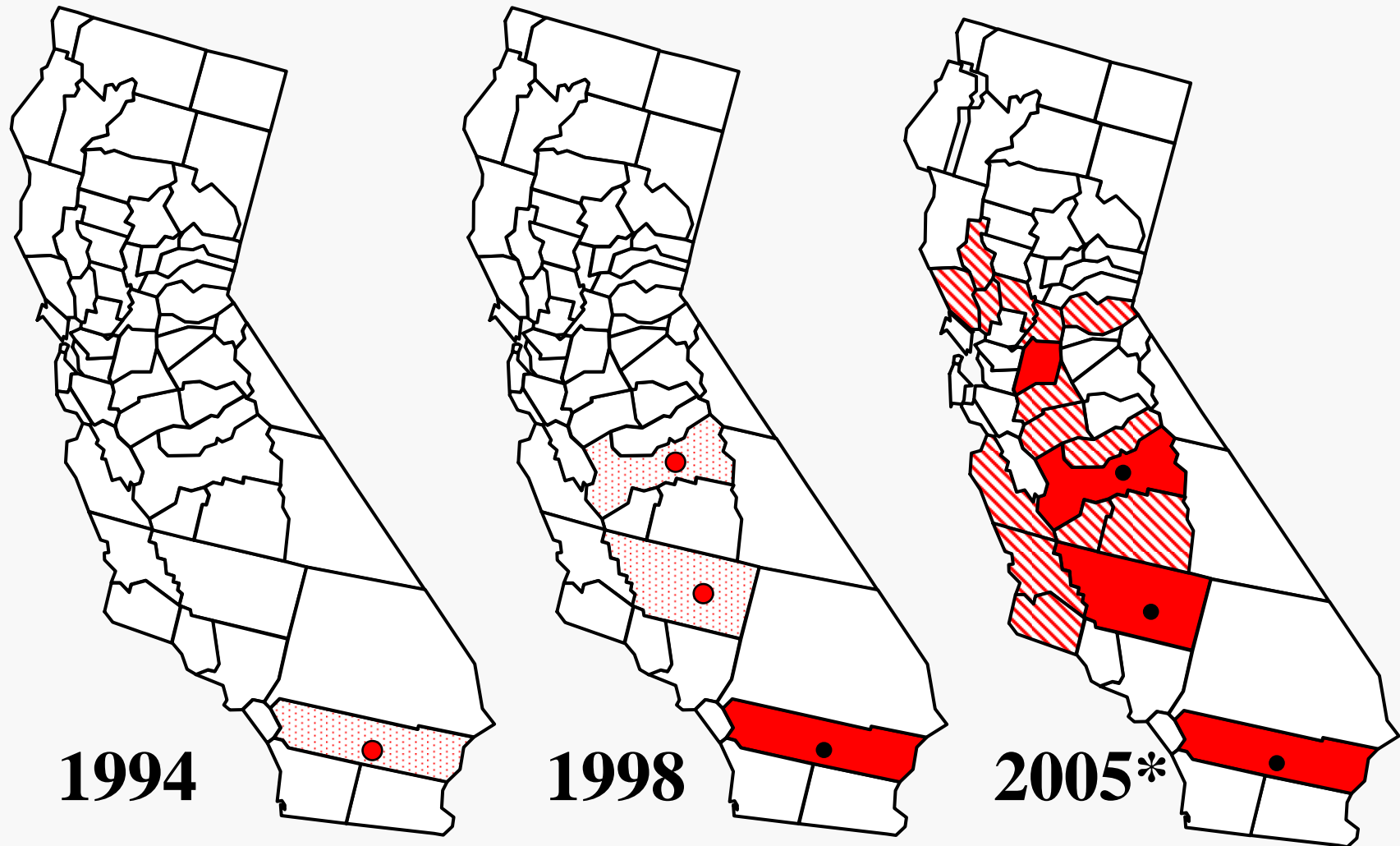
Defoliation & “Raisining”



Dispersal Mechanisms



Rapid Spread as an Invasive Species



* Distribution changes rapidly because of new/unreported finds

Applications of chlorpyrifos (OP) will increase from 2000-2006

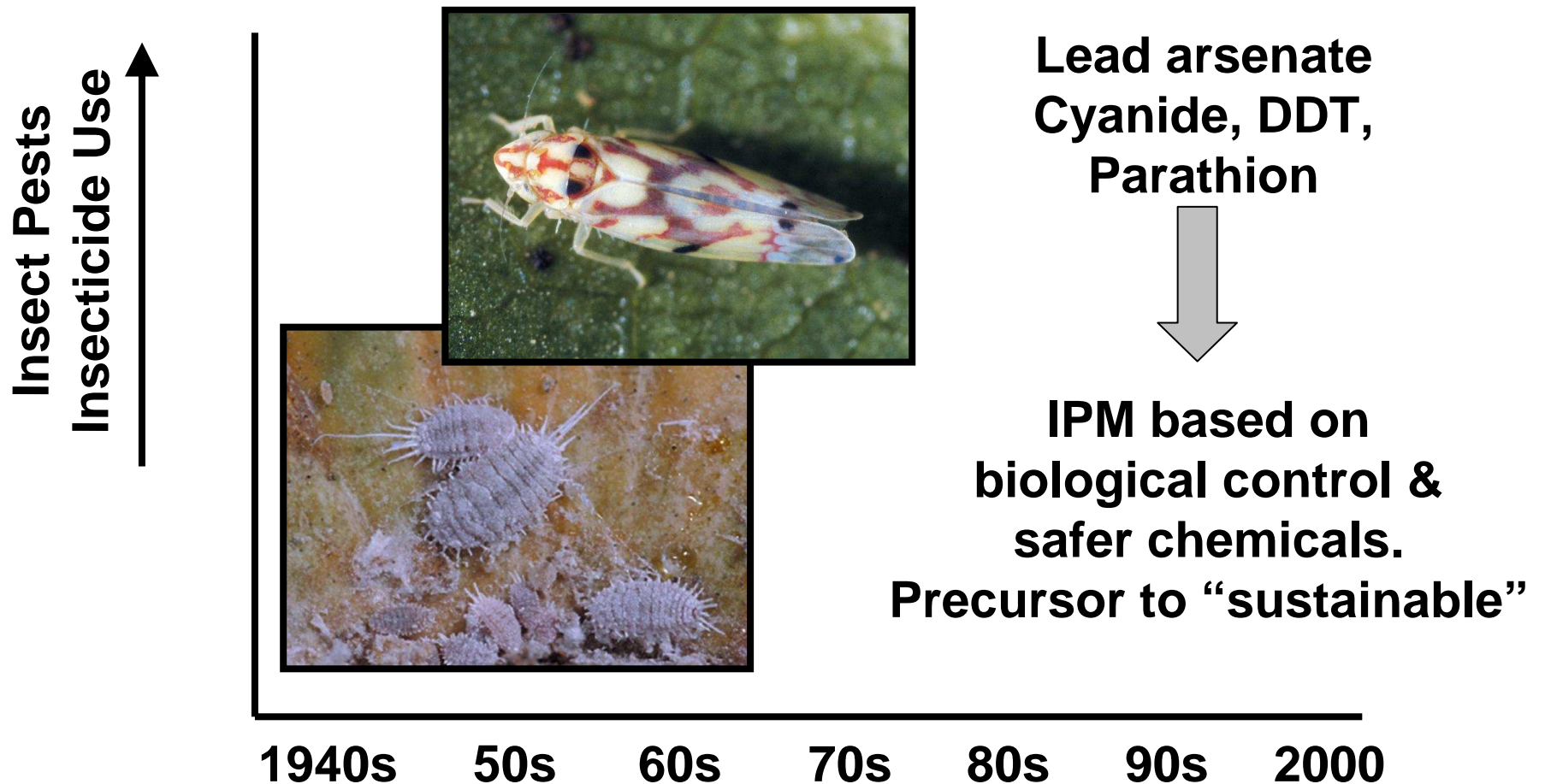
Q1) What is the impact of invasive species on pesticide use?

Q2) How does grape commodity & location impact pesticide use?

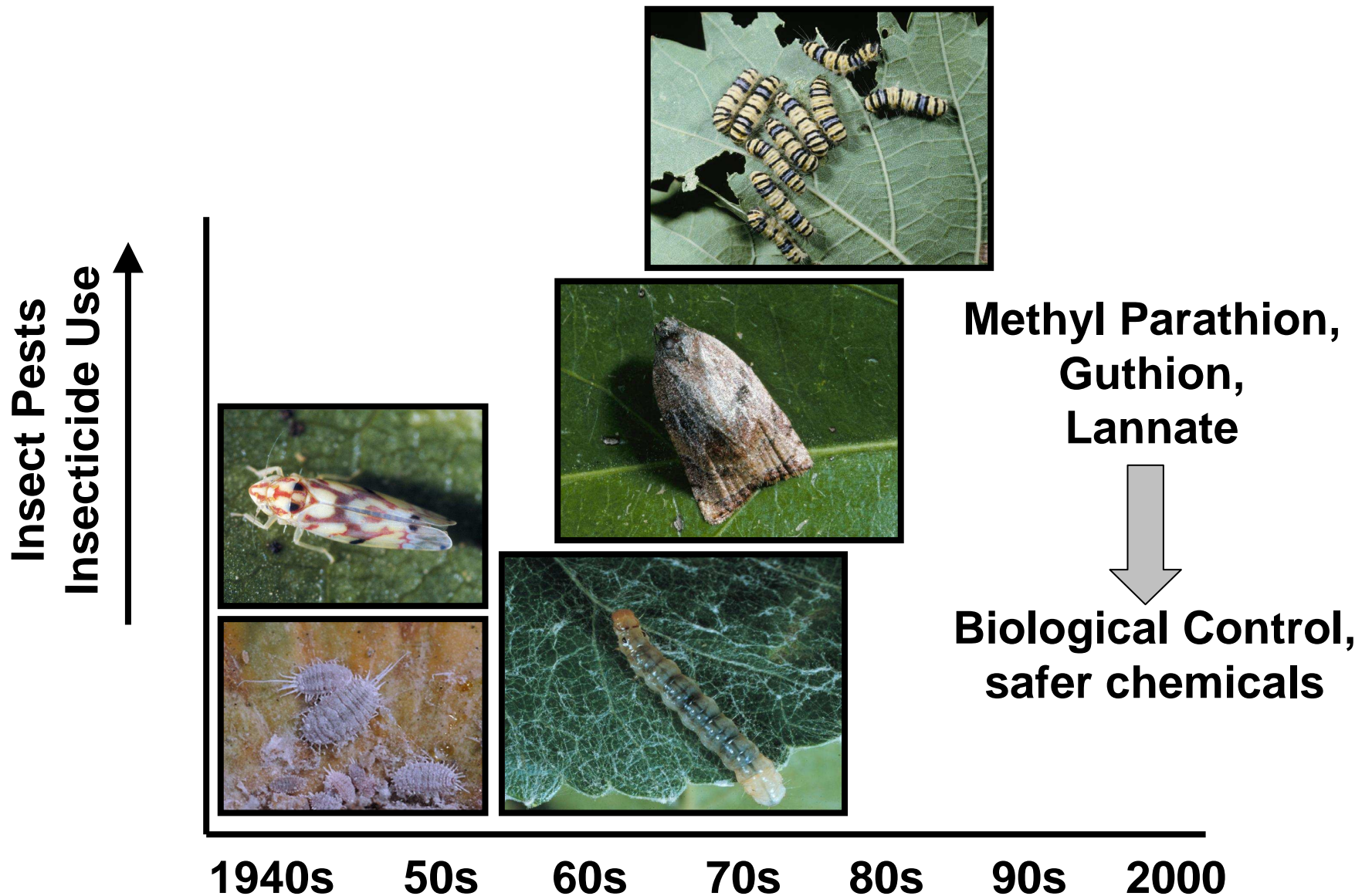


How have invasive species impacted Sustainable Viticulture?

