USDA TART CHERRY ORCHARD MANAGEMENT (RAMP I) FOUR-YEAR SUMMARY FOR UTAH: *"MONITORING AND MANAGEMENT ALTERNATIVES FOR CHERRY FRUIT FLY AND PLUM CURCULIO"*

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2008 NW MI Orchard and Vineyard Show, Traverse City, MI

RAMP Objectives:

- 1A. Develop alternative insect management options for on-farm use (reduce dependency on organophosphate insecticides)
- 1B. Evaluate monitoring and trapping systems
- 1C. Optimize management strategies, tactics, and tools
- 3A. Impacts on ecosystem quality and non-target effects
- 4. Extension and outreach

Develop alternative insect management options for on-farm use (reduce dependency on OP insecticides)

- **A. Western cherry fruit fly**
  - i. Imidacloprid (Provado®)
  - ii. Spinosad formulated as a bait (GF-120®)

Efficacy of new insecticides
Commercial orchard trials

Year	Orch #	Treatment*	# CFF larvae ^
2004	1	Guthion	0
		Provado	0
	2	Dimethoate	0
		Provado	0
	3	Guthion	0
		Imidan	0
		Provado	0
2005	4	Guthion	0 c
		Provado	2.4 a
		GF-120	0.8 b
	5	Guthion	0
		GF-120	0

Year	Orch #	Treatment*	# CFF larvae^
2005	6	Guthion	0
		GF-120	0
	7	Guthion	0
		GF-120	0
2006	8	Provado/Guthion	0
	9	Provado/Imidan	0
	10	Provado/GF-120	0
	11	Provado/GF-120	0
	12	GF-120	0
	13	Provado/Guthion	0.0002
	14	Provado/GF-120	0
	15	Provado/GF-120	0.0004

*Total of 2-6 applications per season, ^Cumulative # CFF larvae per 100 fruit (2,000-5,000 fruit sampled per orchard)

Efficacy of new insecticides
Research orchard trials

Year	Orch #	Treatment*	# CFF larvae^
2004	16	Untreated	44.7 a
		Guthion	1.1 b
		GF-120	0.3 c
2005	17	Untreated	9.3 a
		Guthion	1.3 b
		GF-120	0.1 c
2006	18	Untreated	10.0 a
		GF-120	4.0 b
		GF-120+AC	3.3 b
		GF-120+AA	0.3 c
		Success	2.3 bc
		Provado	1.8 bc

Year	Orch #	Treatment*	# CFF larvae^
2007	19	Untreated	9.1 a
		GF-120	1.9 b
		GF-120+AA	0.8 b
		GF-120+U	1.4 b
		GF-120+TY	0.5 b
		GF-120+CCJ	0.9 b

*Total of 2-6 applications per season; AC=ammonium carbonate, AA=ammonium acetate, U=urea, TY=torula yeast, & CCJ=concentrate cherry juice (10% w/v)

^Cumulative # CFF larvae per 100 fruit (2,000-5,000 fruit sampled per orchard)

Insecticide efficacy summary

- Spinosad (GF-120 and Success) and imidacloprid (Provado) offer greater flexibility in REIs and PHIs than OP insecticides
- GF-120 offers an alternative application method
- The two products differ in pest target stage
  - Provado: larvicide (ovicide), & adulticide
  - Spinosad: adulticide
- GF-120 cannot protect fruit against migrating females that contain mature eggs
  - Prevented fruit injury for orchards $\leq$ ~ 20 cumulative CFF on traps
- Important to rotate applications of neonicotinoid (Provado) with other insecticide classes
  - Stimulation of spider mites

Develop alternative insect management options for on-farm use (reduce dependency on OP insecticides)

- **B. Plum curculio**
  - **i. Influence of temperature and concentration on the performance of two entomopathogenic nematodes (EPNs)**
    - Laboratory – Wax worm larvae
  - **ii. Influence of EPN species and concentration on mortality of plum curculio (PC) life stages**
    - Laboratory – PC Colony
  - **iii. Suppression of PC by EPNs in home yard fruit trees in northern Utah**
    - Field – Brigham City, UT

