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Control of Direct Pests in Organic Apple: Successes and Challenges

Jay Brunner
Washington State University
Tree Fruit Research and Extension Center

Direct Pests of Tree Fruit

(Apple pests in red)

Lepidoptera

- Codling moth
- Oriental fruit moth
- Peach twig borer
- Lesser appleworm
- Leafrollers
- Lacanobia sp.
- Eye spotted bud moth

Homoptera

- Pear psylla (russet)
- Rosy apple aphid
- San Jose scale

Diptera

- Apple maggot
- Western cherry fruit fly
- *Spotted winged drosophila*

Hemiptera

- Lygus bug
- Stink bugs
- Campylomma
- Box elder bug

Thysanoptera

- Western flower thrips

Control Tactics for Direct Pests of Tree Fruit Crops

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Bt products	Leafrollers, Lacanobia Fruitworm, *Codling Moth,* Oriental Fruit Moth, Peach Twig Borer,
Virus (CpGV)	*Codling Moth*

Control Tactics for Direct Pests of Tree Fruit Crops

Surround	Lacanobia Fruitworm, Apple Maggot, leafrollers
Lime Sulfur	Leafrollers

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Oil (HMO, Fish)	Codling Moth, San Jose Scale, Rosy Apple Aphid, *Oriental Fruit Moth*
Botanicals	Not available or effects too short
Fatty acids (soap)	*Mullein Plant Bug (Campylomma)*

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Biological Control	*Leafrollers*, San Jose Scale, Rosy Apple Aphid, *Codling Moth*, *Peach Twig Borer*, *Oriental Fruit Moth*

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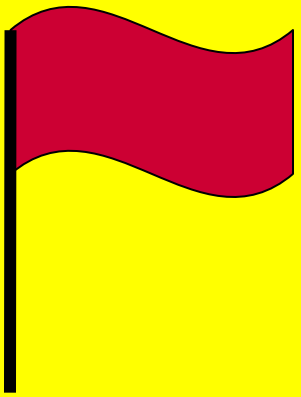

Thysanoptera

- Western flower thrips

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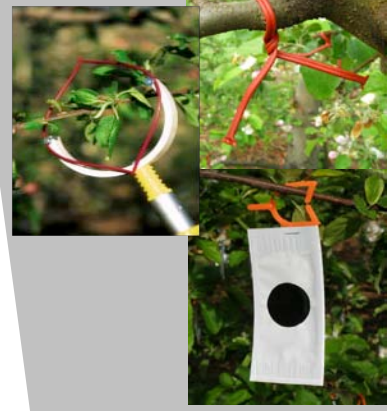
Codling Moth Control
Key to apple organic production



- Use of **pheromones** (mating disruption) is necessary to sustain control of CM
- Only ***hand applied dispensers* are registered** for use in organic orchards – loss of this technology in organic apple production would be a disaster.
- *Sprayable pheromone* formulations and *puffer* technology are **NOT** registered for use in organic apples.
- Supplementing pheromone treatment with insecticides is necessary to achieve acceptable crop protection.
- Overuse of some supplemental insecticides could disruption biological control for other pests.

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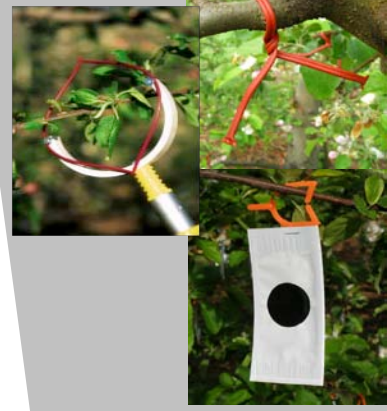

- **Supplementing pheromone** treatment with insecticides is necessary to achieve acceptable crop protection.
- What are the options and what works?

  Entrust (spinosad)

  CpGV (virus) – Cyd-X, ViroSoft

  Horticultural Mineral oil / Fish Oil

  Particle film (Surround)

  Bt products

  Neem

  Biological control

  Nematodes

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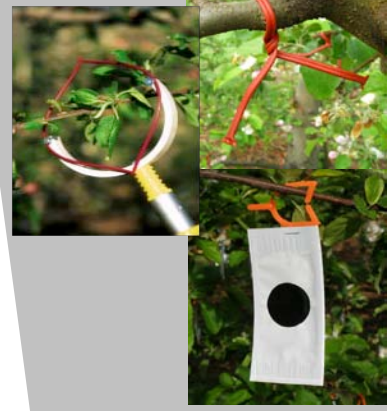

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Biological control

Nematodes

Experience indicates that these options have limited value.