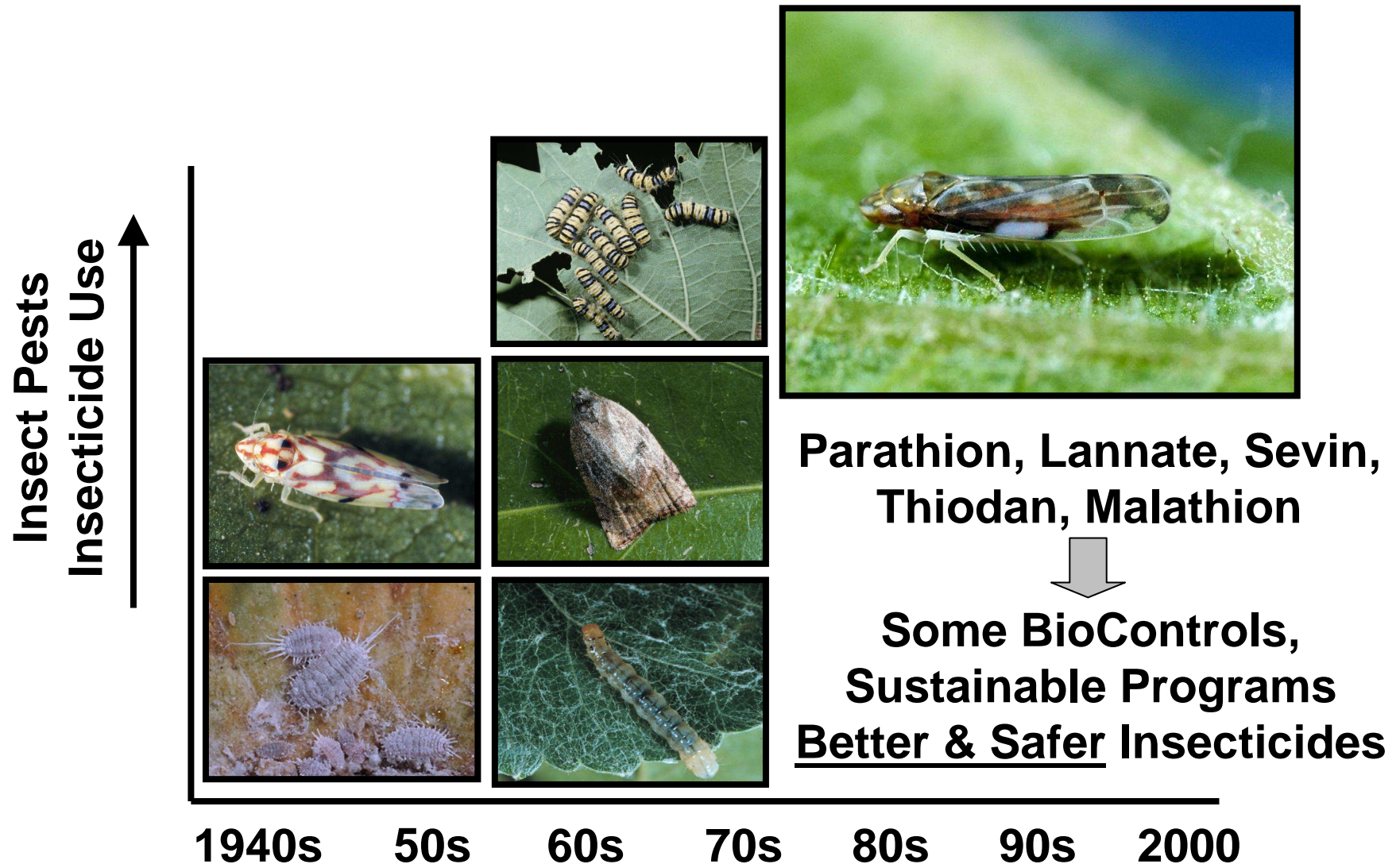
Are growers even using IPM and Sustainable practices?



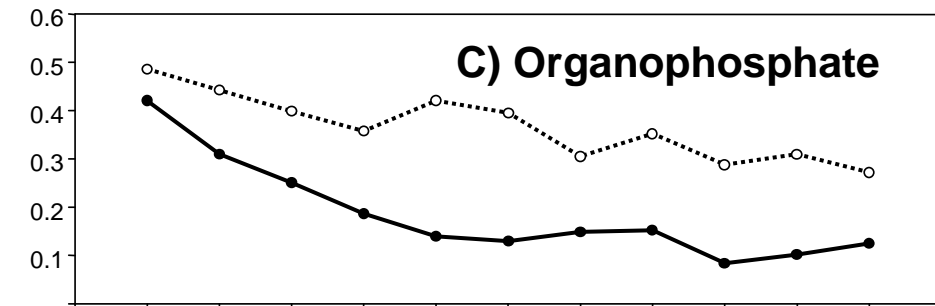
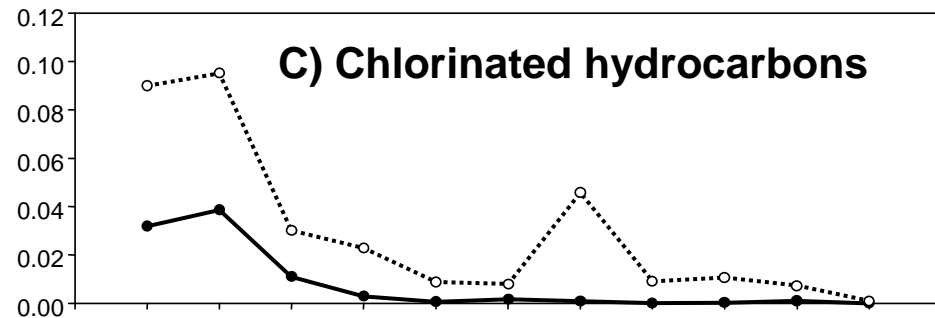
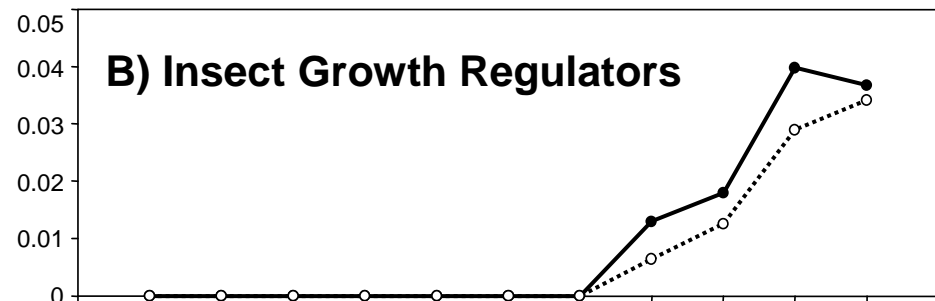
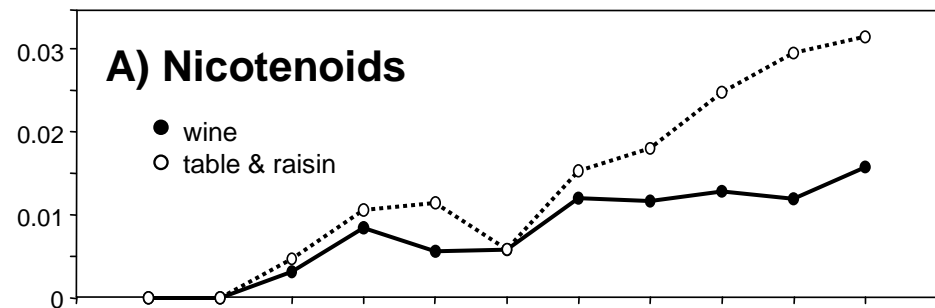
There has been a steady increase in insect pests and a clear response in the development of more sustainable IPM programs



With each new insect pest, there is an initial increase in the use of “hard” insecticides, followed by scientifically-based development of better, more sustainable IPM programs



