

Alternative Pest Management Practices for Fruit

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Introduction

- Soft alternative apple pest management tactics:
 - Plum curculio (PC) trap trees in edge rows baited with benzaldehyde (BA) & aggregation pheromone grandisoic acid (GA) attracted more PC than did unbaited trees (Prokopy et al. 2003).
 - Bacillus thuringiensis* (Bt) killed Oriental fruit moth (OFM) & granulosus virus (CpGV) killed codling moth (CM) (Polesny et al. 2000, Simon et al. 1999, Minarro and Dapena 2000, Rashid et al. 2001).
 - Stapling cardboard strips to apple trunks controlled CM making organic apple production viable in British Columbia (Judd et al. 1997).

Objectives

- To compare PC damage in trees baited with BA & GA to unbaited trees
- To compare insecticide treatments: soft [Entrust (Spinosad), Javelin (Bt), Cyd-X (CpGV)]; and synthetic [Guthion & Calypso (Thiacloprid)]
- To compare fruit damage in conventional & alternative spray blocks

Methods

Early April 2004 and 2005 (bloom), every 5th apple tree in the orchard perimeter by the woods was baited with 8 BA & 2 GA lures (5 replicates) (Photo A & B). Fifty fruit per tree were inspected for PC damage in late May (Photo C). In 2004, one tree plots (5 replicates) in a RCBD were treated with: Guthion or Calypso on 17 & 26 May, 24 June & 8 July; and Cyd-X, Javelin, or Entrust on 17, 26 May, 24 June, 1 & 8 July (Table 2). These treatments were applied weekly to two other blocks from 24 August to 15 September. Fifty fruit per tree were inspected for damage.

Tables 3 & 4 lists sprays applied in 2004 & 2005 to a conventional (1 A) & an alternative (2 A) apple block. Percent CM & OFM larval damaged fruit (Photo D) were recorded for each generation & at harvest. On 8 September 2004, 80+ trees in both blocks had cardboard strips stapled to trunks (Photo E). In late November or early December, strips were removed & dissected to determine the number of overwintering CM larvae.

Table 1. Plum curculio (PC) fruit damage in baited & unbaited apple trees in perimeter row by woods

Year - Tree size- Treatment	% PC fruit damage
2004 - Intermediate-sized trees	
Bait + pyramid trap	17.0 a
No bait + pyramid trap	5.2 b
No bait, no pyramid trap	2.5 b
2005 - Small-sized trees	
Bait	11.6 a
No bait	3.6 b
2005 - Standard-sized trees	
Bait	25.0 a
No bait	33.8 a

Photo A) BA=benzaldehyde B) GA=grandisoic acid C) PC damage D) CM or OFM damage & E) cardboard strip

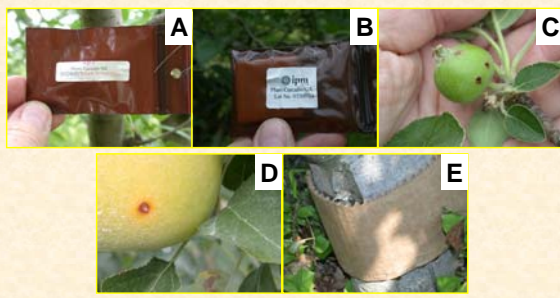


Table 2. Effects of Guthion and alternative insecticides on apple fruit damage by codling moth (CM) and Oriental fruit moth (OFM) in Springdale, AR (2004)

Sample Date	Treatment	% CM larvae	% OFM larvae	% New damage
25 May Pre-trt	Cyd-X	0 a ¹	2.4 a	8.0 a
	Javelin	0 a	0.8 b	7.2 a
	Calypso	0 a	0.6 b	5.6 a
	Entrust	0.6 a	0.6 b	8.4 a
	Guthion	0.2 a	1.4 ab	6.0 a
11 June	Check	0.2 a	0.8 b	7.4 a
	Cyd-X	0.4 a	0.4 b	1.2 b
	Javelin	0 a	0.2 b	1.8 ab
	Calypso	0 a	0.2 b	2.0 b
	Entrust	0.4 a	0.2 b	1.4 b
16 July	Guthion	0 a	0 b	0 c
	Check	0.4 a	1.2 a	3.8 a
	Cyd-X	0 a	1.2 a	6.4 a
	Javelin	0.2 a	0.4 a	2.6 b
	Calypso	0 a	0.2 a	0.6 c
	Entrust	0 a	0.6 a	2.2 b
	Guthion	0.2 a	0.2 a	1.2 bc
	Check	0 a	1.2 a	9.2 a