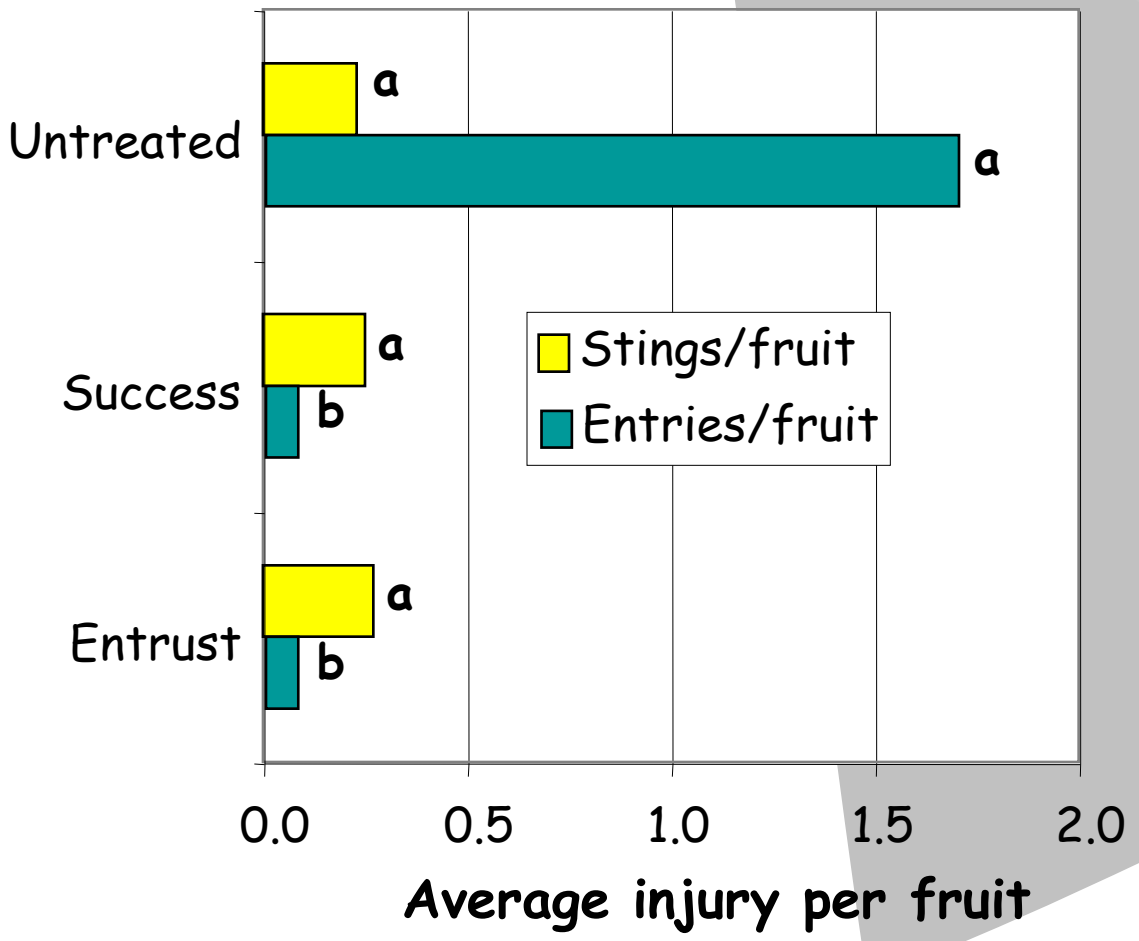
Biological control can always add value to any program but not a primary control for CM.

Entrust the organic formulation of spinosad

Spinosyn-based products (Entrust and Success) provide good control in a season long program, however, there are significant numbers of "stings" present at harvest.

Can achieve an **85-90%** reduction in successful entries in high pressure situations which is not good enough to keep a resident population from increasing.

Entrust (spinosad) is also an excellent control for leafroller larvae and other Lepidoptera larvae in tree fruit crops.



Codling Moth Control
Key to apple organic production

Oil is an ovicide against codling moth

Applied 50 DD prior to egg hatch, repeated at 150 DD (high pressure) or 200 DD (low pressure) intervals

Key to good efficacy is coverage!

Replicated single tree plots

Handgun applications

1% oil v/v

Three applications per gen.

	Percent Fruit Injury	
Treatment	1st generation	2nd generation
HMO-summer	79%	59%
Assail	92%	88%
HMO-summer	69%	32%
Assail	79%	68%
Stylet oil	98%	69%
HMO-summer	92%	88%
Guthion	100%	97%

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Concerns with long-term effects of multiple applications on plant vigor/fruit size

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Particle film technology - Surround