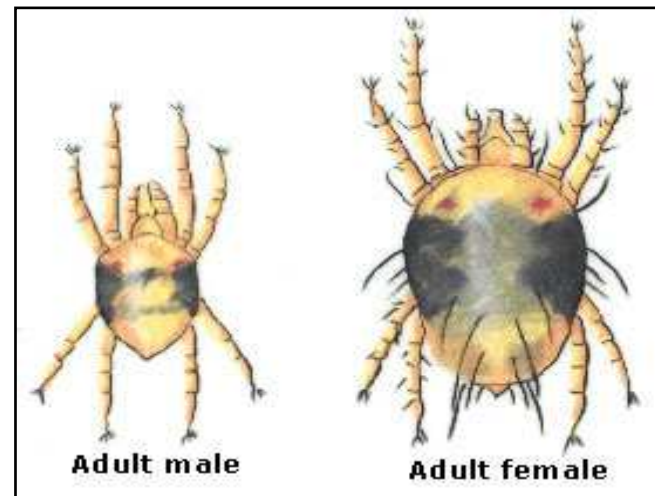
Pounds (a.i.) / acre



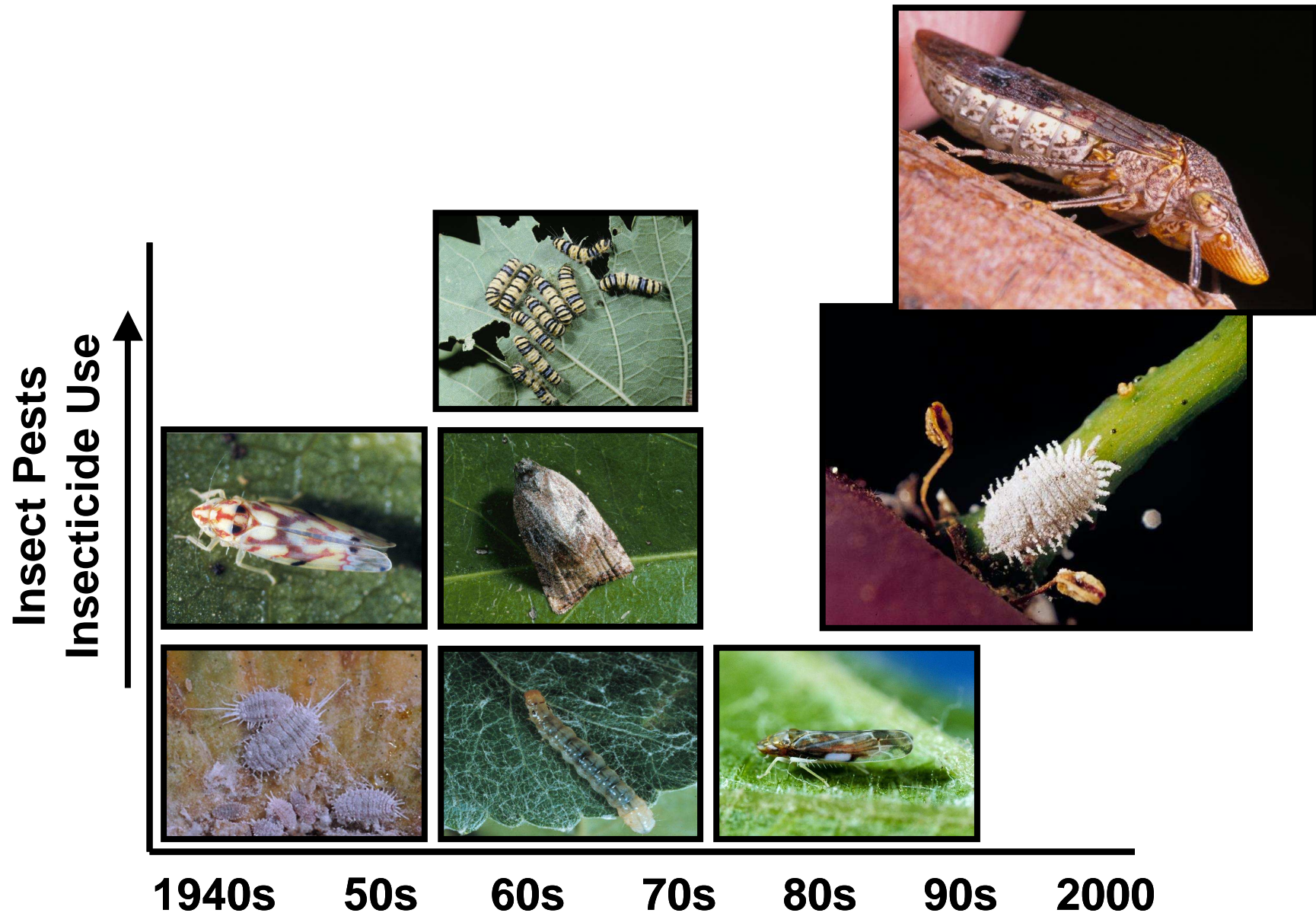
1992

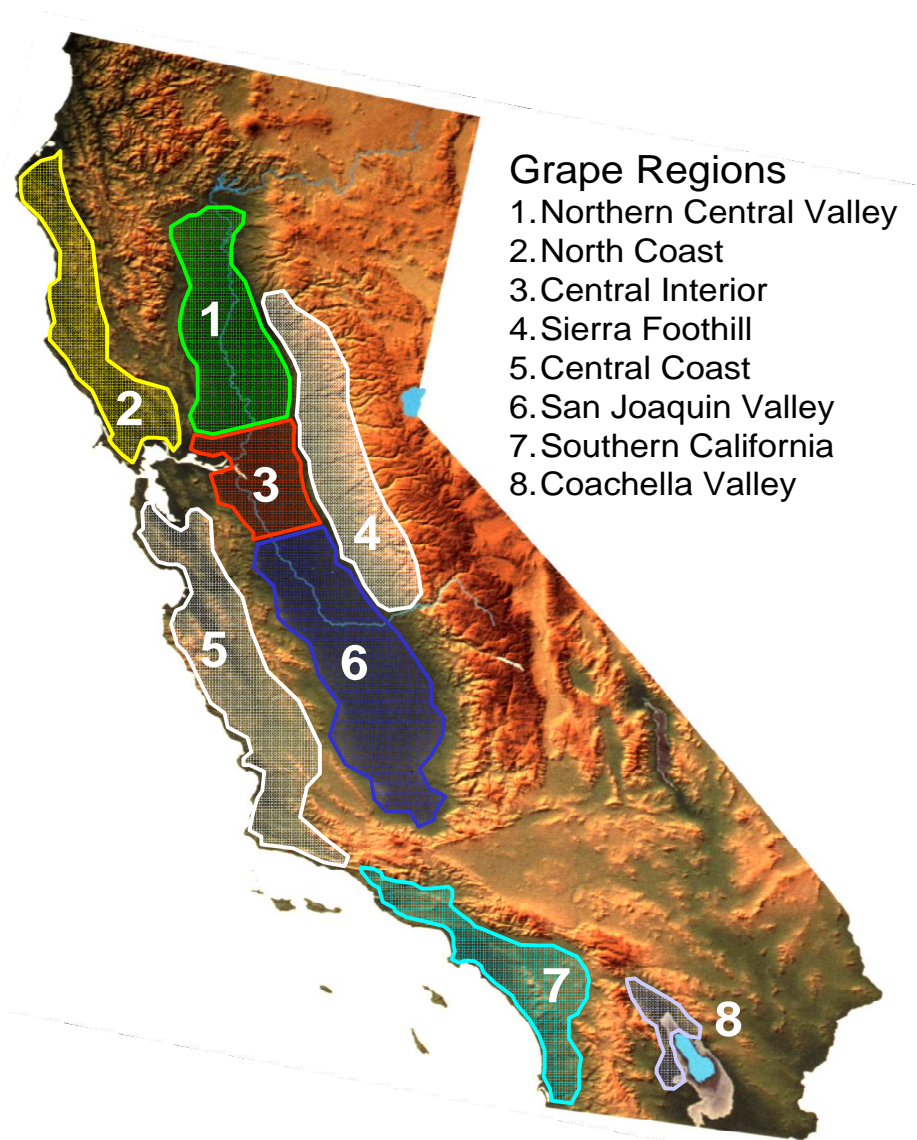
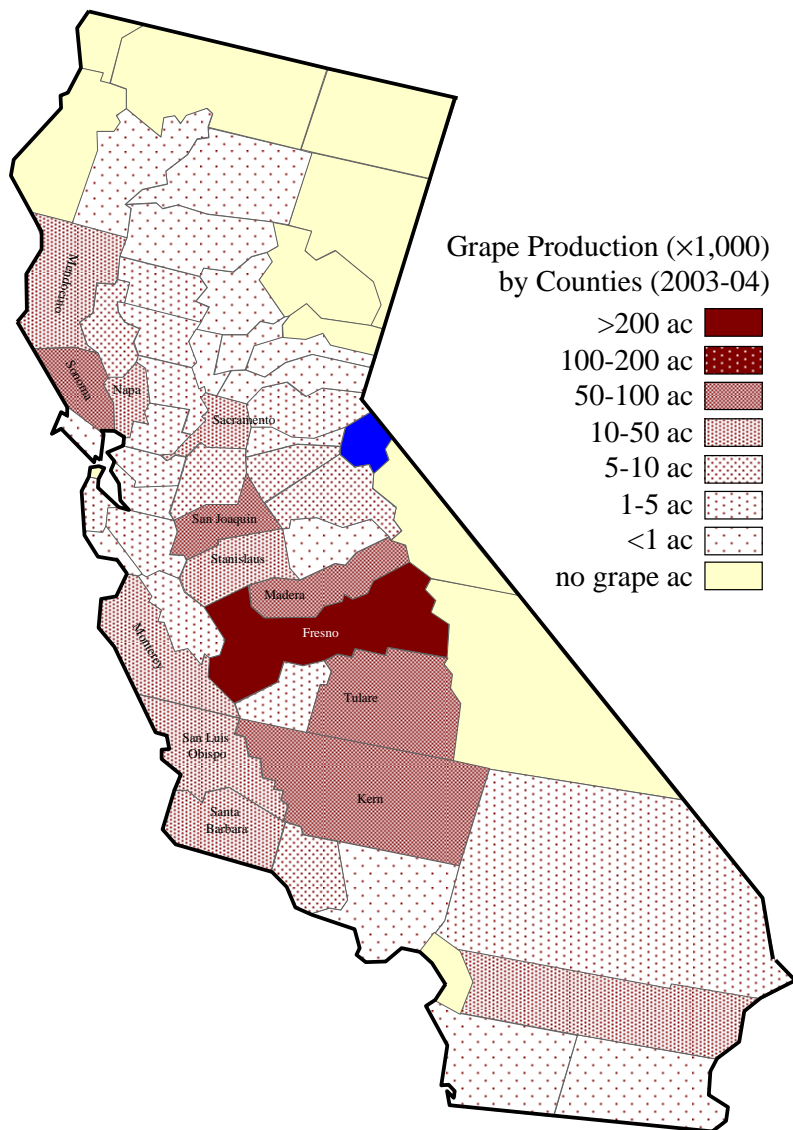
2003

