



2009-2011 IPM Summary

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UVM OrganicA Research Project:

- Five high-value varieties
 - Gingergold, Honeycrisp, Liberty, Macoun, Zestar!
- Orchard 1
 - High density (580 trees/acre), trellised vertical axe
 - New planting in prepped ground
 - Mulched or cultivated tree row
- Orchard 2
 - Topworked 18 year-old M26 planting
 - Mowed sod tree row

UVM OrganicA Research Project: Orchard 1



UVM OrganicA Research Project: Orchard 2



Orchard 1 Cytokinin Trial, 2009-2010

- Poor growth and fruit yield in Orchard 1 through 2008 led to biostimulant study
 - Seacrop 16 (North American Kelp)
 - Stimplex (Acadian Agritech)
 - Both contain cytokinin isolates from *A. nodosum*
- Split-plot design of three treatments (Seacrop16, Stimplex, NTC) foliar applied at recommended field rates
- Mostly no effects from either material during study

UVM OrganicA Research Project: Expectations

- Diseases:
 - Apple scab primary disease of concern
 - Susceptible cultivars, require mineral fungicide spray program
 - Foliar rust, fruit rots may be an issue under organic management
- Insects:
 - The usual suspects: plum curculio, European apple sawfly, codling moth, other leps



2009-2011 Rainfall

Monthly Rainfall (inches) 2009-2011						
	2009		2010		2011	
	Measured	Dev from 20 yr avg	Measured	Dev from 20 yr avg	Measured	Dev from 20 yr avg
Apr	6.42	3.60	3.08	0.26	7.88	5.06
May	6.15	2.70	1.52	-1.93	8.67	5.22
Jun	1.9	-1.79	5.87	2.18	3.52	-0.17
Jul	2.49	-1.66	2.25	-1.90	3.68	-0.47
Aug	5.72	1.81	3.51	-0.40	6.11	2.20
Total	22.68	<u>4.66</u>	16.23	-1.79	29.86	<u>11.84</u>

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Jun	1.9	-1.79	5.87	2.18	3.52	-0.17
Jul	2.49	-1.66	2.25	-1.90	3.68	-0.47
Aug	5.72	1.81	3.51	-0.40	6.11	2.20
Total	22.68	<u>4.66</u>	16.23	-1.79	29.86	<u>11.84</u>

2009 Spray Program

# Apps	Material	Active Ingredient	1° Target Pest
1	Champ WG	Copper	FB
3	Microthiol Disperss	Sulfur	AS
9	Miller Lime Sulfur	Lime Sulfur	AS
3	Dipel	<i>Bt</i>	Lep
3	Entrust	Spinosad	Lep, AMF
2	JMS Stylet Oil	Mineral Oil	MT
5	Surround	Kaolin	PC, EAS, CM
1	Trilogy	Neem Oil	EAS

2010 Spray Program

# Apps	Material	Active Ingredient	1° Target Pest
2	Agri-mycin 17	Streptomycin	FB
1	Champ WG	Copper	FB
7	Microthiol Disperss	Sulfur	AS
6	Miller Lime Sulfur	Lime Sulfur	AS
2	Aza-Direct 1.2L	Neem Extract	TPB,CM
3	Dipel	<i>Bt</i>	Lep
1	Entrust	Spinosad	Lep, AMF
1	JMS Stylet Oil	Mineral Oil	MT
1	PyGanic	Pyrethrum	EAS
6	Surround	Kaolin	PC, EAS, CM

2011 Spray Program

# Apps	Material	Active Ingredient	1° Target Pest
1	Champ WG	Copper	FB
6	Microthiol Disperss	Sulfur	AS
6	Miller Lime Sulfur	Lime Sulfur	AS
1	Aza-Direct 1.2L	Neem Extract	TPB
9	Cyd-X	Granulosis virus	CM
12	Dipel	<i>Bt</i>	Lep
4	Entrust	Spinosad	Lep, AMF
3	JMS Stylet Oil	Mineral Oil	MT
9	Surround	Kaolin	PC, EAS, CM