Summer use **suppresses** several pests

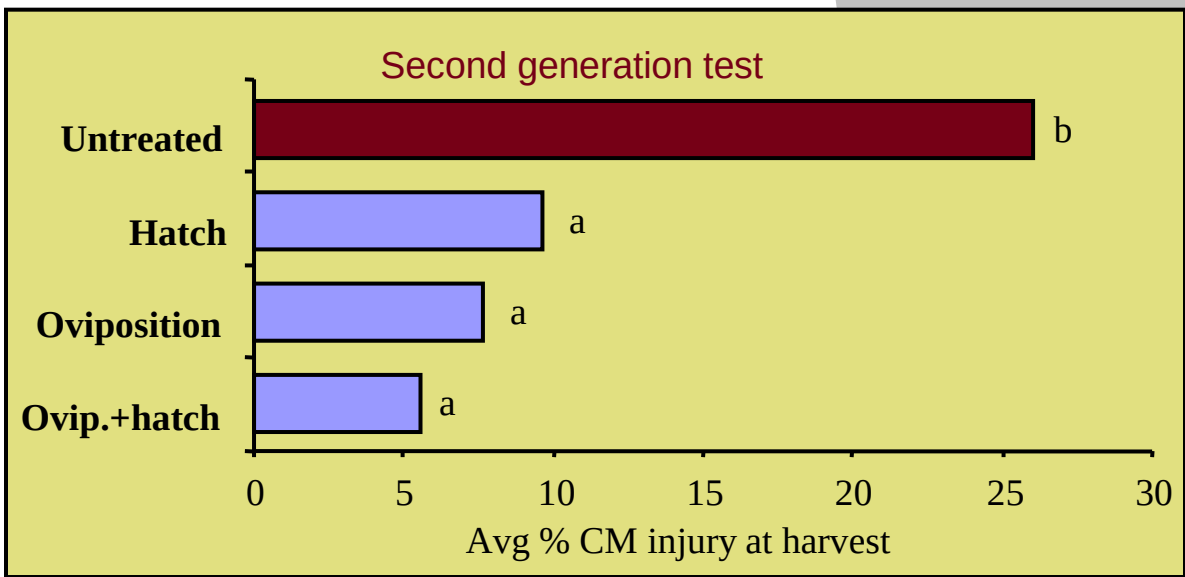
Mode of action - mortality of young larvae/nymphs; repellency of larvae or adults

Disrupts biological control of spider mites and leafminer (parasite) - possibly other general predators

Used more for **sunburn protection** than as a pesticide

Surround has an impact on:

- Codling moth
- Leafrollers
- Lacanobia
- Apple maggot (MI)



CM Granulosis Virus Bioassay results - 2003

Dose-response bioassay

	Cyd-X	Carpovirusine	Virosoft
LC_{50} (10^{13}OB/1000L)	0.039	0.003	0.089

No statistical difference between products

Field-age residue bioassay

Treatment	Average corrected % mortality (7d)			
	1 DAT	3 DAT	7 DAT	14 DAT
Cyd-X	59b	44b	71b	22a
Carpovirusine	71b	56b	50b	33a
Virosoft	59b	62b	29ab	11a

Organic CM control - Small field test

Treatment	Rate AI/A (OBx10^{13})	Interval	1st generation % injury	1st generation Moths/tree
Cyd-X	0.27	14 d (6)	40.0	
Cyd-X	0.27	7 d (12)	29.2	
Carpovirusine	0.40	10 d (8)	34.8	
Virosoft	0.38	10 d (8)	38.8	
Entrust	40 gram	14 d (6)	22.8	
Untreated	- - -	- - -	48.2	

Organic CM control - Small field test

Treatment	Rate AI/A (OBx10^{13})	Interval	1st generation % injury	1st generation Moths/tree
Cyd-X	0.27	14 d (6)	40.0	1.8
Cyd-X	0.27	7 d (12)	29.2	3.6
Carpovirusine	0.40	10 d (8)	34.8	1.2
Virosoft	0.38	10 d (8)	38.8	0.0
Entrust	40 gram	14 d (6)	22.8	- - -
Untreated	- - -	- - -	48.2	17.6

Organic CM control - Small field test

Treatment	Rate AI/A (OBx10^{13})	Interval	2nd generation		
			% injury	Entries	Stings
Cyd-X	0.27	14 d (6)	78.8	0.96b	0.82bc
Cyd-X	0.27	7 d (12)	89.6	1.06b	1.40a
Carpovirusine	0.40	10 d (8)	81.6	0.84b	0.79bc
Virosoft	0.38	10 d (8)	81.4	0.93b	1.14ab
Entrust	40 gram	14 d (6)	46.6	0.21c	0.45c
Untreated	- - -	- - -	82.7	1.62a	0.47c

Is it possible to redeem an organic orchard from brink of disaster with current tools?

Case study – Frenchman Ridge Organic Apple Orchard

260 acres (Delicious, Fuji, Gala, Braeburn, Pink Lady)

In organic production for several years

Not isolated site – Frenchman Hill area of WA

Gradual loss of codling moth control over time

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2002

CM density: 75 CM/trap

Pesticides: 15 acre applications

Products used:

Pheromone (600 dpa), oil, Bt

0.6 bins injured fruit/A hand removed

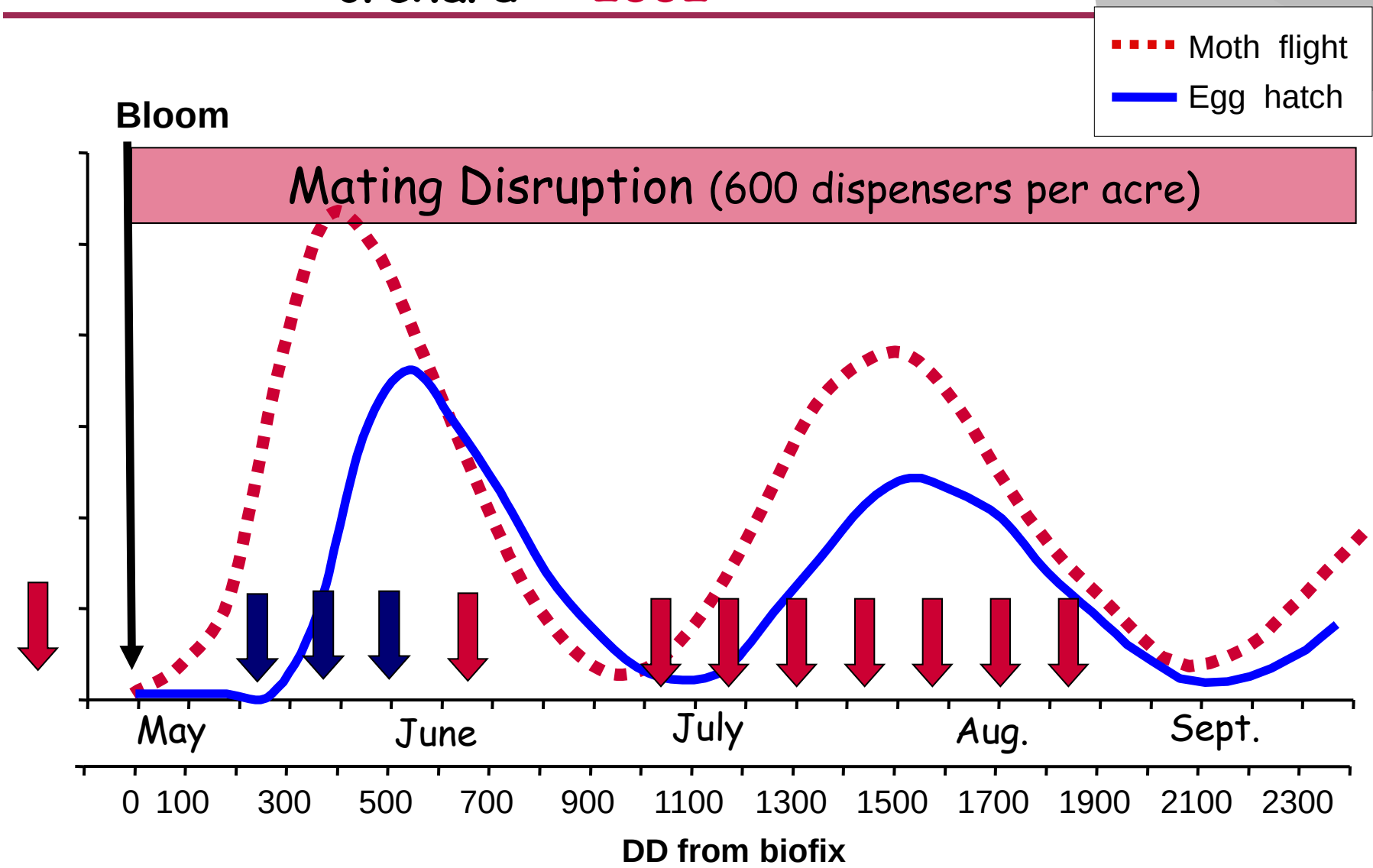
5% fruit injury at harvest (estimated)

64% packout (16 of 25 boxes)

Insecticide + applications = $762/acre

Concerns about oil effect on fruit size/quality

Organic control at Ridge orchard - 2002



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Is it possible to redeem an organic orchard from brink of disaster with current tools?

Case study – Frenchman Ridge Organic Apple Orchard

2003

CM density: 50 CM/trap

Pesticides: 11.25 acre applications

Products used:

Pheromone (600 dpa), CpGV, oil, Bt, Entrust

>1% fruit injury at harvest (estimated)