Insecticide replacement
reduced pests, improved
chances for bio-controls

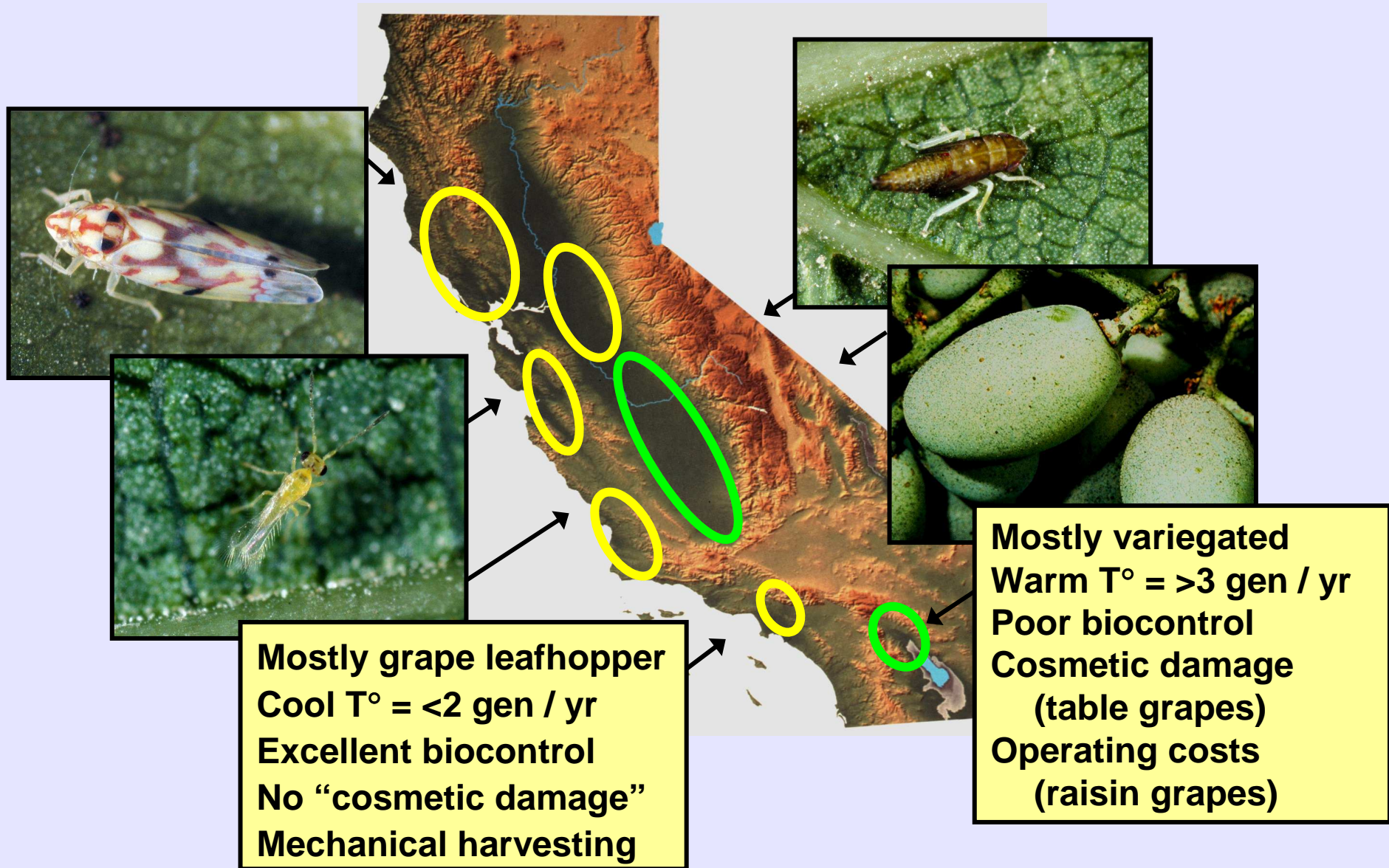


Invasive Species, Grape Commodity and Region?





Cash Values, Cultural Practices & Pest Problems



Liquid Ant Bait vs. Chlorpyrifos for Ant Control

**Argentine ant -
very strong impact on
natural enemies**



***Formica perpilosa*
very strong impact on
natural enemies and
VMB location!**



**Gray ant &
southern fire ant
moderate impact**



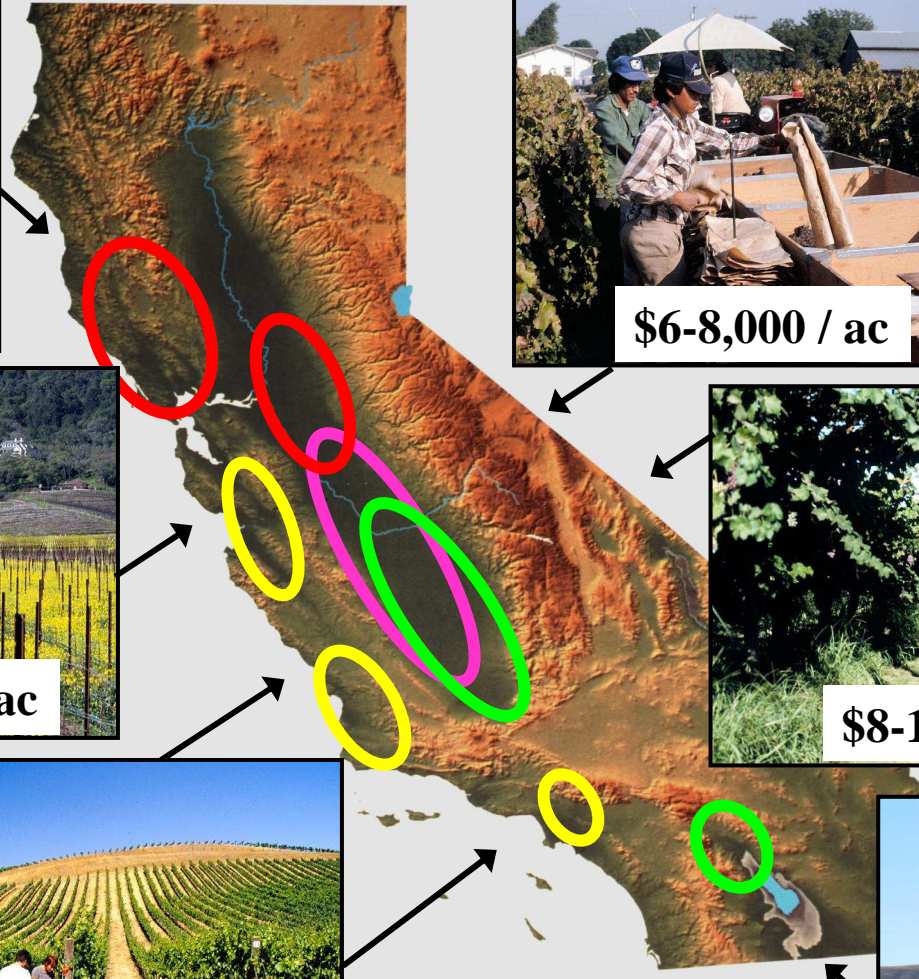
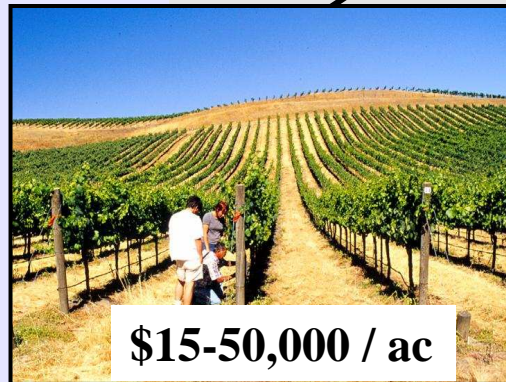
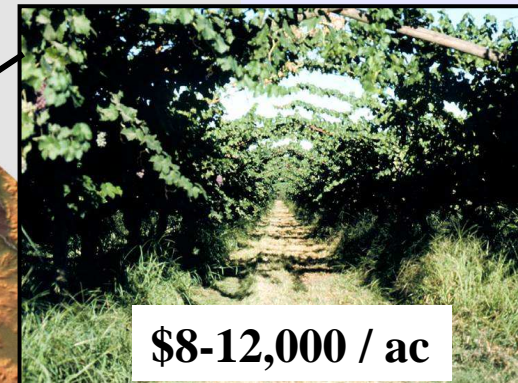
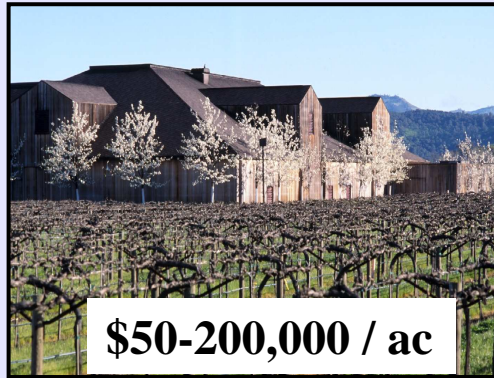
Improving bio-control of the vine mealybug

