

*USDA-ERS PREISM Conference, Practitioner's Panel  
Washington, DC, October 3, 2009*

# How an Economist Manages an Invasive Entomologist, My Experience

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# Invasive Pests - California

- At least 1,370 exotic terrestrial invertebrates have established breeding populations in California since the 1700's.
- 2/3 of all insecticides and acaricides applied to California crops target introduced pests
- The presence of certain 'exotic' pests continues to be a major barrier to the export of California crops

# Origins of California Invasions

NORTH AMERICA	377 (48%)
EUROPE	149 (18%)
ASIA	67
TROPICAL AMERICA	57
AFRICA	37
PACIFIC REGION	35
AUSTRALIA	26

# Composition of Arthropod Invaders

- **Stenorrhyncha** (aphids, scales, leafhoppers, whiteflies, psyllids) 451 (34%)
- **COLEOPTERA** (beetles) 232 (18%)
- **ACARI** (mites) 130 (10%)
- **LEPIDOPTERA** (moths) 129 (10%)
- **DIPTERA** (flies) 89
- **THYSANOPTERA** (thrips) 51
- **Heteroptera** (true bugs) 40
- **HYMENOPTERA** (wasps, bees) 33

# Composition of Arthropod Invaders

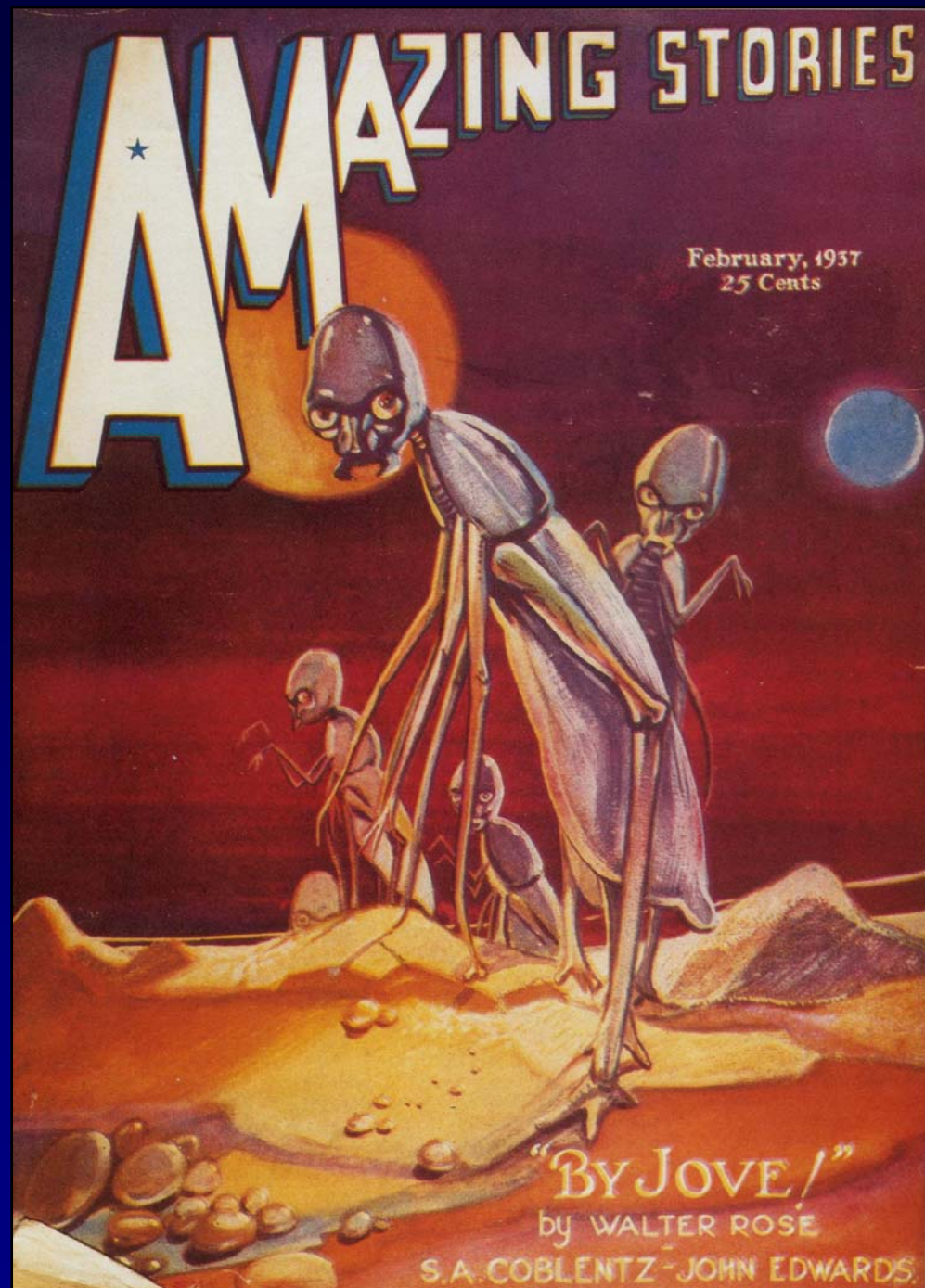
*'Expected' if introduced randomly -*

	Actual	Expected	
• Stenorrhyncha	451	57	↑
• COLEOPTERA	232	506	↓
• ACARI	130	14	↑
• LEPIDOPTERA	129	191	↓
• DIPTERA	89	203	↓
• THYSANOPTERA	51	8	↑
• Heteroptera	40	40	
• HYMENOPTERA	33	182	↓

*Why?*

# Invasive Species

- Pink bollworm
- Mediterranean fruit fly
- Silverleaf whitefly
- Glassy-winged sharpshooter
- Greenhouse whitefly (strawberry strain)
- Olive fruit fly
- Light brown apple moth
- Spotted winged *Drosophila*



# PREISM Grants with R. Goodhue

2003 **Biology and ecology of invasive species: spatial and temporal interactions**  
(Greenhouse whitefly, new biotype)

2007 **Encouraging cooperation between commercial producers and residential users of an invasive species host: designing collective pest management institutions for the olive fruit fly in California** (Olive fruit fly)



# Greenhouse Whitefly





# Prunedale, 2000

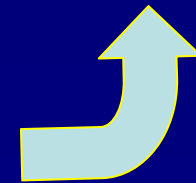
New plantings next to second year plantings