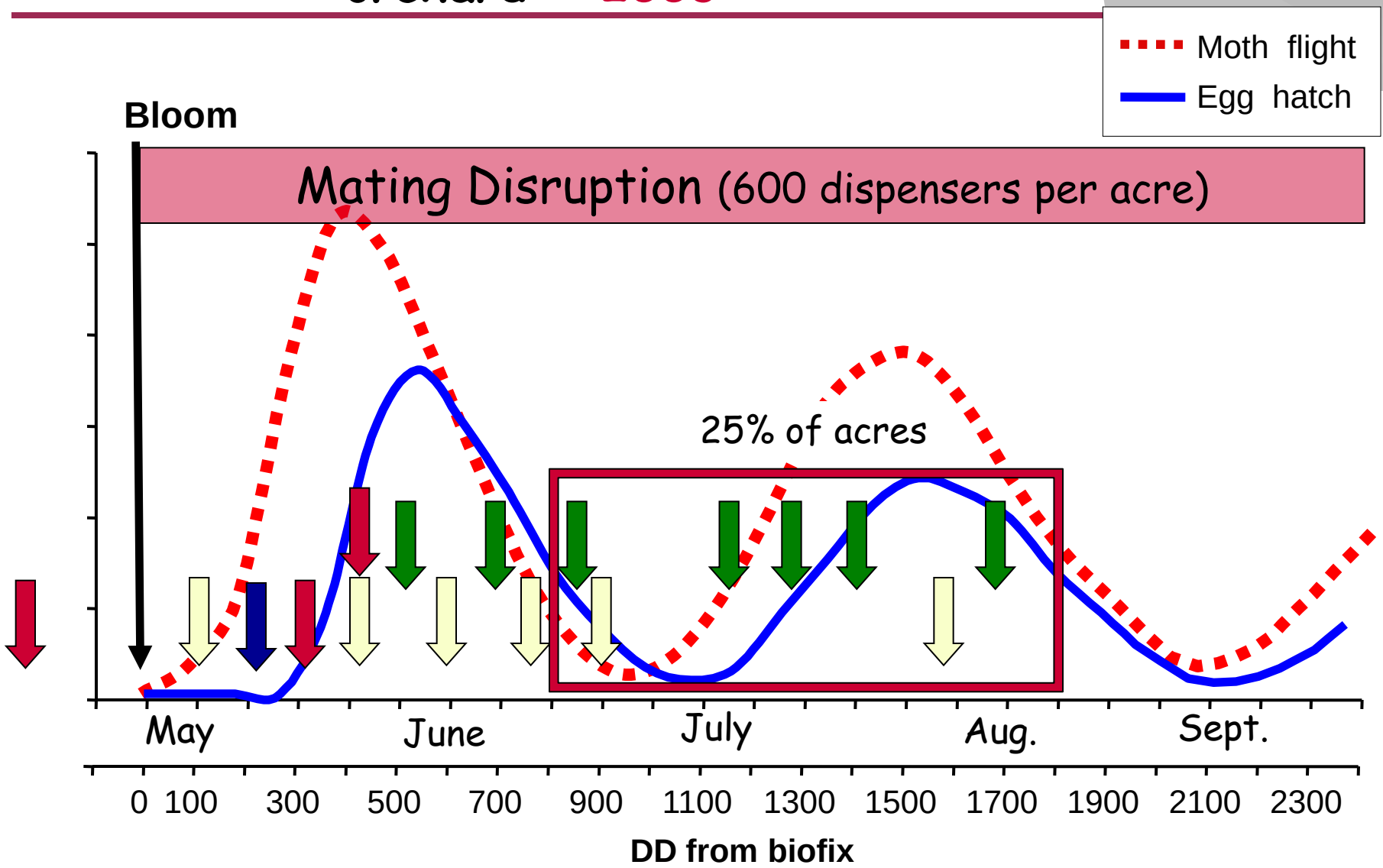
No hand removal of injured fruit

85% packout (21 of 25 boxes)

Insecticide + applications = $796/acre

Concerns about oil effects reduced but *concerns about Entrust effect on biological control of aphids*

Organic control at Ridge orchard - 2003



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2004

CM density: 1.5 CM/trap

Pesticides: 9.25 acre applications (targeted use & partial sprays)

Products used:

Pheromone (600 dpa), CpGV, oil, Bt, Entrust *(targeted use)*

>1% fruit injury at harvest (estimated)

No hand removal of injured fruit

85% packout (21 of 25 boxes)

Insecticide + applications = $563/acre

Reduced concerns about oil effects and *about Entrust effect on biological control of aphids*

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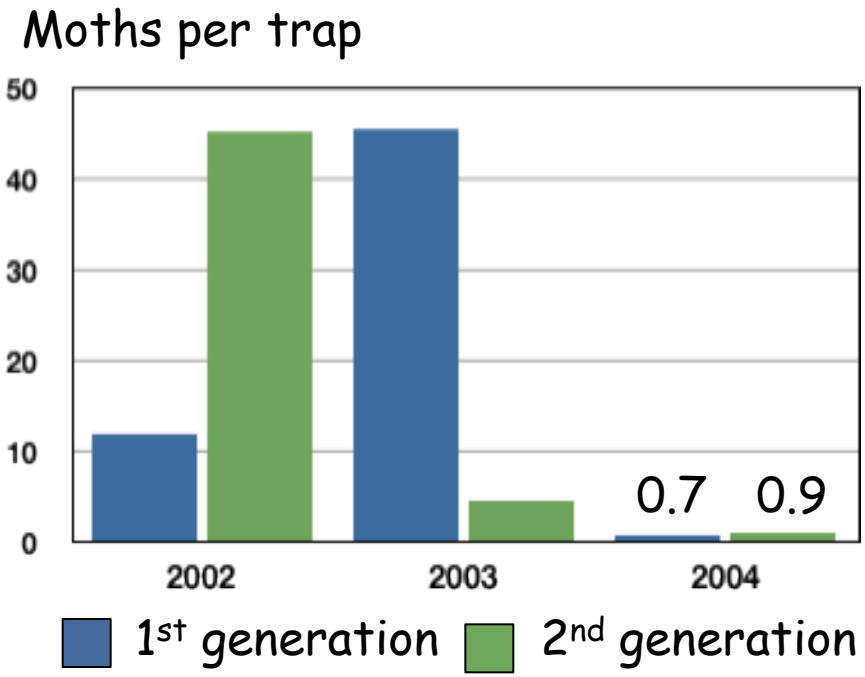

Reduced codling moth population as demonstrated by dramatic reductions in pheromone trap captures