Apple Scab



Foliar Scab

Orchard 1

Cultivar	Foliar Apple Scab		
	% Incidence		
	2009	2010	2011
Ginger Gold	10.56 a	1.46 a	7.99 a
Honeycrisp	0.49 c	0 b	0.40 b
Liberty	0 c	0 b	0 b
Macoun	2.34 b	1.40 a	0.98 b
Zestar!	4.03 b	1.14 a	2.40 b

Orchard 2

Cultivar	Foliar Apple Scab		
	% Incidence		
	2009	2010	2011
Ginger Gold	19.42 ab	2.53 ab	17.30 a
Honeycrisp	0 c	0.05 b	0.10 c
Liberty	0 c	0 b	0 c
Macoun	30.75 ab	3.68 a	9.11 ab
Zestar!	6.95 b	0.91 ab	2.64 bc

Fruit Scab

Orchard 1

Cultivar	Fruit Scab		
	% Incidence		
	2009	2010	2011
Ginger Gold	2.44 a	0	0.42
Honeycrisp	0.22 b	0	0
Liberty	0 b	0	0
Macoun	1.78 ab	0.22	0
Zestar!	0.22 b	0.22	0.63

Orchard 2

Cultivar	Fruit Scab		
	% Incidence		
	2009	2010	2011
Ginger Gold	13.48 a	0.11	0.43
Honeycrisp	0 b	0	0
Liberty	0 b	0	0
Macoun	3.92 ab	0	0
Zestar!	1.4 b	0.13	0.25

2009 Scab in Orchard 2

- Assessment after 1^o scab season:
 - 2 lesions / ~3000 leaves Orchard 1
 - 0 lesions / ~ 2200 leaves Orchard 2
- Match Equipment to Planting, IPM *or* Organic



Rust Diseases



Foliar Rust

Orchard 1

Cultivar	Foliar Rust		
	% Incidence		
	2009	2010	2011
Ginger Gold	37.07 a	19.91 b	51.15 a
Honeycrisp	43.36 a	27.03 a	54.26 a
Liberty	7.18 bc	16.56 bc	30.75 b
Macoun	9.64 b	15.57 bc	26.02 b
Zestar!	5.99 c	12.95 c	29.47 b

Orchard 2

Cultivar	Foliar Rust		
	% Incidence		
	2009	2010	2011
Ginger Gold	43.08 a	24.88 a	41.32 b
Honeycrisp	40.23 a	20.28 ab	54.32 a
Liberty	14.56 b	12.75 b	31.97 bc
Macoun	12.6 b	14.9 b	27.96 cd
Zestar!	4.9 c	13.54 b	21.11 d

Fruit Rust

Orchard 1

Cultivar	Fruit Rust		
	% Incidence		
	2009	2010	2011
Ginger Gold	5.14 a	6.03 a	39.06 a
Honeycrisp	4.02 a	0.26 b	17.29 b
Liberty	0.89 b	0 b	37.92 a
Macoun	0 b	0.25 b	4.81 c
Zestar!	0 b	1.94 b	15.44 b

Orchard 2

Cultivar	Fruit Rust		
	% Incidence		
	2009	2010	2011
Ginger Gold	10.43 a	6.32 a	25.81 a
Honeycrisp	8.41 a	0.89 b	7.52 b
Liberty	1.3 b	1 b	27.04 a
Macoun	0.29 b	0.17 b	2.40 b
Zestar!	1.15 b	1 b	17.30 a

Fungal Rots



Necrotic Leaf Spots

Orchard 1

Cultivar	Necrotic Leaf Spot		
	% Incidence		
	2009	2010*	2011
Ginger Gold	23.52 b	5.08 b	6.51 c
Honeycrisp	4 d	1.15 c	3.75 c
Liberty	13.96 c	2.97 bc	6.01 c
Macoun	38.49 a	14.6 a	31.48 a
Zestar!	45.78 a	15.45 a	18.70 b