PC-infested wild plums

EPN-infected PC larvae

Mean number of days required to kill 50% of wax worm last-instar larvae by EPNs

Source	Mean mortality of *G. mellonella* (± SE)
Temperature	
10 °C	14.3 ± 2.3 a
20 °C	3.2 ± 0.3 b
30 °C	3.9 ± 0.5 b
Nematode Species	
H. bacteriophora	8.0 ± 2.2 a
S. feltiae	5.2 ± 0.7 a
Nematode concentration	
20 IJs /larva	6.7 ± 1.6 a
50 IJs / larva	6.5 ± 1.8 a

Wax worm larvae infected with *Heterorhabditis bacteriophora*

Steinernema feltiae

Mean maximum corrected percent mortality of wax worm larvae caused by EPNs

Nematode Concentration	Temperature (°C)	Hb [a] (Mean ± SE)	Sf [b] (Mean ± SE)
20 IJs / larva	10	72.8 ± 20.0	100.0 ± 0.0
	20	98.9 ± 1.1	100.0 ± 0.0
	30	78.2 ± 9.8	61.74± 15.1
50 IJs / larva	10	87.8 ± 12.2	100.0 ± 0.0
	20	100.0 ± 0.0	93.9 ± 6.1
	30	100.0 ± 0.0	95.0 ± 5.0

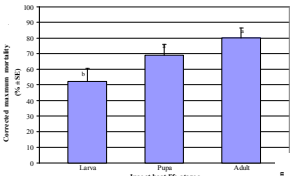
Hb [a] = *H. bacteriophora* and Sf [b] = *S. feltiae*

Influence of temperature and EPN species on total cumulative nematode reproduction

Source	Total cumulative nematode reproduction (± SE)
Temperature	
10 °C	11,150.8 ± 1,720.8 b
20 °C	143,002.6 ± 1,0713.5 a
30°C	113,541.2 ± 1,3883.6 a
Nematode Species	
H. bacteriophora	173,943.5 ± 1,3409.3 a
S. feltiae	63,187.6 ± 5,680.8 b

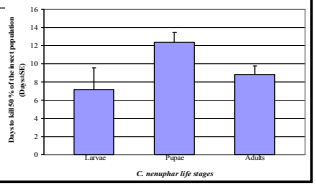
Infective juveniles emerging from insect cadaver

Susceptibility of PC life stages to EPNs

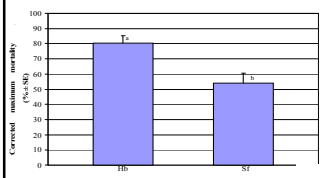


EPN-infected larvae

PC pupae & adult

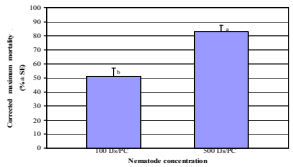


EPN virulence to PC

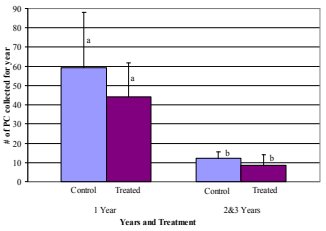


Heterorhabditis-infected larvae

Steinernema-infected larvae



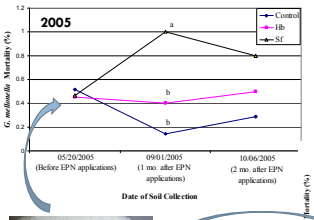
Field suppression of PC with EPNs



EPNs applied with backpack sprayer

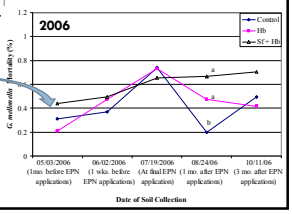
Trunk screen traps monitored PC adults

Recycling (self-perpetuation) of EPNs in the field



Bait field soil for EPNs with wax worm larvae

H. bac. detected before EPNs applied – native EPN



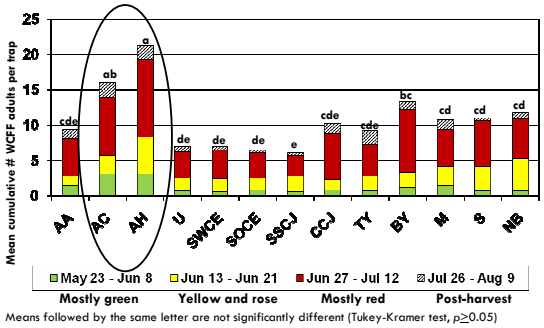
Evaluate monitoring and trapping systems