Anagyrus pseudococci
female

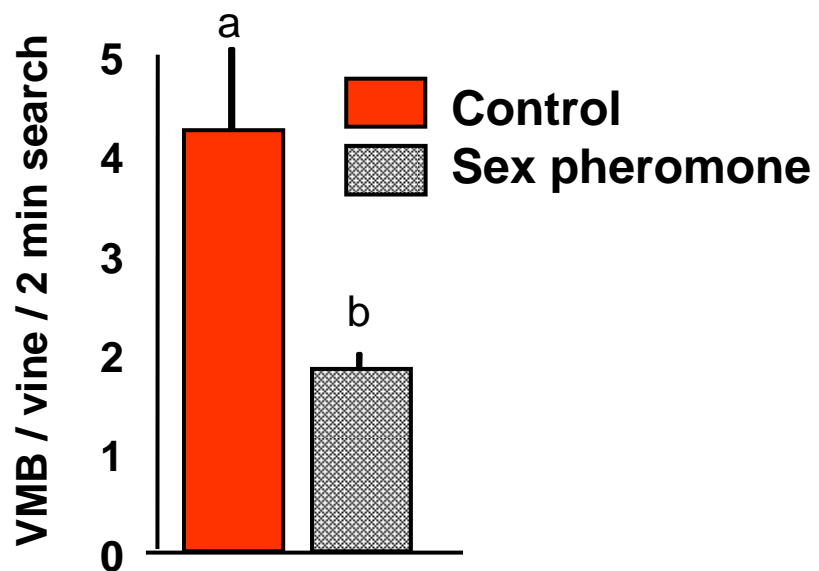


**Climate will impact
vine mealybug
biology and may
parasitoid impact**

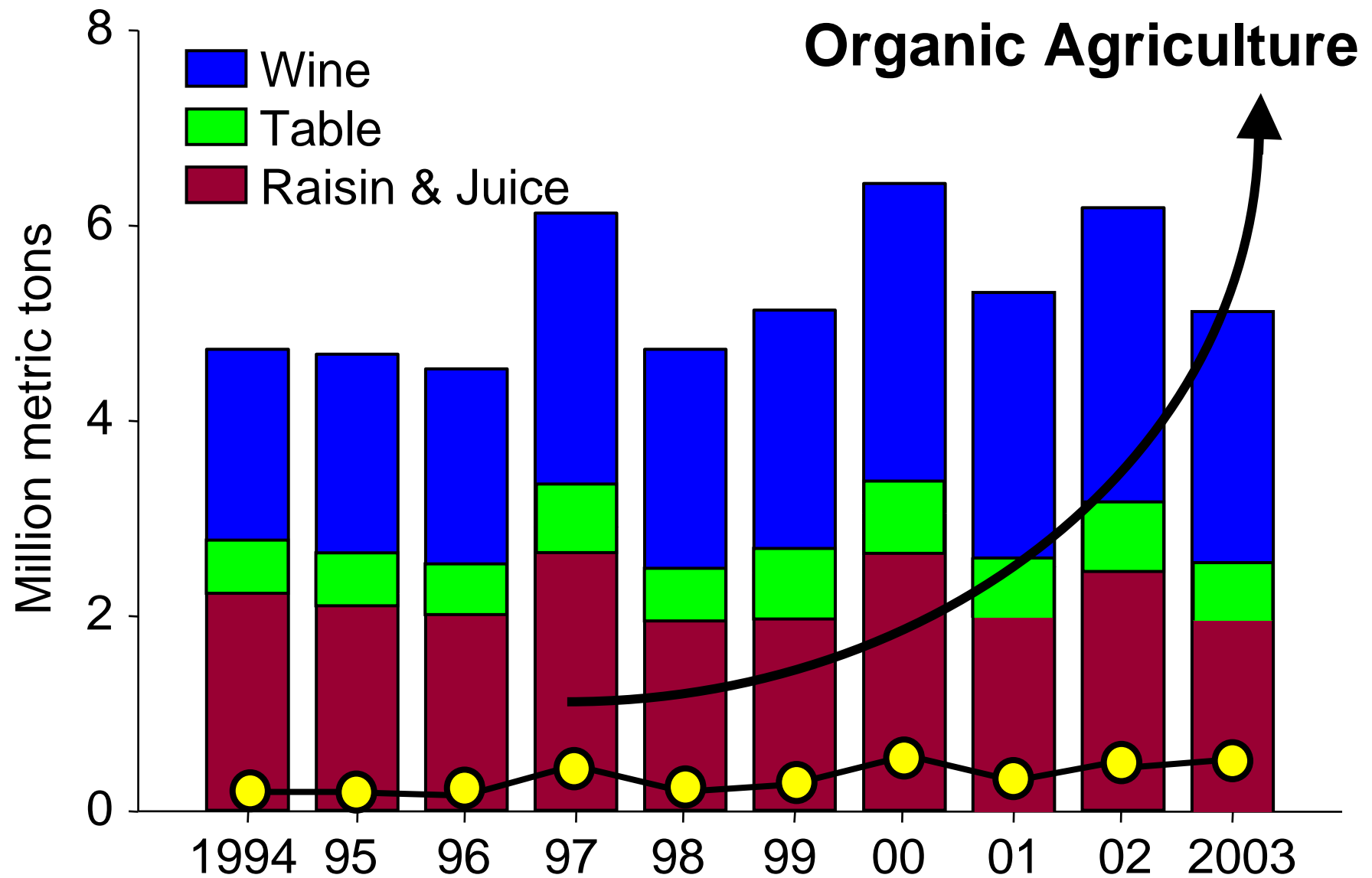
Cash Values, Cultural Practices & Pest Pressure



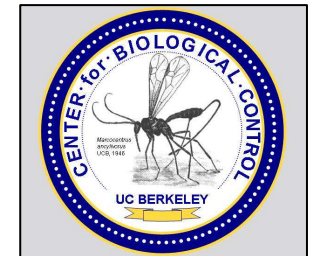
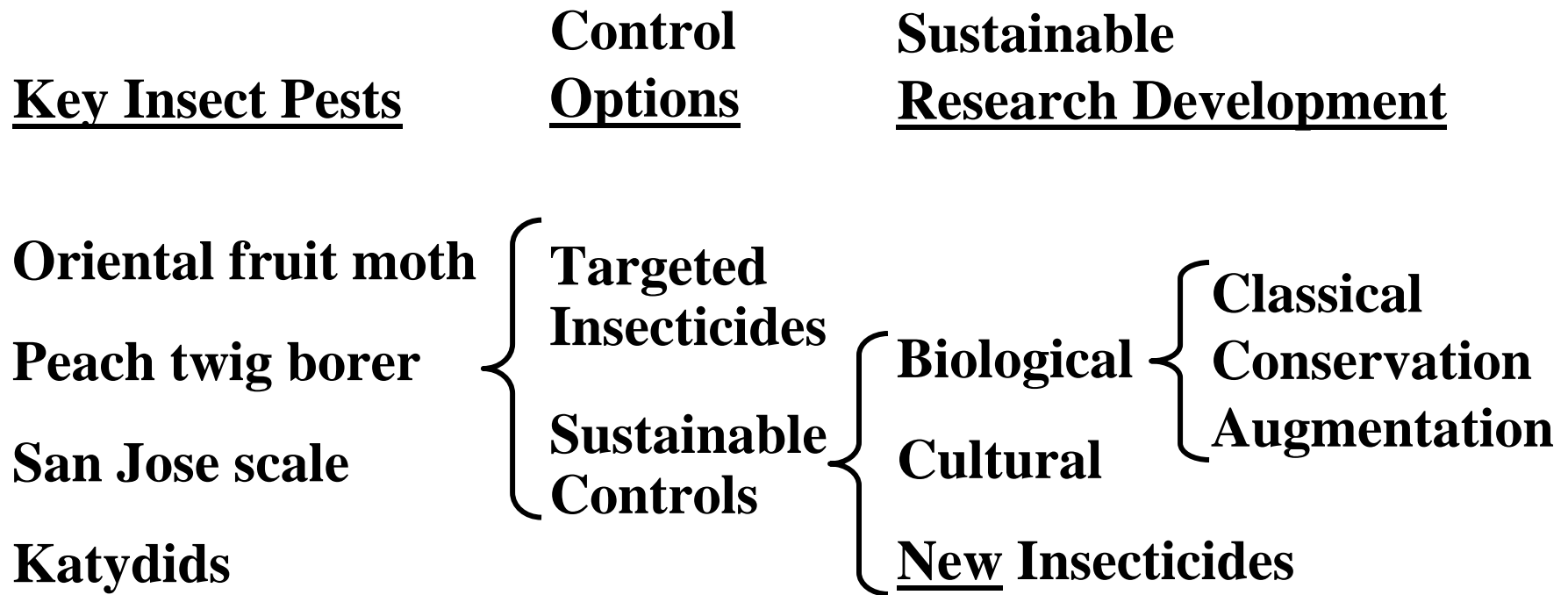
Developing Mating Disruption Programs



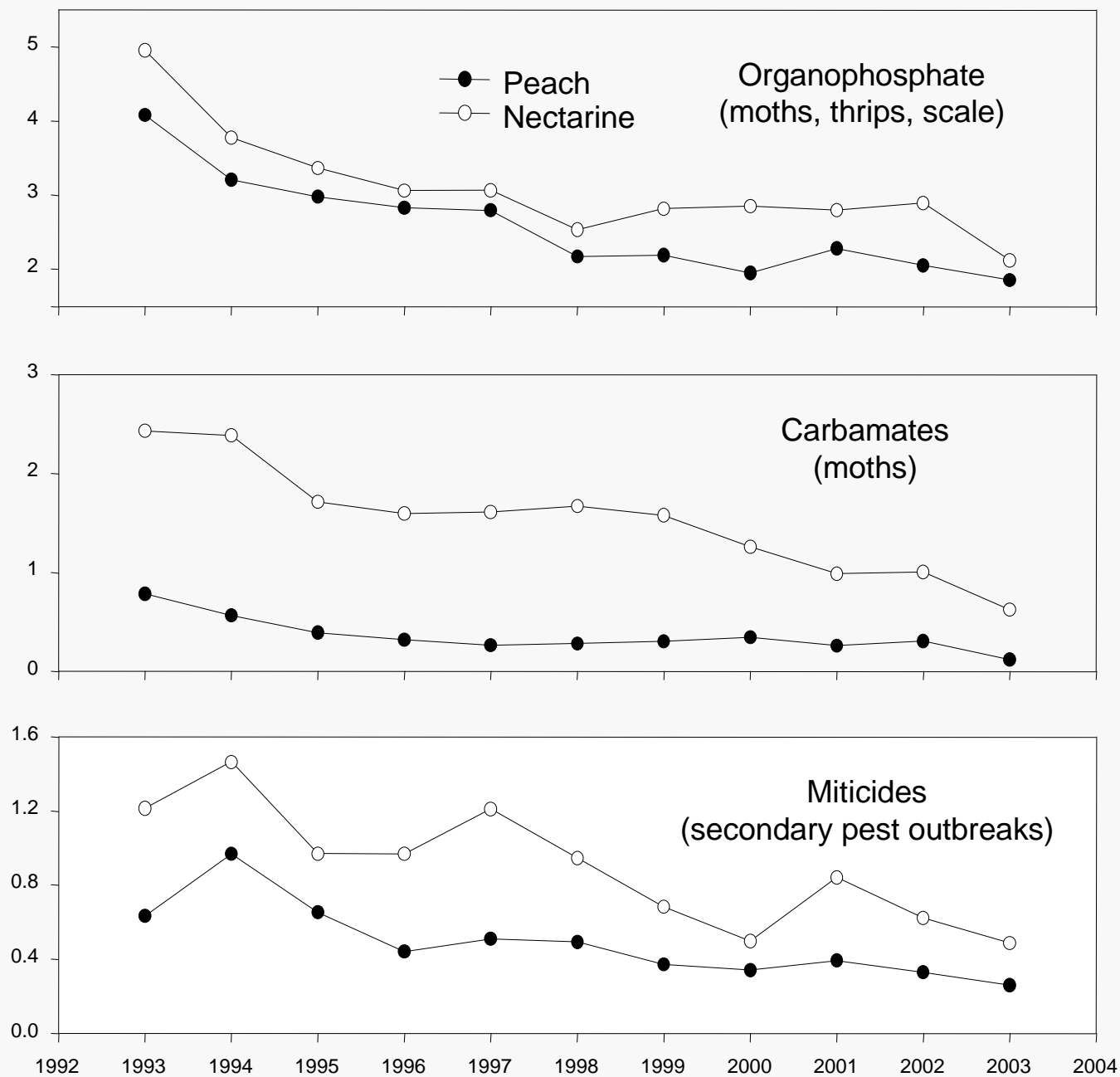
Invasive Species Impact California Grape Production