Orchard 2

Cultivar	Necrotic Leaf Spot		
	% Incidence		
	2009	2010	2011
Ginger Gold	22.28 b	6.68 bc	9.73 b
Honeycrisp	3.85 c	1.63 c	1.80 c
Liberty	21.31 b	4.33 c	6.38 bc
Macoun	41.91 a	15.85 a	31.16 a
Zestar!	47.6 a	11.39 ab	9.29 b

Necrotic Leaf Spot: Orchard 1 Kelp Extract Treatments, 2010

	2010 Percent of terminal leaves with NLS, August					
	NTC		Stimplex		Seacrop16	
					All	
Ginger Gold	3.7		5.8		5.8	5.1 b
Honeycrisp	0.7		0.4		2.3	1.2 c
Liberty	4.4		1.9		2.6	3.0 bc
Macoun	11.8		12.5		19.5	14.6 a
Zestar!	17.7		11.5		17.2	15.5 a
All	7.6	AB	6.4	B	9.5	A
P-values from Two-Way ANOVA					cultivar	p<0.01
					kelp	p=0.04
					cultivar x kelp	p=0.10

Numbers followed by the same letter within a row or column do not differ at $\alpha=0.05$

Fruit Rot

Orchard 1

Cultivar	Fruit Rot		
	% Incidence		
	2009*	2010	2011
Ginger Gold	2.22 ab	0.47 b	3.85 b
Honeycrisp	4.11 a	9.20 a	2.64 b
Liberty	0 b	5.32 ab	2.71 b
Macoun	0 b	0.22 b	1.27 b
Zestar!	3.07 a	1.25 b	12.31 a

Orchard 2

Cultivar	Fruit Rot		
	% Incidence		
	2009	2010	2011
Ginger Gold	1.59	7.10 b	19.81 a
Honeycrisp	4.14	32.69 a	16.41 a
Liberty	3.13	10.92 b	17.50 a
Macoun	0.88	5.63 b	3.47 b
Zestar!	4.45	9.61 b	12.51 ab

Fruit with Rots:

Orchard 1 Kelp Extract Treatments, 2009

	2009 Percent of fruit with rots							
	NTC ^y		Stimplex ^x		Seacrop16 ^x		All	
Ginger Gold	4.0		0.0		2.7		2.2	ab ^w
Honeycrisp	0.0	B	7.7	A	4.7	AB	4.1	a
Liberty	0.0		0.0		0.0		0.0	b
Macoun	0.0		0.0		0.0		0.0	b
Zestar!	1.3		4.8		3.1		3.1	a
All	1.1		2.5		2.1			
P-values from Two-Way ANOVA					cultivar		p<0.01	
					kelp		p=0.21	
					cultivar x kelp		p<0.01	

Numbers followed by the same letter within a row or column do not differ at $\alpha=0.05$

2009-2011 Synopsis: Disease

- Apple scab less of a problem than anticipated
 - Full, seasonal coverage with sulfur and liquid lime sulfur sprays have generally been effective in maintaining fruit scab <1%
 - Foliar scab has been more difficult
 - Management demands good sanitation, sprayer coverage, timing

2009-2011 Synopsis: Disease

- Rusts remain problematic
 - Habitat modification by removal of wild hosts is important
 - So far, little management effect apparent from scab sprays
 - Future research plan in no/reduced sulfur orchard

2009-2011 Synopsis: Disease

- Fruit rots especially troublesome
 - Increasing annually on some cultivars, especially in Orchard 2
 - Rots downgrade fruit to 'cull'
 - Future research:
 - Is sulfur/lime sulfur damaging lenticels and leading to increased rot susceptibility?
 - Can orchard sanitation tactics reduce incidence of rots?

