Insecticide Efficacy for Insect Management of Eastern NY Commercial Tree Fruit – Organic

Pest Management Efficacy Workshop

March 5, 2021 8AM

Hudson Valley Research Laboratory

Conference Room

3357 Route 9W, Highland, NY

Peter Jentsch

Senior Extension Associate – Entomology

THE JENTSCH LAB

INSECT BIOLOGY, ECOLOGY, AND MANAGEMENT IN HUDSON VALLEY AGRICULTURAL COMMODITIES

WELCOME ENTOMOLOGY BROWN MARMORATED STINK BUG INVASIVES ORGANIC AG. RESEARCH TREE FRUIT THE HEIRLOOM ORCHARD

VEGETABLE SWEET CORN SMALL FRUIT GRAPE IN THE NEW

- INSECTICIDE AND ACARICIDE STUDIES
- SCOUTING REPORT
- HISTORICAL TREE PHENOLOGY & HUDSON VALLEY FRUIT PRODUCTION

Tree Fruit

2019 Seasonal Overview

RESULTS OF INSECTICIDE AND ACARICIDE STUDIES IN EASTERN NEW YORK

Pome fruit insecticide screening has been a vital component of the Hudson Valley Laboratory's department of Entomology since its inception. Listed below are the yearly publications pertaining to pear and apple insecticide screening for the yearly pest complex of newly developed and standard materials on schedules fitting to the region. BMSB studies are included in reports beginning in 2011.

Search

RECENT BLOG PAGES

- Last Call.....Webinar: HVRL Research Updates for NYS Commercial Apple Pest Management.

Weekly Scouting observations, tree phenology, IPM predictive modeling events

Observations made at the Hudson Valley Research Laboratory orchards in untreated research plots representing relatively high insect pest pressure. Predictive Modeling information is taken from the Highland Station NEWA web site.

Date	Baskerville-Emin (BE) DD Accumulations (previous day NEWA) 43 F	50 F	# / trap / day (pheromone trap)	Field Observations / Trap Catches / Models
5/26	645.6	316.6		Degree day accumulations beginning 1 January, 2020
			6.5	Black Stem Borer (BSB) (54/39)
			2.5	Codling Moth (CM) (26/9)
			0.0	Grape Fruitworm (0/0)
			1.1	Lesser Apple Worm (LAW) (6/9)
			1.7	Oriental Fruitmoth (OFM) (6/18)
			1.0	Pear Psylla 25 Nymphs/25 leaves
			3.7	Redbanded Leafroller (RBLR) (26)
			1.0	San Jose Scale (SJS) (0/14) FIRST CATCH
			0.2	Pear Psylla 6 Eggs/25 leaves
			0.0	Speckled Green Fruitworm (SGFW) (0/0)
			3.3	Spotted Tentiform Leafminer (28/18)
			1.4	Tufted Apple Budmoth (14/5) FIRST CATCH
				Fruit Injury
			4%	Lepidopteran feeding in Untreated (UT) Ginger Gold (GG) fruitlets
			8%	Plum Curculio (PC) feeding in UT GG fruitlets
			20%	Tarnished Plant Bug (TPB) feeding in UT GG fruitlets
			4%	European Apple Sawfly (EAS) feeding in UT GG fruitlets
			24%	PC on UT cherry, multiple varieties
				Degree Day Modeling
			487	STLM (biofix 3/30) eggs hatching, sap feeding mines appear
			454	OFM (biofix 4/6) End of hatch at $646DD_{43BE}$. 2nd flight at 700-$1100DD_{43BE}$.
			134	CM (biofix 5/15) Moths flying and first eggs laid. Eggs hatch at 220 DD. Action threshold at $220DD_{50BE}$, predicted on May 30. SJS (biofix 5/26)
			0.2	Weekly Rainfall
			1.73	Monthly Rainfall
			8.79	Total Rainfall (Since 1 March, 2020)