Developing Sustainable Controls for Tree Fruit



Pounds (a.i.) / acre



Developing Sustainable Controls for Tree Fruit

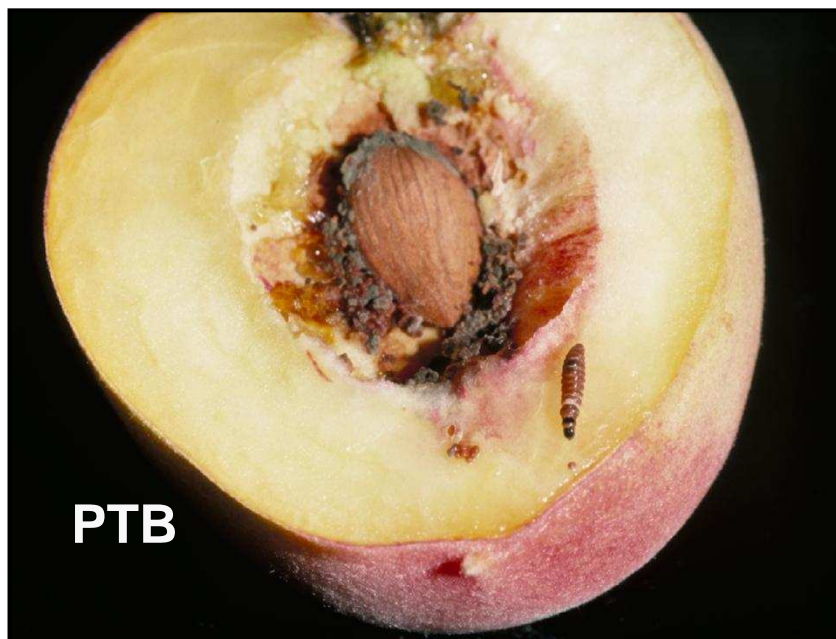
Key insect pests were moths:

Peach Twig Borer

Oriental Fruit Moth

(new SJV pest 1940s)

**1970-90s – OPs & Carbamates
(dormant OP & oil applications)**



Developing Sustainable Controls for Tree Fruit

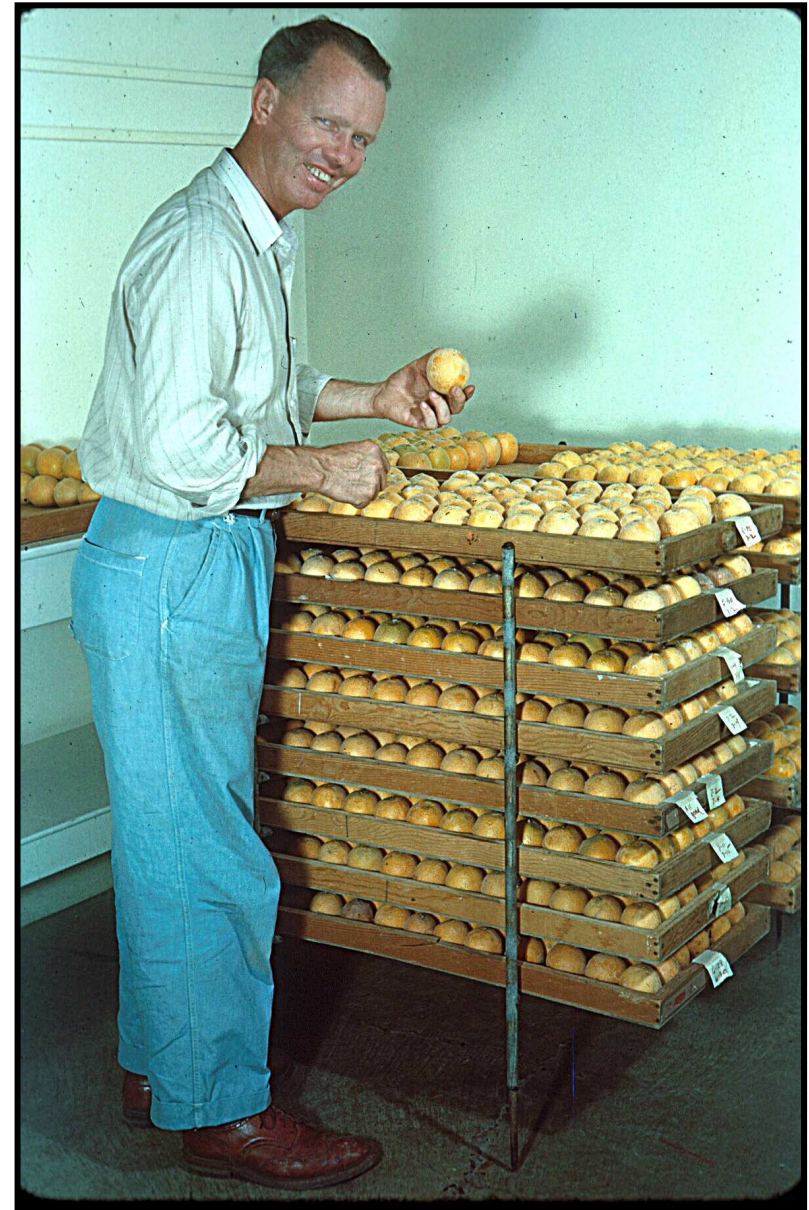
**What sparked “sustainable”
stone fruit IPM?**

**OFM and PTB sex pheromones
were used to monitor flights.
Major advance in in the 1980s
with OFM mating disruption.**



Developing Sustainable Controls for Tree Fruit

Bio-Control program for OFM.
1950s released millions of
“Macrocentrus ancyliivorus”
Considered a failure – in fact,
accounts for 40-70% parasitism
of 3rd - 4th generation OFM.



Developing Sustainable Controls for Tree Fruit

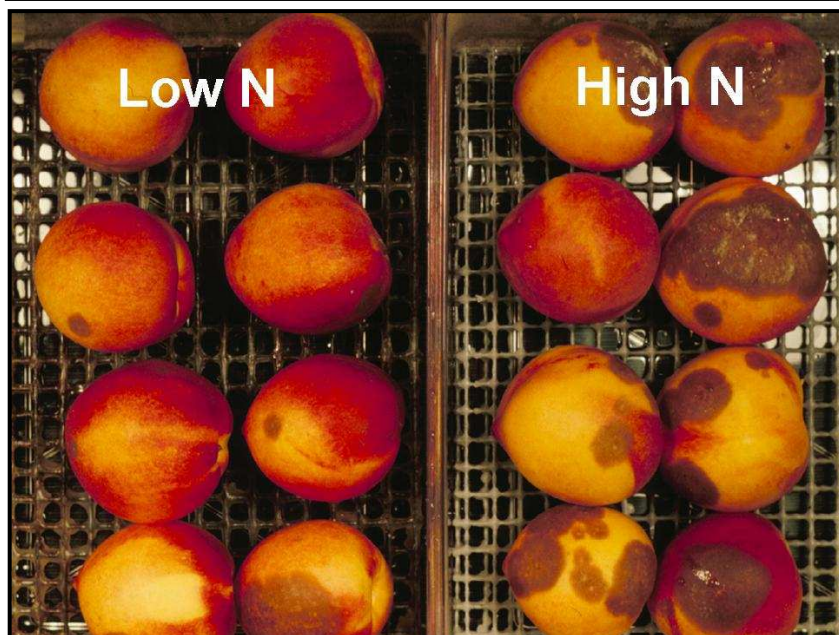
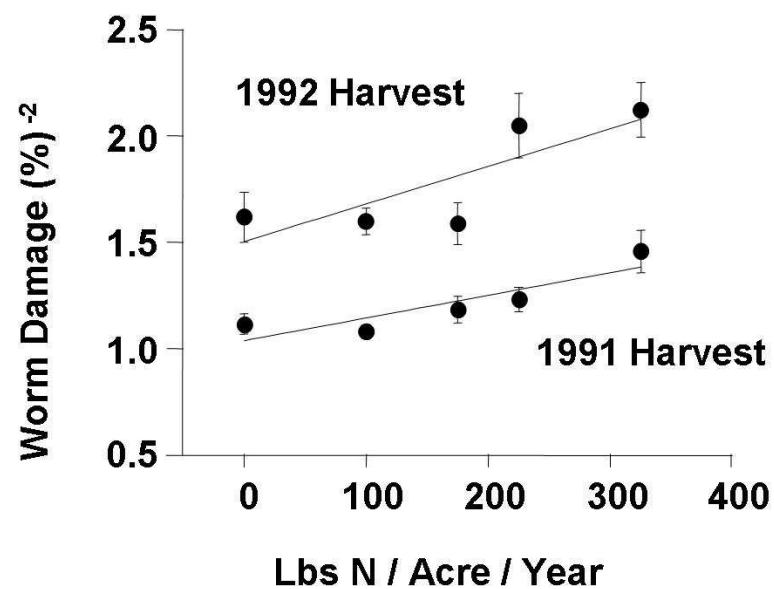
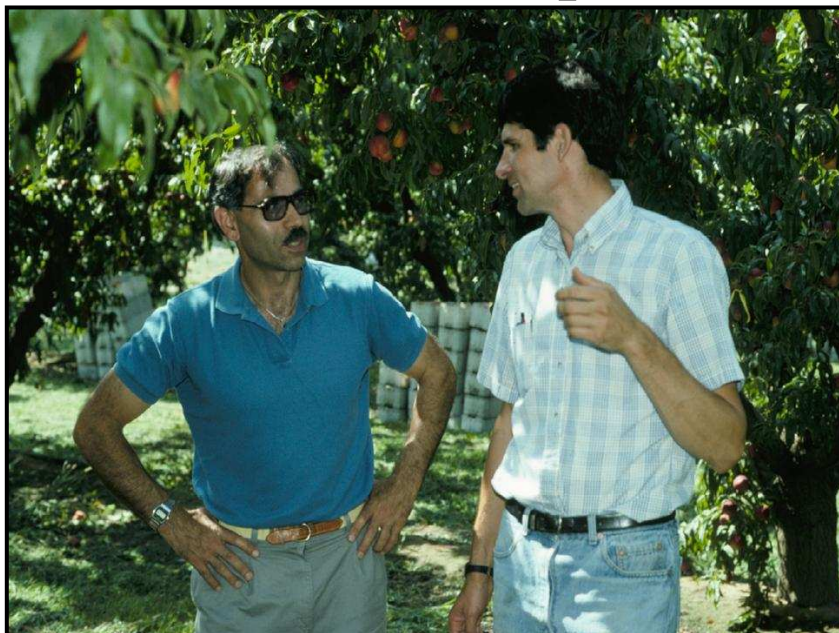
OFM mating disruption removed the need for summer insecticides

PTB dormant spray (oil & OP) alternatives now sought.