Foliar European Red Mites

Orchard 1

Cultivar	Foliar European Red Mites		
	% Incidence		
	2009	2010	2011
Ginger Gold	97.36	91.44 a	100.00
Honeycrisp	96.79	91.43 a	100.00
Liberty	98.76	75.74 b	99.74
Macoun	96.56	87.88 a	99.74
Zestar!	96.55	90.75 a	99.67

Orchard 2

Cultivar	Foliar European Red Mites		
	% Incidence		
	2009	2010	2011
Ginger Gold	92.17	88.39	98.81
Honeycrisp	91.96	94.82	98.44
Liberty	86.73	87.65	94.00
Macoun	83.70	92.27	92.92
Zestar!	82.26	90.51	92.78

Fruit Arthropod Damage Assessment



Surface Lepidoptera Damage on Fruit

Orchard 1

Cultivar	Surface Lepidoptera Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	6.03 b	42.17 a	13.33 b
Honeycrisp	9.33 ab	21.94 abc	15.76 ab
Liberty	9.78 ab	14.78 bc	9.79 bc
Macoun	15.71 a	13.16 c	4.58 c
Zestar!	10.12 ab	31.14 ab	23.28 a

Orchard 2

Cultivar	Surface Lepidoptera Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	9.26	48.53 a	18.59 b
Honeycrisp	9.55	9.98 b	35.72 a
Liberty	10.82	13.96 b	17.17 b
Macoun	17.75	15.62 b	14.80 b
Zestar!	9.31	53.69 a	19.49 b

Internal Lepidoptera Damage on Fruit

Orchard 1

Cultivar	Internal Lepidoptera Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	4.59a	3.39c	1.35b
Honeycrisp	0.44b	54.48a	3.47b
Liberty	1.33ab	31.69b	3.33b
Macoun	1.26ab	22.20b	3.96b
Zestar!	3.92a	14.42bc	12.82a

Orchard 2

Cultivar	Internal Lepidoptera Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	10.54a	12.11c	4.69
Honeycrisp	3.33b	59.41a	9.82
Liberty	3.44b	41.95ab	9.29
Macoun	2.18b	24.17bc	7.07
Zestar!	5.57ab	17.84c	9.14

Total CM Trap Captures per Year

Seasonal total CM per orchard/block per trap, UVM Horticulture Research Farm

Block	Unmanaged Orch 3	IPM	Orch 1	Orch2
2009	189	89	17	53
2010	64	144	117	163
2011	120	185	163	255

Plum Curculio Damage on Fruit

Orchard 1

Cultivar	Plum Curculio Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	0.67	15.08 ab	6.98ab
Honeycrisp	4.44	2.22 b	11.04 a
Liberty	0.89	28.90 a	5.63ab
Macoun	0.98	24.60 a	4.38b
Zestar!	0.47	12.89 ab	10.95 a

Orchard 2

Cultivar	Plum Curculio Damage		
	% Incidence		
	2009	2010	2011
Ginger Gold	5.47	6.04	5.60ab
Honeycrisp	17.75	11.77	9.77 ab
Liberty	12.77	11.42	5.98ab
Macoun	11.82	9.67	1.60b
Zestar!	13.31	10.48	10.95 a

Tarnished Plant Bug Damage on Fruit

Orchard 1

Cultivar	Tarnished Plant Bug Damage			
	% Incidence			
	2009	2010		2011
Ginger Gold	10.76	22.79	a	8.23
Honeycrisp	12.22	11.88	ab	9.38
Liberty	12.22	5.93	b	11.46
Macoun	8.80	10.45	ab	10.42
Zestar!	10.99	13.77	ab	10.03

Orchard 2

Cultivar	Tarnished Plant Bug Damage			
	% Incidence			
	2009	2010		2011
Ginger Gold	20.13	14.40		9.52
Honeycrisp	14.04	9.46		9.61
Liberty	17.90	9.55		7.20
Macoun	14.13	9.87		10.13
Zestar!	14.60	8.48		4.76

Apple Maggot Fly Damage on Fruit

Orchard 1

Cultivar	Apple Maggot Fly Damage			
	% Incidence			
	2009*	2010		2011
Ginger Gold	0.22	0.22	ab	0b
Honeycrisp	0.00	2.09	a	0b
Liberty	0.44	0.00	b	0b
Macoun	0.00	0.00	b	0b
Zestar!	0.22	0.00	b	0.63 a