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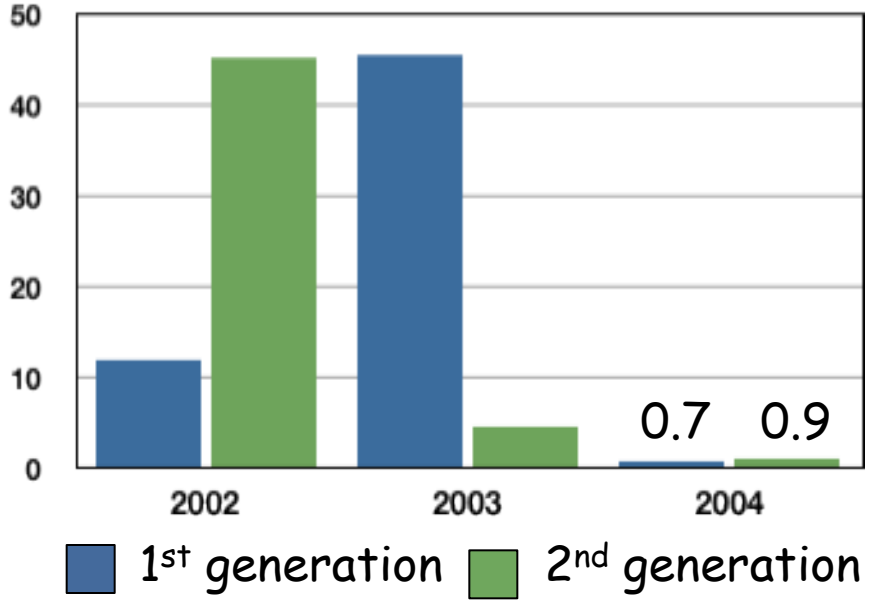
Moths per trap



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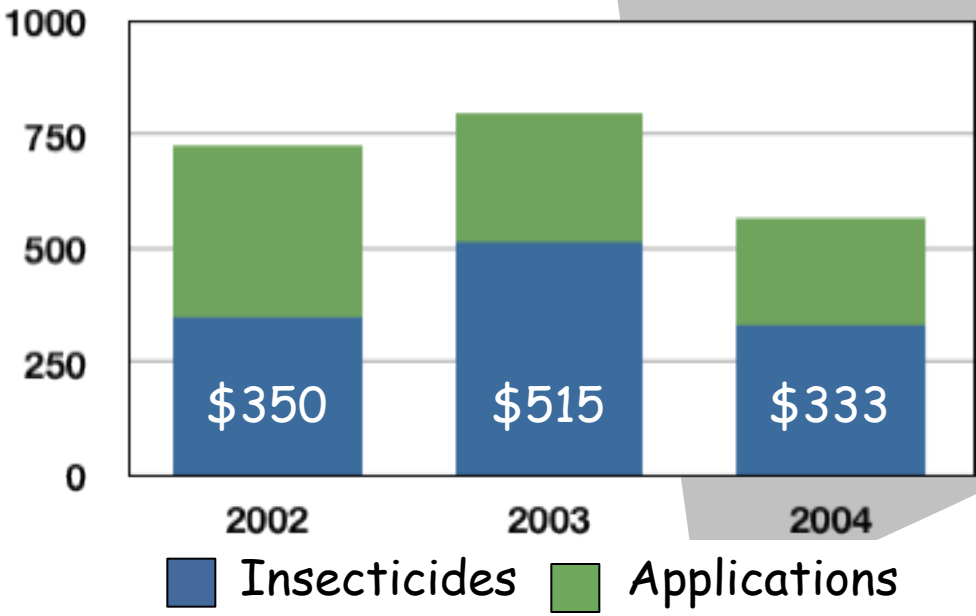
Control costs/A



Codling moth control costs increased in 2003 but declined in 2004 as pest population was reduced to manageable levels

Is it possible to redeem an organic orchard from brink of disaster with current tools?

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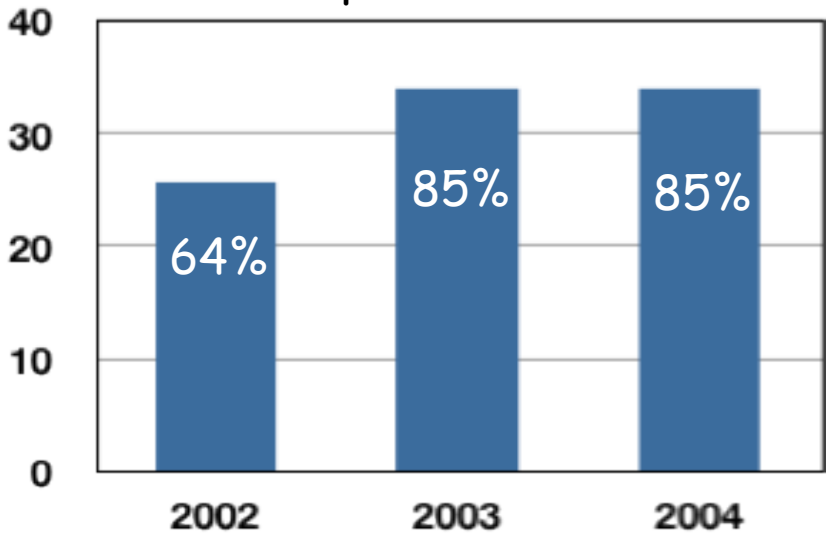
Packed bins per acre



Fruit quality (yield) increased due to successful control of codling moth. Fruit quality maintained even though control costs reduced in 2004.