Infested  
second year  
planting

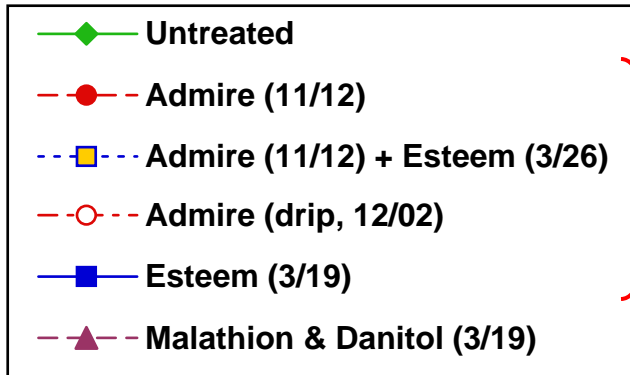


New  
planting



# Greenhouse Whitefly Nymphs Watsonville, 2003

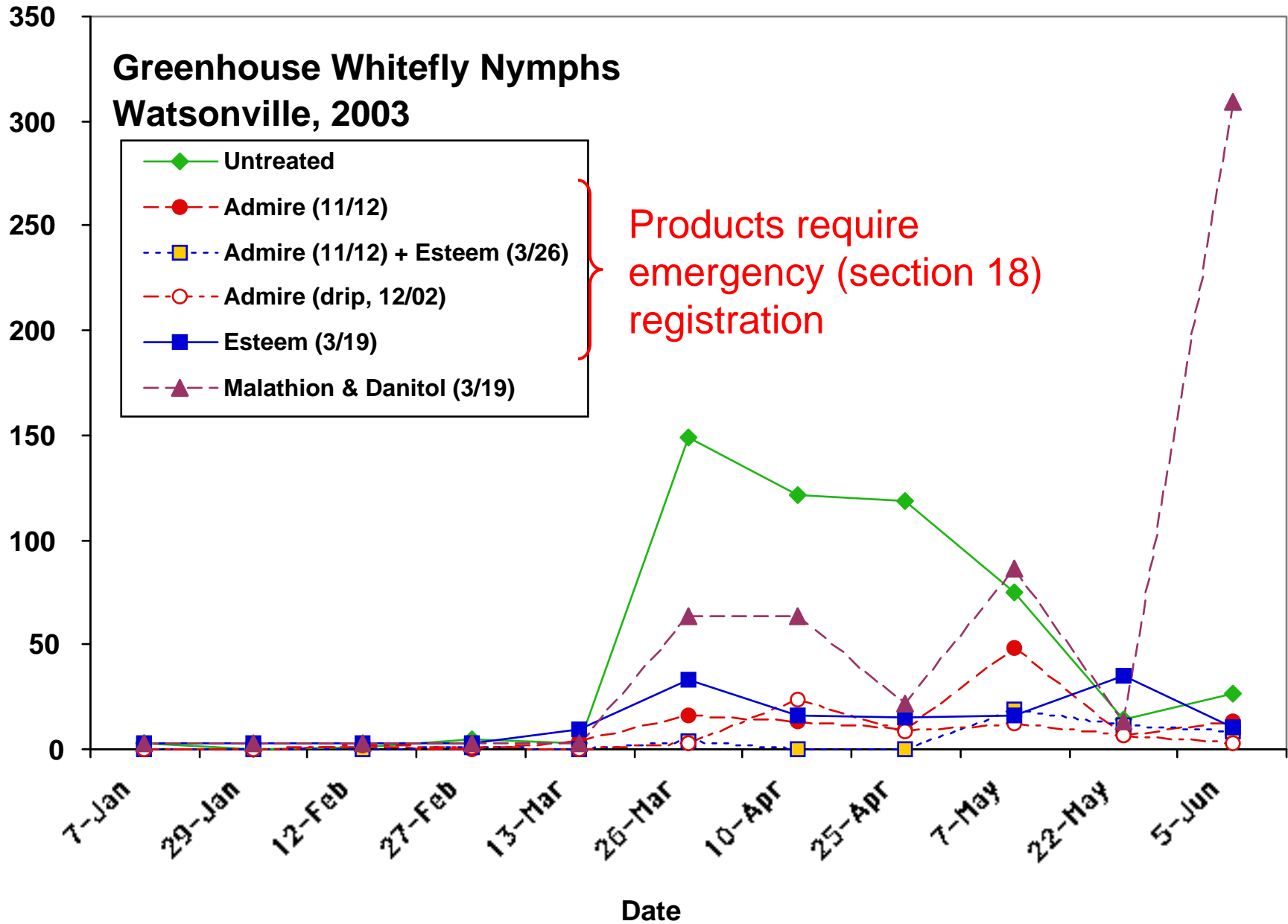
Number of  
Nymphs/Trifoliolate



Products require  
emergency (section 18)  
registration

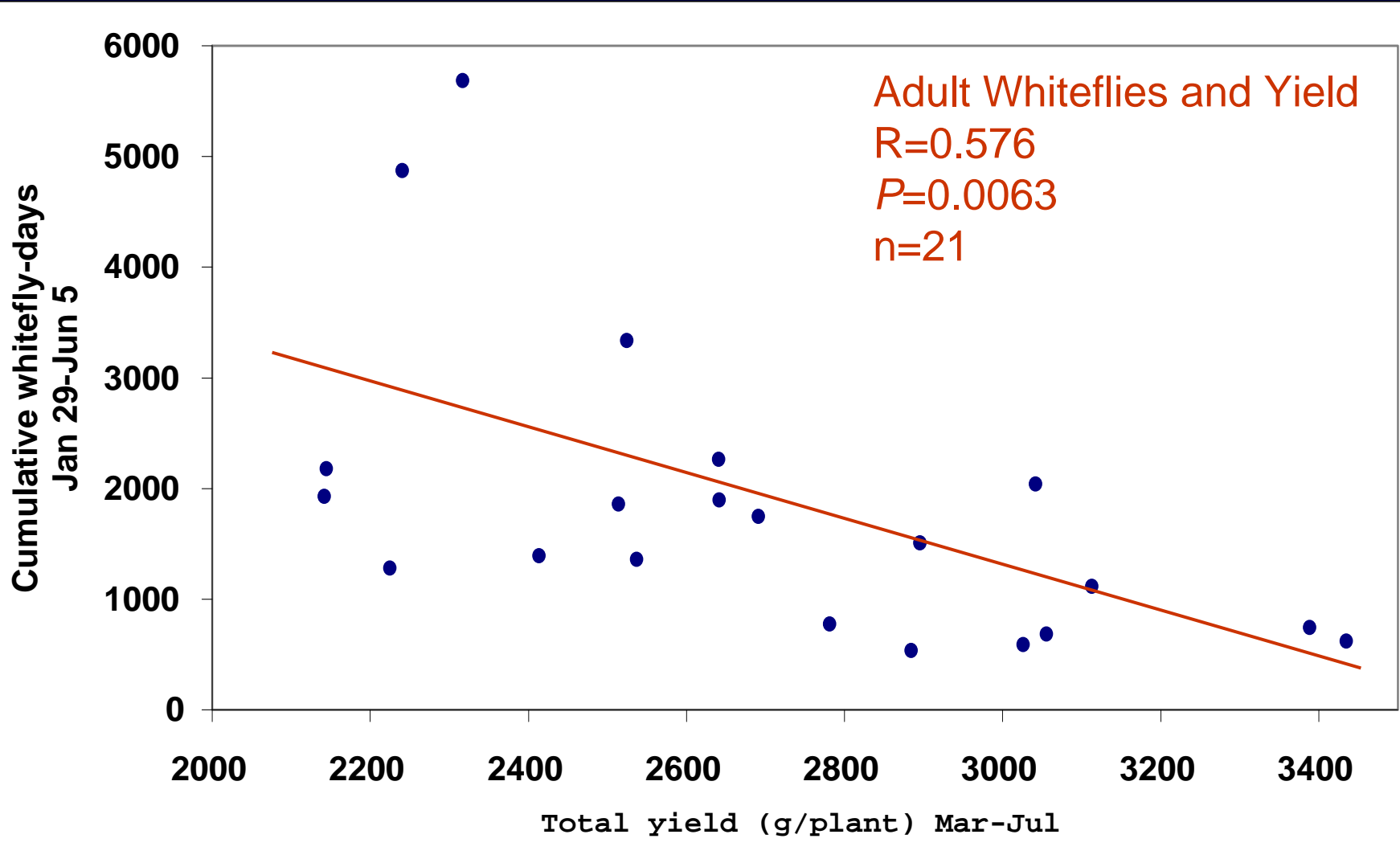
7-Jan 29-Jan 12-Feb 27-Feb 13-Mar 26-Mar 10-Apr 25-Apr 7-May 22-May 5-Jun

Date



# Greenhouse Whitefly Adults, Watsonville 2002-03

## Season Long Management





# Santa Cruz County, 2004



# Publications

- McKee, G.J., F.G. Zalom, and R.E. Goodhue. 2007. Management and yield impact of the greenhouse whitefly (*Trialeurodes vaporariorum*) on California strawberries. *HortScience*. 42(2): 280-287.
- McKee, G.J., R.E. Goodhue, F.G. Zalom, C.A. Carter, and J.A. Chalfant. 2009. Population dynamics and the economics of invasive species management: the greenhouse whitefly in California-grown strawberries. *Journal of Environmental Management*. 90: 561-570.
- McKee, G.J, and F.G. Zalom. 2009. A model of greenhouse whitefly *Trialeurodes vaporariorum* (Westwood) population development and management on Camarosa variety strawberry plants. *Journal of Asia-Pacific Entomology*. 12: 117-122.