Orchard 2

Cultivar	Apple Maggot Fly Damage			
	% Incidence			
	2009	2010		2011
Ginger Gold	0.53	0.11		0.21
Honeycrisp	1.37	0.32		0.42
Liberty	0.76	0.00		0.00
Macoun	0.71	0.00		0.40
Zestar!	0.41	0.25		0.00

Apple Maggot Fly Damage on Fruit: Orchard 1 Kelp Extract Treatments, 2009

	2009 Percent fruit with apple maggot damage						
	NTC		Stimplex		Seacrop16		All
Ginger Gold	0.7		0.0		0.0		0.2
Honeycrisp	0.0		0.0		0.0		0.0
Liberty	1.3		0.0		0.0		0.4
Macoun	0.0		0.0		0.0		0.0
Zestar!	0.7		0.0		0.0		0.2
All	0.5	A ^w	0.0	B	0.0	B	
P-values from Two-Way ANOVA F-test					cultivar		p=0.41
					kelp		p=0.01
					cultivar x kelp		p=0.45

Numbers followed by the same letter within a row or column do not differ at $\alpha=0.05$

2009-2011 Arthropod Synopsis:

- AMF essentially not present
 - Active elsewhere on the farm
 - Removal of wild hosts reduced population?
 - Entrust efficacy?
- TPB, PC, EAS sporadically problematic
 - Intensive spray schedule
 - Addition of neem @ pink reduced fruit drop from EAS as observed in 2008
 - Damage rarely or uncommonly downgrades fruit @ packout

2009-2011 Arthropod Synopsis: Mites

- Phytophagous mites are a serious and increasing problem in both orchards
 - Despite seeding both orchards with *T. pyri* predators
- Sulfur, lime sulfur, and Surround all have shown reductions in predatory mites populations and subsequent flareups of phytophagous mites in previous studies
 - Kelp-extract applications showed no effect in two years of study
- Future research:
 - How to reduce phytophagous mite-suppressive sprays
 - Use of crop oils later in season to suppress mite buildups

2009-2011 Arthropod Synopsis: Mites

- Future research:
 - Pest management strategies to reduce phytophagous mite-suppressive sprays
 - Use of crop oils (mineral oil/neem/botanical extracts) later in season to suppress mite buildups

2009-2011 Arthropod Synopsis: Leps

- 'Surface'
 - OBLR, RBLR, GFW, early CM?
 - Sublethal materials (Bt, carpovirusine) may allow some surface damage?
- 'Internal'
 - CM, probably not OFM
 - Carpovirusine
 - Reduced CM in 2011 but still high, and at high cost
 - 2012- Explore addition of mating disruption to improve management
 - Conventional wisdom- plots should be large and contiguous

Challenges & Future Research



- **Non-Target Impacts of Scab Management (Sulfur and Lime Sulfur)**
- **Rust Management**
- **ERM Management**
- **Fruit Rots**
- **Codling Moth Management**

Orchard 4 - High Density, Scab-Resistant



2011

**Crimson Crisp
Crimson Gold
Crimson Topaz
Williams Pride
Winecrisp
Querina
Galarina**



OrganicA

a resource for organic apple production

- Organic Apple Website
<http://www.uvm.edu/organica/>

 OrganicA - a resource for organic apple production

Practical Guide for Organic Apple Production

[Organic Basics](#) - [Horticulture](#) - [Organic IPM](#) - [Economics & Marketing](#) - [Listserves & Blogs](#)

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~ [Practical Guide for Organic Apple Production](#) ~

The goal of this publication is to share the authors' experiences and knowledge about organic apple production in New England.
[click here to view the guide](#)



Welcome to OrganicA - a resource for organic apple production

The pages of this site are intended to provide information to New England apple growers who are interested in organic apple production and who want to examine the **opportunities** of organic production given the shift in cultivars and the new research-generated information that is available. This website is a product of [The OrganicA Project](#).

The OrganicA Project is a **collaborative partnership** among three land-grant universities and stakeholders throughout in the region. The project includes both research and a closely integrated organic apple outreach program which is disseminating research findings, information, and insights. **The long-term goal of this multi-state, multidisciplinary project is to enhance adoption of organic apple production in New England** through research that advances the scientific knowledge base and provides practical information to stakeholders.