Date	Baskerville-Emin (BE) DD Accumulations (previous day NEWA) 43 F	50 F	# / trap / day (pheromone trap)	Field Observations / Trap Catches / Models
5/31	801.5	430.9		Degree day accumulations beginning 1 January, 2020
			6.5	Black Stem Borer (BSB) (19/72)
				Brown Marmorated Stink Bug (6 adults/trap)
			3.7	Codling Moth (CM) (45/7)
			0.9	Dogwood Borer (DWB) (5/7) 1st CATCH
			0.1	Fruit Tree Leafroller (FTLR) (1) 1st CATCH
			12.4	Grape Berry Moth (GBM) (87)
			2.2	Lesser Apple Worm (LAW) (26/5)
			0.6	Oriental Fruitmoth (OFM) (1/7)
			1.2	Pear Psylla 61 Nymphs/50 leaves
			0.8	Redbanded Leafroller (RBLR) (4/7)
			0.0	San Jose Scale (SJS) (0/0)
			0.1	Sparganothis (SPAR) 1st CATCH
			0.4	Pear Psylla 19 Eggs/ 50 leaves
			0.0	Speckled Green Fruitworm (SGFW) (0/0)
			0.8	Spotted Tentiform Leafminer (2/9)
			1.1	Tufted Apple Budmoth (14/5) 1st SUSTAINED CATCH
			0.3	Variegated Leafroller (VLR) (2/2) 1st CATCH
				Fruit Injury
			1.3%	Lepidopteran feeding in Untreated (UT) Ginger Gold (GG) fruitlets
			41.3%	Plum Curculio (PC) feeding in UT GG fruitlets
			9.3%	Tarnished Plant Bug (TPB) feeding in UT GG fruitlets
			0%	European Apple Sawfly (EAS) feeding in UT GG fruitlets
			32%	PC on UT cherry, multiple varieties
				Degree Day Modeling
			$209DD_{50}$	Plum Curculio migration model. Residue needed to $308DD_{50}$
			643	STLM (biofix 3/30) Sap feeding and tissue mines are present.
			610	OFM (biofix 4/6) 1st moth flight and egg hatch over. 2nd flight at 700-$1100DD_{43BE}$.
			249	CM (biofix 5/15) Moths capture increasing, eggs hatching. Application for CM larval 10% hatch at 250 DD after first adult SC.
			114	SJS (biofix 5/26) 1st generation crawlers developing.
			0.31	Weekly Rainfall
			2.04	Monthly Rainfall (May 2020)
			9.1	Total Rainfall (Since 1 March, 2020)

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Historical Weather Data

Data represents historical McIntosh tree phenological observations from the Hudson Valley Laboratory Research Laboratory Orchard.