Looked at bio-controls



What is the impact of N fertilization? Increase in moths!



What is the impact of N fertilization? Increase in moths!



**PTB movement also
led to use of bloom-
time sprays with
“Success” and “Bt”**



Developing Sustainable Controls for Tree Fruit

Impact of removing dormant OP and in-season ‘broad-spectrum insecticides? – SJS outbreaks

San Jose scale problems return (SJS has LONG history in USA).

BioControl attempted repeatedly.



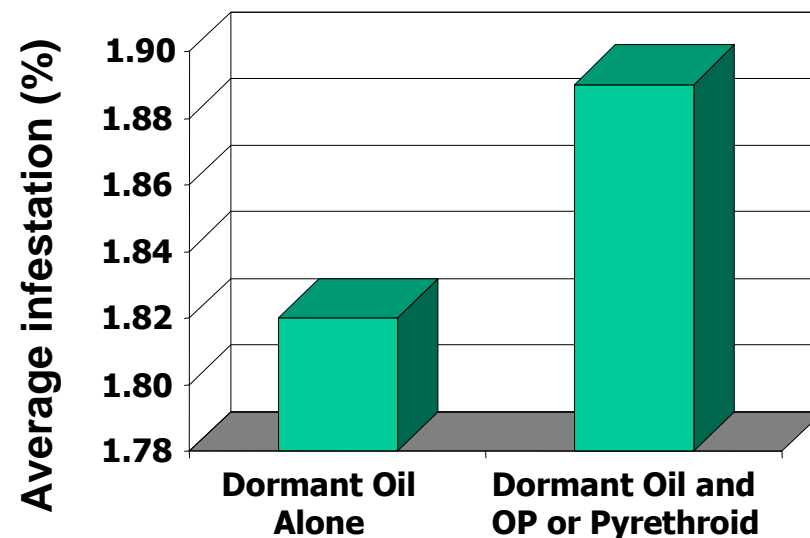
What replaced dormant OPs? New material applied better!

Walt Bentley tested dormant oil:
800 GPA (higher rate
for better coverage)
8% Volck supreme oil
(higher concentration)
February treatment
(better than December)

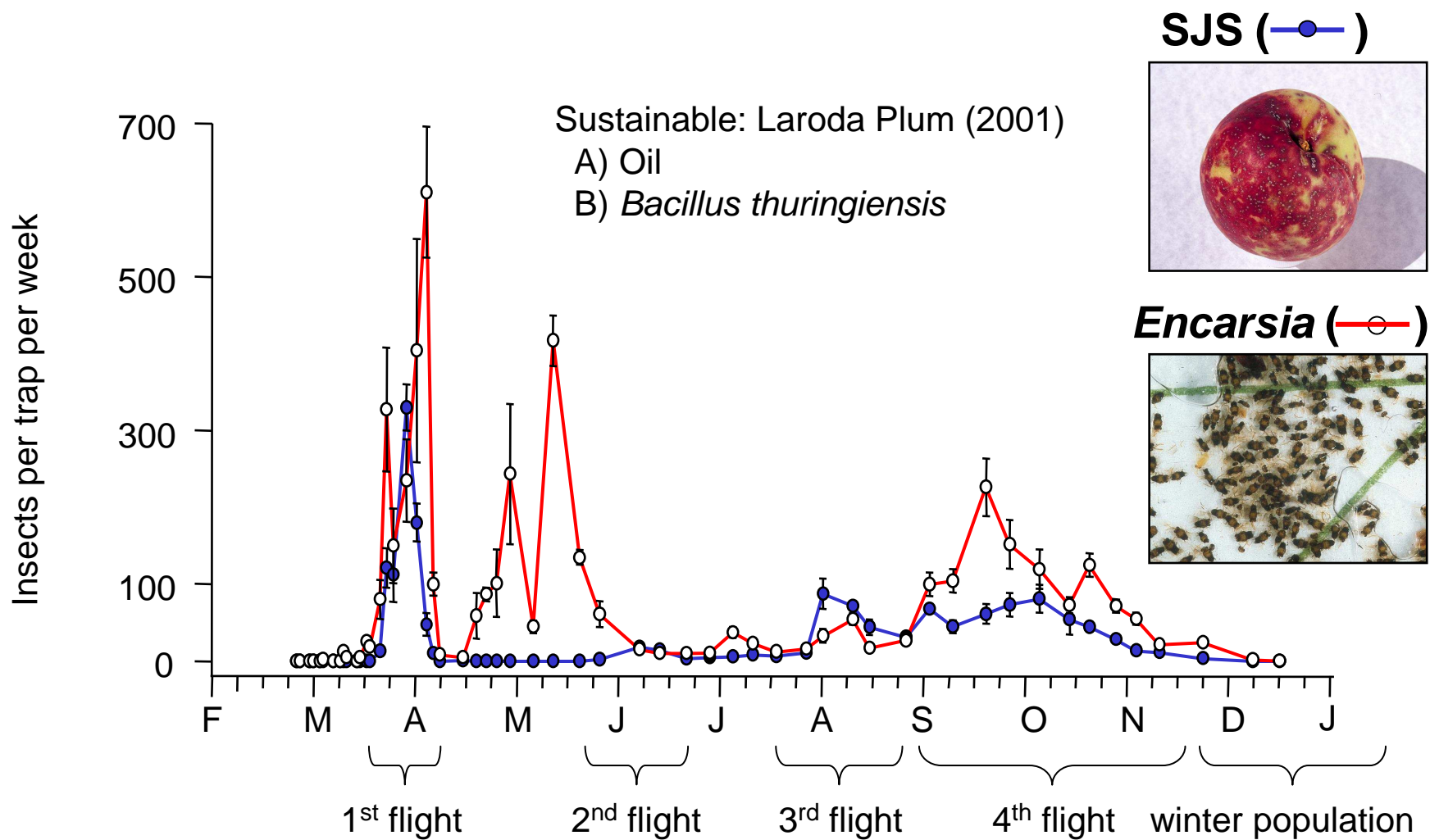


Monitor!
Early-season sprays

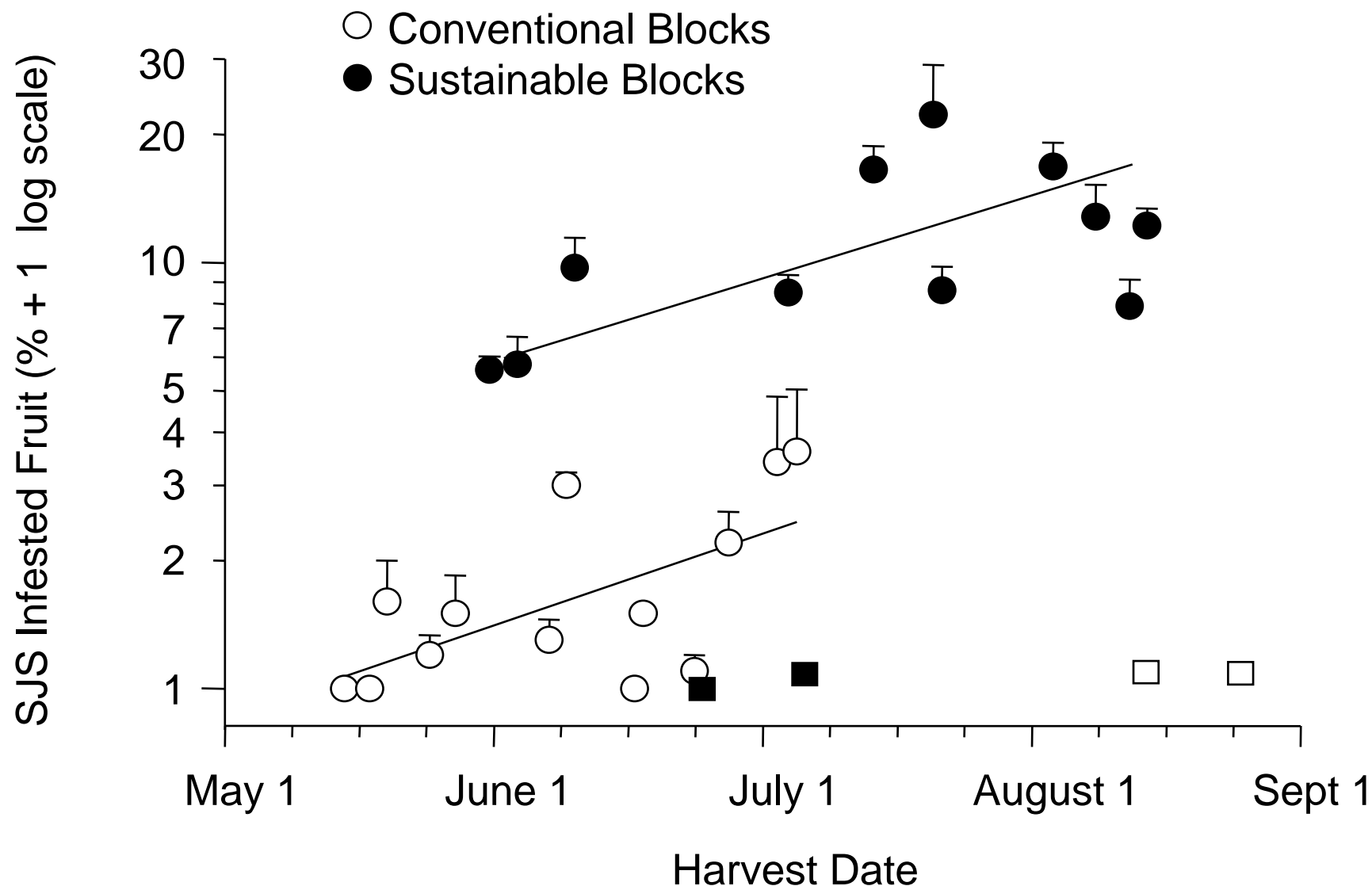
Esteem (IGR)