The OrganicA Project is holistically examining the **opportunities and challenges of organic production** within the two major orchard systems growers are using to change to new cultivars and with five of the top apple cultivars that growers identified as important to the future of the industry. The project was initiated with these two systems in 2006 with the 'orchard establishment' phase completed in 2009. Phase 2, the 'early bearing' phase, is underway. Based on findings from the initial research, an additional orchard was planted in 2011 with eight scab-resistant apple cultivars in a high density orchard system.

Major funding for the project comes from the **USDA Organic Research & Extension Initiative**. Additional funding sources are listed at: [Project Funding Sources](#)

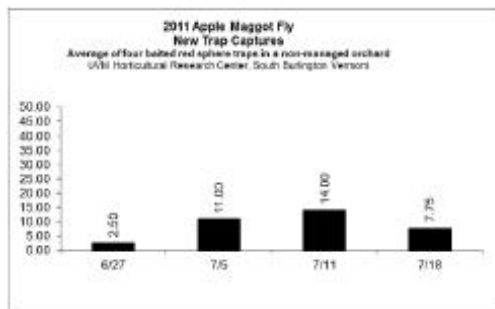
Orchard Observations

<http://www.uvm.edu/~organica/ListserveBlogs/listserveblogs.html>

Organica
a resource for organic apple production

Orchard Observations
Lorraine P. Berkett
July 26, 2011

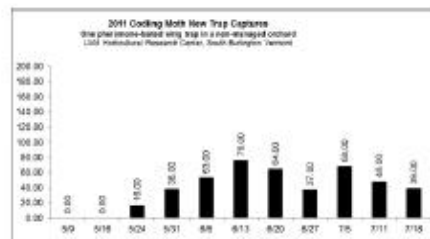
Apple Maggot Flies (AMF) – This part of the growing season is usually a very active time for AMF. Below are the weekly new trap captures in a non-managed orchard at the Hort Farm through last week using baited, sticky red spheres.



We will be checking the traps by tomorrow to determine if intervention is needed in Orchard 1 and 2 this week.



This is a Honeycrisp apple that came from Orchard 1 this morning. It is always not good to see **Codling Moth** (CM) larval damage. Last year we had high fruit damage from this insect; populations seem to have built up at the Hort Farm. As mentioned in the last issue of 'Orchard Observations', trap captures of adult moths have been high again this year (see graph below with updated pheromone trap captures in a non-managed orchard on the farm through last week).



We continue to try to reduce the CM population in the organic orchards through the use of BT and codling moth granulovirus.

I am happy to report that other arthropod 'pests' such as aphids, leafhoppers, and mites are at low levels -- at least presently! The very hot, dry weather we have experienced over the last week is favorable for **European red mite** (ERM) and twospotted spider mite (TSSM) populations and we will be monitoring them closely.

In walking through Orchard 1 and 2, the most prevalent disease symptom is rust lesions -- the wet spring was very favorable for infection -- even on fruit. At harvest, we will be collecting data to see what cultivars had more damage to fruit and foliage.



Rust lesion on Ginger Gold and Honeycrisp.

Rots at the calyx end of an apple can be caused by a number of fungi. The picture below is a Honeycrisp apple with a rot developing. However, as I looked closer at the apple -- that whitish, oblong egg shell at the end of a slender stalk -- that was an egg of an 'aphid lion' which is the immature stage of a green lacewing insect. So, although I did not like seeing the rot, I was happy to see that biological control is occurring in the orchard!!



Honeycrisp apple with rot and an 'aphid lion' eggshell.

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Funding Sources



United States
Department of
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National Institute
of Food and
Agriculture

Organic Research & Extension Initiative



Integrated Pest Management (IPM) Program



The
UNIVERSITY
of VERMONT



Vermont Tree Fruit Growers Association



**Risk
Management
Agency**
United States
Department of
Agriculture



Thank You !



a resource for organic apple production



Thank you !