# Postscript

Areawide management program to break the continuous development of whiteflies

- Central California - fewer second year plantings
- Ventura County - Whitefly management district formed - whitefly abatement voluntarily or otherwise at a critical point in life cycle
- Admire and Esteem registered and used

# Olive Fruit Fly



# Olive Fruit Fly

First Detected, 1998

Same family of insects as:

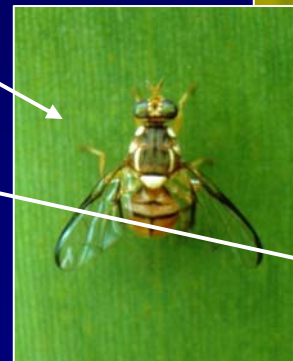
Mediterranean fruit fly

Oriental fruit fly

Apple maggot

Cherry fruit fly

Walnut husk fly



UC Statewide IPM Project  
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# Olive Fruit Fly - Damage



# Olive Fruit Fly - Research

- Statewide monitoring
  - Trapping studies
  - Biology and phenology
  - Insecticide efficacy
  - Orchard sanitation
  - Varietal susceptibility
- Hannah Burrack,  
NC State University
- Establish origin (Eastern Mediterranean)
  - Spinosad resistance monitoring
  - Alternative baits and toxicants



# Olive Fruit Fly - Management

- GF-120 (spinosad) bait - The only effective and practical to use insecticide registered
- Orchard sanitation - Remove remaining olives from the tree after harvest
- Areawide suppression - Remove, clean or treat olive trees outside of orchards which may be sources of continued invasions.
- New plantings - Plant less susceptible varieties
- Biological control - In landscape plantings

# Olive Fruit Fly - GF-120 Resistance



# Olive Fruit Fly - GF-120 Resistance

California Location	# of apps	RR
Sonoma 1-CA	69	13.28
Ohlone-CA	49	11.44
Sonoma 2-CA	60	10.69
Butte-CA	69	10.09
Stags Leap-CA	66	9.13
Silverado-CA	66	5.69
Ventura-CA*	43	5.50
Tux-CA	34	4.47
Chania-GR*	25	4.34
Solano-CA	16	4.31
Livermore-CA	0	4.03
Hudson-CA	0	3.78
Paso Robles-CA	13	3.69
San Luis Obispo-CA	17	3.16
San Jose-CA	0	2.78
Davis-CA	0	2.47
UC Davis-CA	3	1.81
Oroville-CA	0	1.47

Greece Location	# of apps	RR
Aghios Nicolaos-GR*	8	3.09
Promiri-GR*	0	3.06
Livadia-GR	3	1.47
Drakia-GR	0	1.13
Argalasti-GR	0	0.94
Mytilini-GR	2	0.38

Cyprus Location	# of apps	RR
Nicosia-CY*	0	1.31
Pafos-CY*	3	1.28
Limassol-CY*	0	1.19
Katokopia-CY*	0	1.16
Mazotos-CY*	0	1.00
Dromolaxia-CY*	0	0.69
Evrychou-CY	0	0.19
Zygi-CY	0	0.16

# Entomologist's Perspective on Invasive Species - It's Only Going to Get Worse

Detection

Risk assessment

Trade issues - quarantines and/or phytosanitary certification (if necessary)

Chemical controls (band aid)

Integrated pest management - areawide management

# Invasive Species Policy - An Areawide and Community Approach...

Spotted Wing Drosophila



Light Brown Apple Moth



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