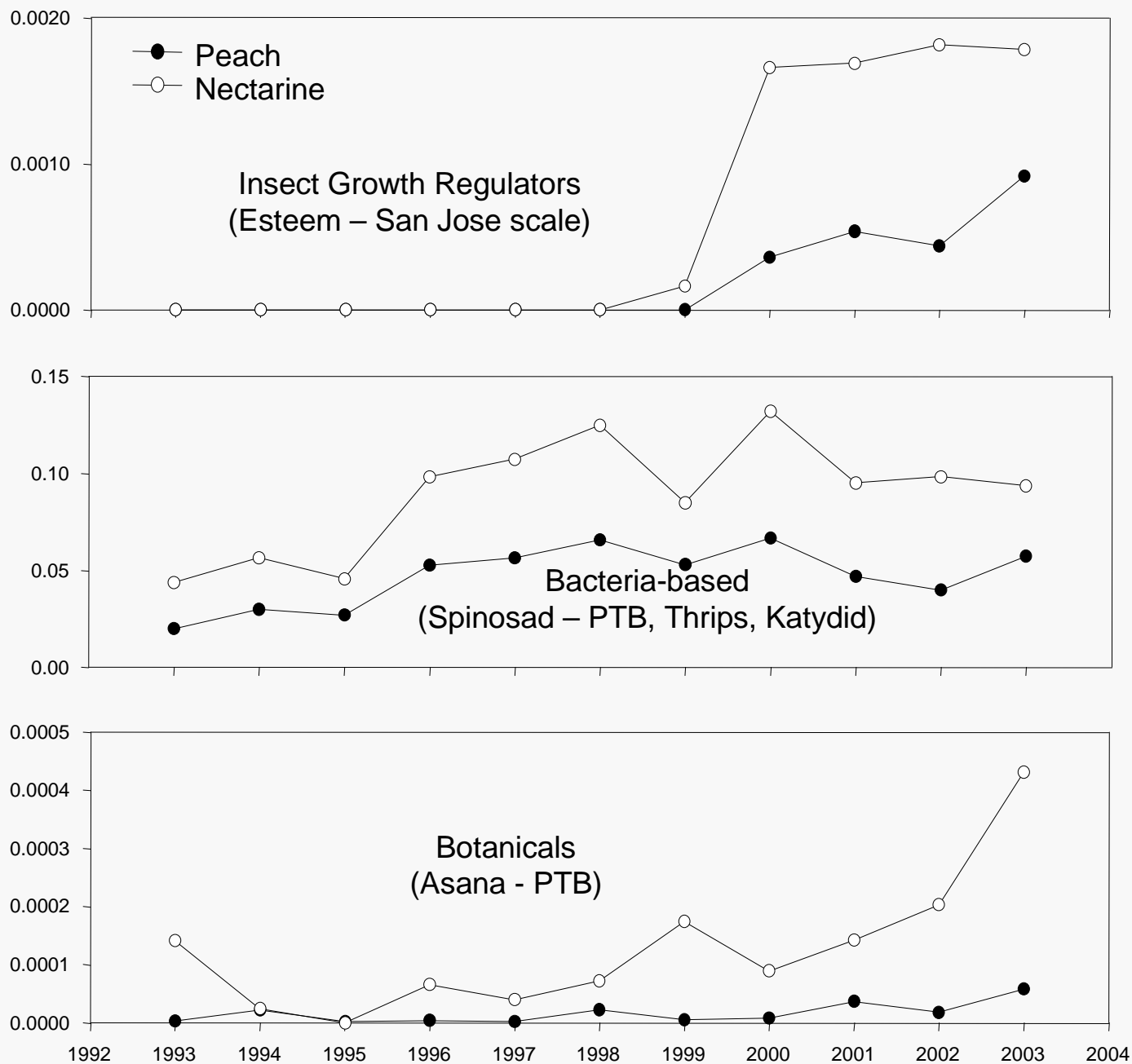
Best method to conserve SJS parasites? Soft Insecticides!

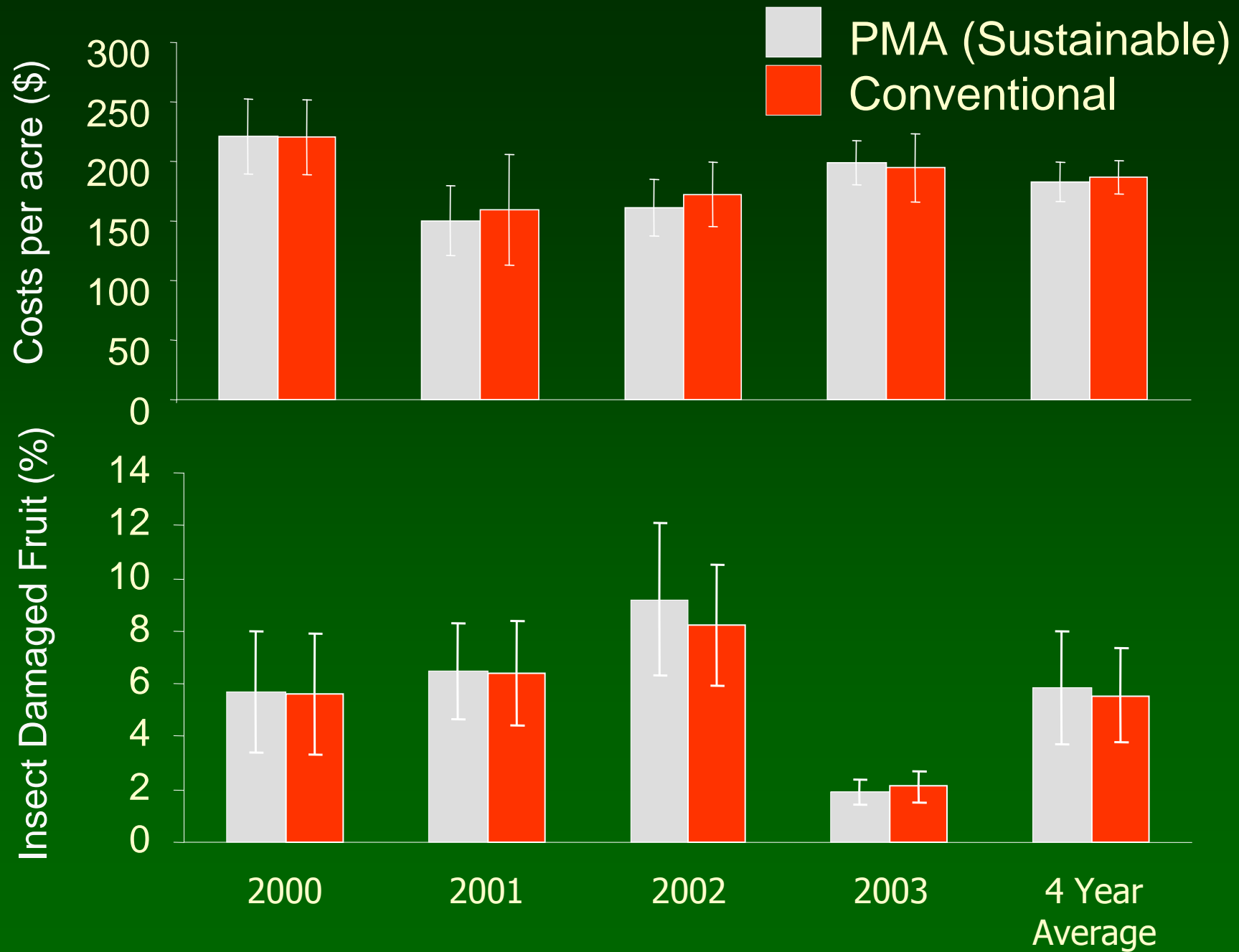


Good example of SJS biology & damage is harvest date



Pounds (a.i.) / acre



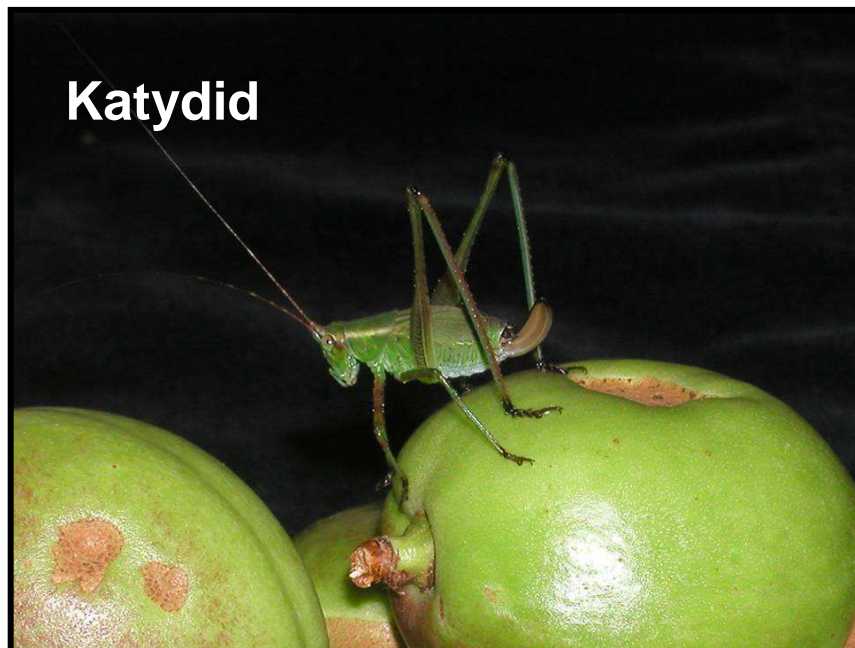


Now that moths and SJS are controlled – What next?

Western flower thrips



Katydid



Three Parts to Study

Part III. Bio-Control Theory & Practice

- (a) Description of past and current bio-control and IPM in key California crop systems
- (b) Verify actual practice and effect of bio-control in commercial crop systems.
- (c) What opportunities could be realized through policy interventions?