Table 3. Insecticides & 3M Sprayable OFM applied for mating disruption (MD) to two apple blocks in Berryville, AR (2004)

Date	DD (CM OFM) ¹	Conventional	Alternative
21 May	74 936		4,000 <i>N. fallacis</i> / A
24 May	147 1023	Intrepid (IGR)	Intrepid
31 May	305 1217	Guthion	Cyd-X + Entrust
3 June	372 1299	Intrepid + Guthion	Cyd-X + Entrust
10 June	534 1495		Cyd-X + Entrust
17 June	722 1718	Guthion	Cyd-X + Entrust
24 June	867 1900	MD	Cyd-X + Xentari
2 July	1043 2114		Cyd-X + Entrust
6 July	1150 2239	Intrepid	
12 July	1300 2400	MD	Cyd-X
17 July	1450 2602	Intrepid	Cyd-X
26 July	2900 2890	MD	
9 Aug.	2000 3276		Cyd-X
17 Aug.	2150 3460	Diamond (IGR)	Cyd-X + Xentari
21 Aug.	2250 3571	Cyd-X	Cyd-X + Xentari
8 Sept.	2705 4117		Cardboard on trunks
2-10 Dec.			Removed strips

¹ DD = cumulative degree-days after 1st significant trap catch of OFM (base 45°F) on 25 March or CM (base 50°F) on 18 May

Table 4. Insecticides or Isomate-C dispensers applied for mating disruption to two apple blocks in Berryville, AR (2005)

Date	DD (CM OFM)	Conventional	Alternative
3 May	42 96	Sevin + 200 Isomate-C TT	250 Isomate-C+
10 May	149 237	Esteem	
16 May	245 363	Cyd-X + Calypso	Cyd-X
23 May	395 549	7,500 <i>N. fallacis</i> / A + Cyd-X + Intrepid	Cyd-X + Entrust
1 June	535 736	Pyramite (10 trees by road)	7,500 <i>N. fallacis</i> / A
13 June	841 1101		Acramite on 1 side
23 June	1094 1393	Calypso	
28 June	1255 1580		Cyd-X + Dipel
14 July	1702 2114		Cyd-X + Dipel
28 July	2190 2671	Intrepid	Cyd-X + Dipel
		Placed cardboard strips on trunks	
9 Aug.	2538 3080	Diamond+Cyd-X+Surround	Cyd-X + Dipel
18 Aug.	2823 3410	Cyd-X+Surround	Cyd-X + Javelin
25 Aug.	3048 3670	Diamond + Cyd-X	Cyd-X + Javelin
17 Nov.			Removed cardboard strips

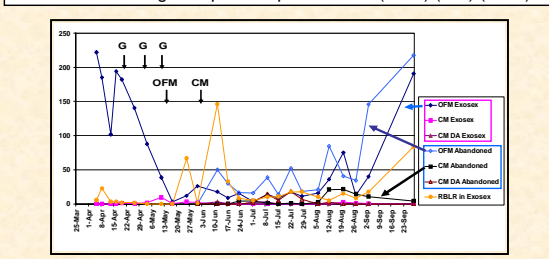
¹ DD = cumulative degree-days after 1st significant trap catch of OFM (base 45°F) on 25 March or CM (base 50°F) on 4 May

Table 5. Percent CM fruit damage & number of live CM larvae per cardboard strip on trunks in conventional & alternative insecticide blocks in Berryville, AR (2004 and 2005)