- A. Western cherry fruit fly
  - Trap placement / position
  - Trap density
  - Adult attractants
    - Traps
    - GF-120 droplets
  - Insecticide effects on adult dispersal

Summary Points on Trap Density and Placement

- Higher trap density increased adult trap catch
  - 3 traps per acre > 1 trap per acre > 4 traps per orchard
- Adult catch on border vs. interior traps varied
  - More adults caught on border than interior traps in some years and orchards
  - Varied with primary source of fruit fly population
  - In one study, greater proportion on border traps were males
  - Males may disperse differently than females
- Percentage of adults caught was greater in orchards with traps on both borders and within interiors
  - First catch was an average of 2.4 days earlier
- Adults were caught earlier in orchards with higher fruit fly densities

Adult attractants on traps

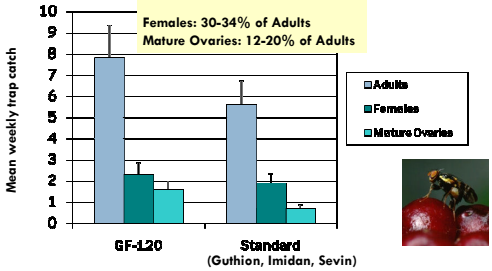


Means followed by the same letter are not significantly different (Tukey-Kramer test, $p \geq 0.05$)

Insecticide effects on adult dispersal

Significant Effect:
Mature Ovaries: GF-120>Standard

Females: 30-34% of Adults
Mature Ovaries: 12-20% of Adults



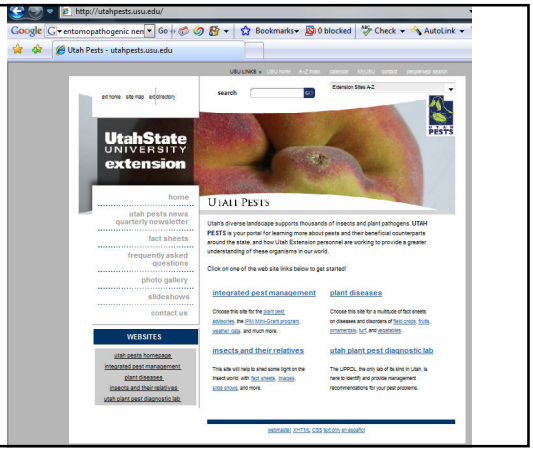
*For 16 traps in each treatment of 6 cherry orchards from late May to mid Aug, 2004 & 2005

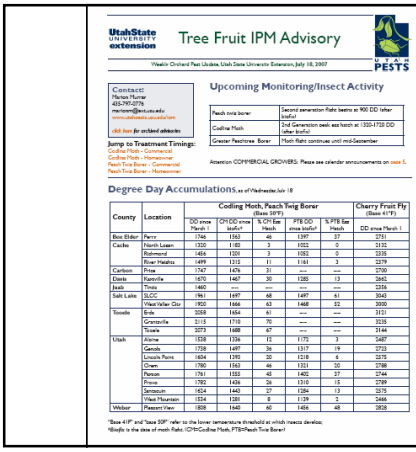
Optimize management strategies, tactics, and tools

- **Western cherry fruit fly**
  - **Provado**
    - Larvicide (within fruit), adulticide (moderate)
    - Minimize application number, rotate with non-neonicotinoids (avoid mite stimulation)
  - **GF-120 (& other spinosad formulations)**
    - Suppress CFF when adult numbers ≤ ~ 20 cumulative per trap
    - Good adulticide, no non-target effects, alternative application method
- **Plum curculio**
  - **EPNs for population suppression**
    - Not stand-alone control, 2-3 years of use substantially reduced PC densities, target summer generation
    - A fit with diverse, multi-pronged IPM strategies
    - Potential for recycling (self-perpetuation)