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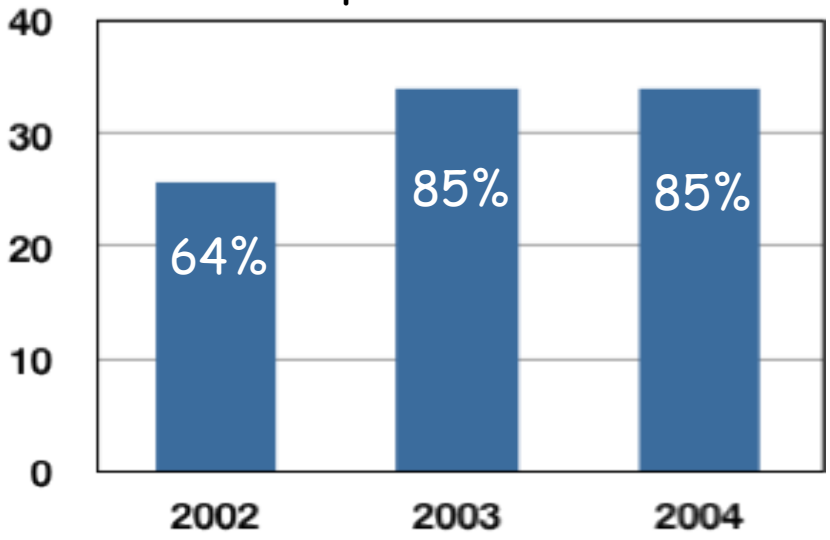

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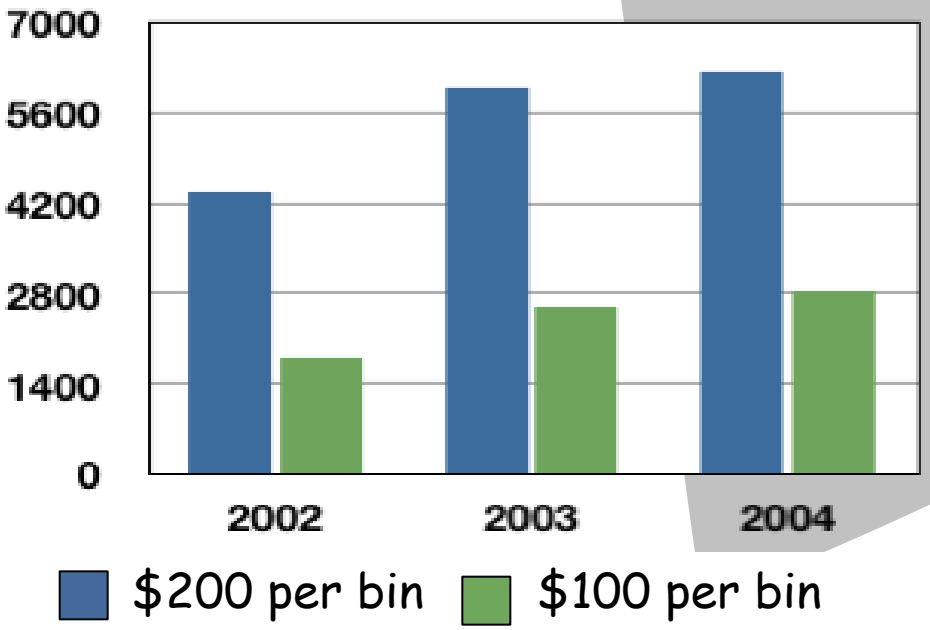
Net return per acre



Bottom line – net return per acre increased even with increase cost of codling mot control due to reduced crop loss.

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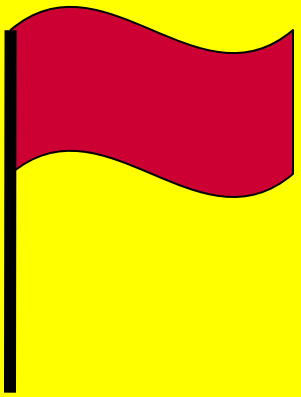


Thysanoptera

- Western flower thrips

True bug control in organic production

Mullein plant bug

Different susceptibilities between apple varieties

Some chemical controls – soaps, neem, pyrethrins (?)