Date	Conventional		Alternative	
	2004	2005	2004	2005
1 July		0.02		0.01
9 July	0		0	
16 July	2.5		0	
23 July	0.2	0.02	0.2	0.02
2 Aug.	1.5		0.8	
10 Aug.	1.3	0.03	1.7	0.01
24 Aug.	1.8	0.04	3.0	0
1 Sept.	1.5	0	1.0	0.1
8 Sept.	1.5		6.7 ¹	
15 Sept.	Harvest		12.0 ¹	
22 Sept.			Harvest	
No. CM/strip	1.8 ²	0.75 ²	0.24 ²	0.06 ²

¹ Mostly frass on fruit with larval tunnels < 1/4" depth
² Number of CM larvae per cardboard strip stapled on trunks in 2004 & 2005 in conventional (106 & 118 trees) and alternative (114 & 80 trees) blocks

Fig. 1. Number of CM, OFM & RBLR per pheromone or DA kairomone trap in abandoned & treated apple blocks = Guthion (G) + 10 Exosex mating disruption dispensers / A (OFM) (CM) (2004)



Results

- PC baited apple trees (Table 1):**
 - PC damage in small to intermediate-size baited trees > unbaited trees = baited trees
 - PC damage similar in baited and unbaited standard-size trees
 - Scouting only baited trees in perimeter for new PC damage could aid timing PC sprays
- Alternative sprays in 2004 (Table 2; Fig. 1):**
 - Abandoned block in June - OFM larval damage in check, Javelin & Cyd-X trees > Guthion, Calypso & Entrust (779 OFM / trap / season)
 - Commercial block in August - CM larval damage in check & Javelin trees > Cyd-X or Cyd-X + Javelin (55 CM & 12 OFM / trap / season)
 - Cardboard strips - more overwintering CM larvae in check trees than trees treated with Cyd-X or Javelin
- Season total baited trap catch dropped from 2004 (Fig. 2) to 2005 (Fig. 3):**
 - 2004: 12.6 OFM; 55.0 CM/trap; 34.9 CM/DA kairomone trap; & 596 RBLR
 - 2005: 4.9 OFM; 34.9 CM/trap; 29.2 CM/DA kairomone trap; & 483 RBLR
 - 2004 and 2005: OFM populations were < 1.3 moths/trap/week = justification for no OFM management tactics in 2005
- Release predator mites in late May 2004 & 2005 (Table 3 & 4; Fig. 3):**
 - Conventional block - 5 mites/leaf peak on 1 June
 - Alternative block - had < 1 mite/leaf all season
- From 2004 to 2005 (Table 5):**
 - Conventional block CM counts drop from:
 - 1.5 to 0.05% damage with deep tunneling
 - 1.8 to 0.75 overwintering larvae / cardboard strip
 - Alternative block CM counts drop from:
 - 12 to 0% frass damage with shallow tunneling (< 1/4" depth)
 - 0.2 to 0.06 overwintering larvae / cardboard strip

Fig. 2. Number of CM, OFM and RBLR in orchard with 3M Sprayable OFM pheromone (3M) in 2004

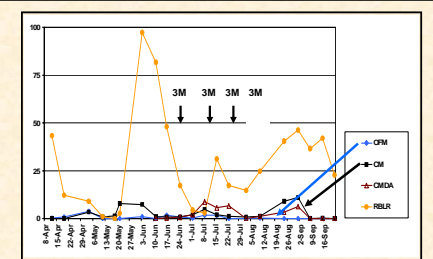
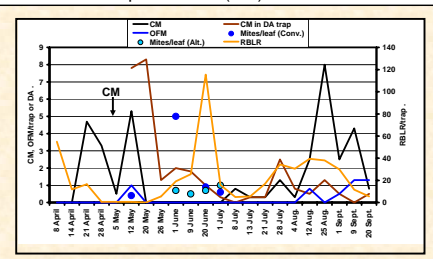


Fig. 3. Number of CM, OFM, RBLR & European red mites in conventional & alternative blocks with 200+ Isomate-CM dispensers / A (CM) in 2005



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