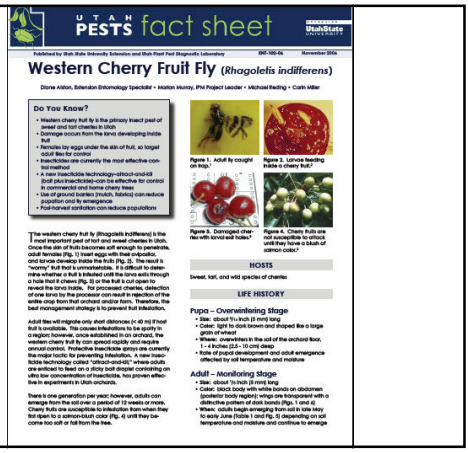
Extension and Outreach

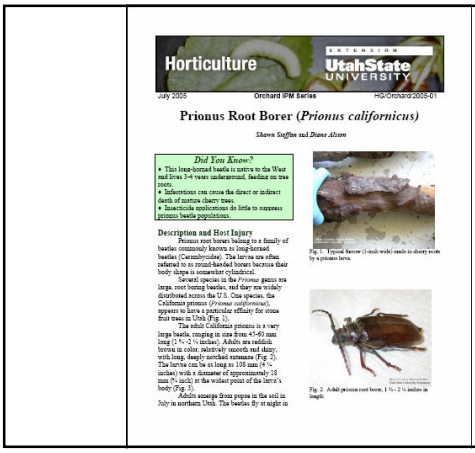
- **2004-07**
  - **13 meetings & field days**
  - **Over 640 face-to-face contacts**
- ***Utah Pests* web page**
  - www.utahpests.usu.edu
    - Pest advisory service
    - Orchard spray timing advisories
    - Photo gallery (pests & natural enemies)
    - Research reports, slideshows, other resources
    - Extension publications / fact sheets

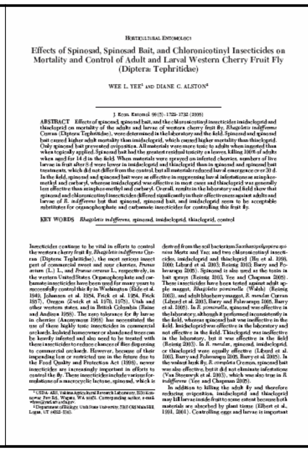




Example of weekly Tree Fruit IPM Advisory







Horticultural Entomology

Effects of Spinosad, Spinosad Bait, and Chloronicotinyl Insecticides on Mortality and Control of Adult and Larval Western Cherry Fruit Fly (Diptera: Tephritidae)

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J. Econ. Entomol. 99(5): 1722–1732 (2006)

ABSTRACT Effects of spinosad, spinosad bait, and the chloronicotinyl insecticides imidacloprid and thiacloprid on mortality of the adults and larvae of western cherry fruit fly, *Rhagoletis indifferens* Curran (Diptera: Tephritidae), were determined in the laboratory and the field. Spinosad and spinosad bait caused higher adult mortality than imidacloprid, which caused higher mortality than thiacloprid. Only spinosad bait prevented oviposition. All materials were more toxic to adults when ingested than when topically applied. Spinosad bait had the greatest residual toxicity on leaves, killing 100% of adults when aged for 14 d in the field. When materials were sprayed on infested cherries, numbers of live larvae in fruit after 8 d were lower in imidacloprid and thiacloprid than in spinosad and spinosad bait treatments, which did not differ from the control, but all materials reduced larval emergence over 30 d. In the field, spinosad and spinosad bait were as effective in suppressing larval infestations as azinphos-methyl and carbaryl, whereas imidacloprid was effective in most cases and thiacloprid was generally less effective than azinphos-methyl and carbaryl. Overall, results in the laboratory and field show that spinosad and chloronicotinyl insecticides differed significantly in their effectiveness against adults and larvae of *R. indifferens* but that spinosad, spinosad bait, and imidacloprid seem to be acceptable substitutes for organophosphate and carbamate insecticides for controlling this fruit fly.

KEY WORDS *Rhagoletis indifferens*, spinosad, imidacloprid, thiacloprid, control

Research publication on neonicotinoid and spinosad efficacy on cherry fruit fly

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