Not identified as major pest by organic producers

Lygus bug

Risk of damage associated with cropping mix and possibly ground cover

Management of ground cover can reduce risk of injury

Fruit injury by Lygus does not show up as a major factor in cullage assessments of apple, conventional or organic

True bug control in organic production

Stink Bugs

Immigration from native habitats late in season

Locally important pest and movements unpredictable

NO known effective organic chemical controls

Multiple species involved – complex varies depending on habitats

Possible control options:

- Lure and kill stations
- Trap crops

True bug control in organic production

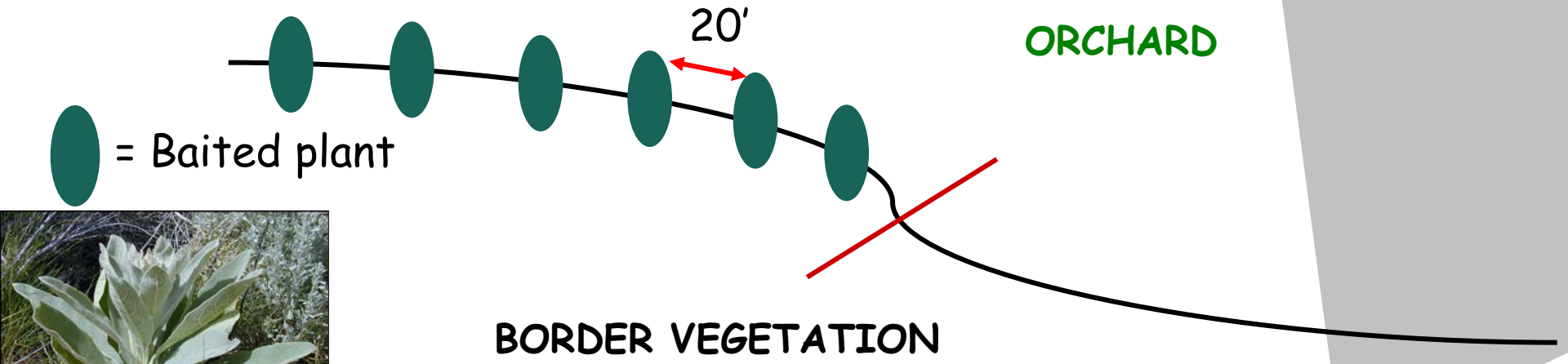
Stink Bugs – Attract and kill approaches

Attract-and-kill:

Lures placed on mullein plants at 20′ intervals along orchard borders

Alternate baited/sprayed (*Carzol with handgun*) blocks with unbaited/unsprayed blocks (400′ sections)

Four orchards were treated then sampled at harvest for injury



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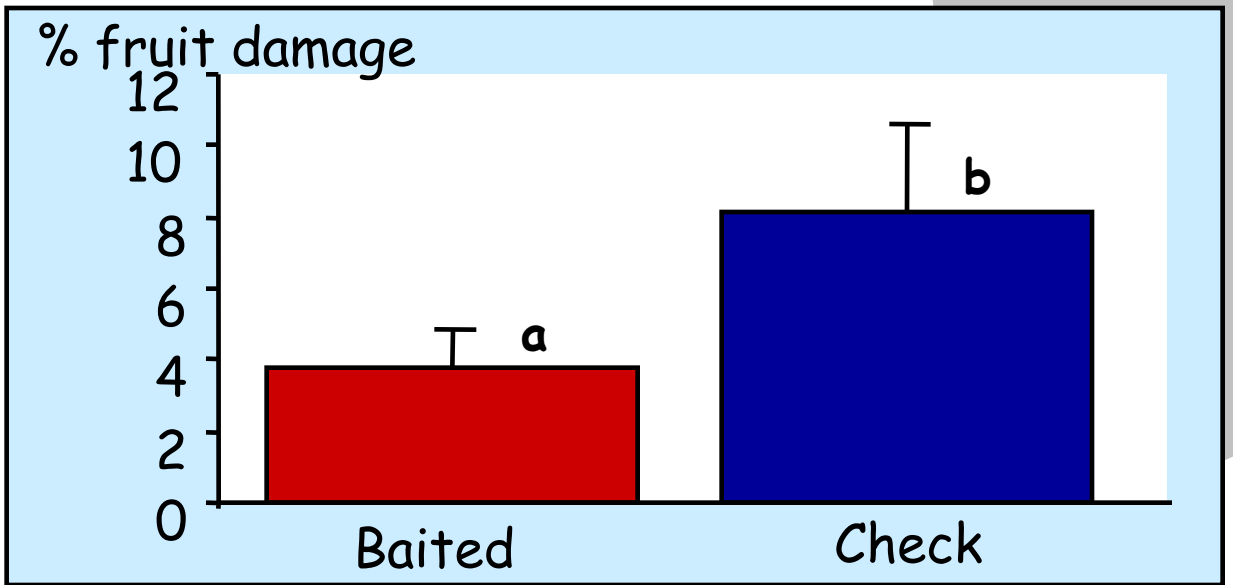
Harvest Damage:
50% reduction in fruit injury



True bug control in organic production

Stink Bugs – Attract and kill approaches

Attract-and-kill:

It might be possible to use pyramid traps as an attract-and-kill technology

Possible to achieve high mortality of bugs treating surface of pyramid traps with effective insecticides

Traps could be placed far enough outside orchards to avoid contamination issues

Concerns over use of multiple pheromones in traps and cost of technology

Threats to Organic Tree Fruit Production in the Western US

- Pheromone technology delisted as an approved organic control – Lose control of KEY Lep pests
- Lose spinosad (Entrust) efficacy due to resistance or delisted as approved control – Lose control of several key pests
- True bugs – no effective controls for most species
- New exotic pests;

  e.g. spotted winded drosophila, brown marmorated stink bug