Departments of Entomology and Plant Pathology
Hudson Valley Research Laboratory

Cornell University
College of Agriculture and Life Sciences

McIntosh Phenology

Year	GT	HIG	T.C.	Pink	Bloom	P.F.	PF DD_{43}	PF DD_{50}
2019	4/10	4/15	4/19	4/22	5/8	5/15	533.1	257.2
2018	4/18	4/28	4/30	5/4	5/9	5/14	514.5	274.6
2017	4/2	4/11	4/17	4/24	4/27	5/8	603.0	312.0
2016	3/17	4/04	4/11	4/18	4/25	5/12	597.8	186.0
2015	4/13	4/20	4/27	5/4	5/6	5/12	527.8	304.5
2014	4/14	4/18	4/28	5/6	5/12	5/19	594.9	321.5
2013	4/13	4/18	4/24	4/30	5/7	5/13	510.6	262.2
2012	3/16	3/18	3/25	4/8	4/16	4/21	506.5	267.5
2011	4/4	4/11	4/25	5/1	5/9	5/16	526.0	268.3
2010	3/20	4/2	4/6	4/10	4/20	4/28	305.0	168.5
2009	4/6	4/13	4/20	4/24	4/29	5/7	452.0	219.6
2008	4/10	4/14	4/21	4/24	4/29	5/7	404.5	207.4
2007	4/2	4/21	4/24	5/2	5/7	5/14	397.0	228.3
2006	4/3	4/10	4/17	4/22	4/26	5/8	419.2	220.0
2005	4/7	4/11	4/18	4/26	5/8	5/16	493.7	258.6
2004	4/12	4/19	4/22	4/27	5/3	5/13	558.5	304.7
2003	4/7	4/16	4/24	4/28	5/1	5/19	595.0	324.7
2002	3/25	4/10	4/14	4/15	4/16	5/7	498.0	283.2
2001	4/11	4/17	4/25	4/28	5/2	5/10	481.3	288.0
2000	3/27	4/2	4/14	4/24	5/1	5/8	488.3	346.0
1999	4/2	4/7	4/12	4/26	5/2	5/13	530.1	174.4
1998	3/27	3/29	4/1	4/10	4/23	5/4	498.1	382.0
1997	4/4	4/11	4/21	4/28	5/1	5/14	422.7	250.0
1996	4/15	4/19	4/22	4/29	5/6	5/20		
1995	4/11	4/19	4/24	4/29	5/8	5/19		
1994	4/11	4/14	4/20	4/29	5/5	5/12		
1993	4/12	4/19	4/24	5/1	5/3	5/10		
1992	4/13	4/21	5/4	5/7	5/12	5/18		
1991	4/5	4/8	4/11	4/17	4/27	5/7		
1990	3/21	4/16	4/23	4/26	4/29	5/11		
1989	3/29	4/17	4/28	5/3	5/9	5/19		
1988	4/4	4/9	4/28	5/5	5/8	5/19		
1987	3/29	4/10	4/18	4/22	4/29	5/16		
1986	3/31	4/7	4/19	4/27	5/3	5/8		
1985	3/30	4/12	4/15	4/22	5/4	5/12		
1984	4/10	4/26	4/30	5/6	5/16	5/24		
1983	4/12	4/27	4/30	5/2	5/5	5/18		
1982	4/15	4/22	4/30	5/4	5/13	5/17		
1981		4/8	4/16	4/22	5/5	5/14		
1980	4/15		4/24	5/2	5/5	5/10		
Earliest day	**3/16**	**3/18**	**3/25**	**4/8**	**4/16**	**4/21**	305.0	168.5 **Low**
Latest day	**4/18**	**4/28**	**5/4**	**5/7**	**5/16**	**5/24**	603.0	382.0 **High**

Midrange: 3/31 (+/-14D) Mean days in bloom 9.4 days

4/7 (+/-20.5D)

4/14 (+/-20D)

4/22 (+/-14D)

5/1 (+/-15D)

5/7 (+/-16.5D)

Mid-Range Dates

- **Green Tip:** 31 March
- **!/2" Green:** 7 April
- **Tight Cluster:** 14 April
- **Pink:** 22 April
- **Bloom:** 1 May
- **Petal Fall:** 7 May

Mean Days Bloom: 9.4 days

Degree Day Range	Low	High
PF DD 43°F	305.0	168.5
PF DD 50°F	603.0	382.0

RESULTS OF 2020 INSECTICIDE AND ACARICIDE STUDIES IN EASTERN NEW YORK

Pub. # HV2020

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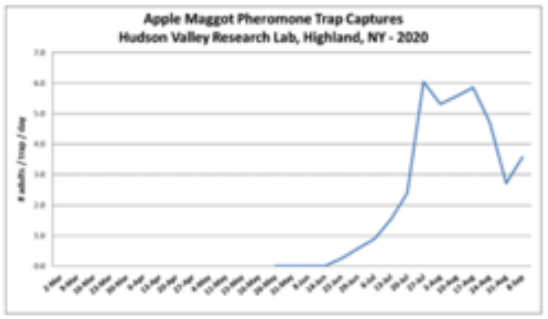
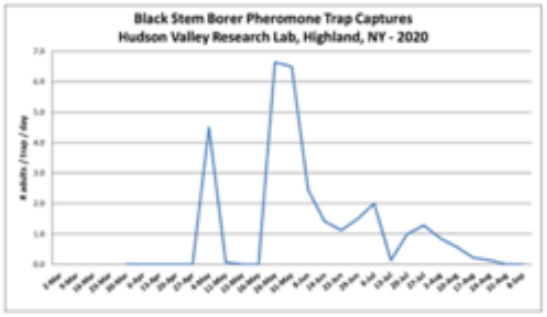
Acknowledgements

The following companies contributed greatly in providing support for these trials; in providing materials used in both research trials and in the maintenance of our orchards as well as grant funding for studies included in this report. FMC Agricultural Solutions; Bayer CropScience, Corteva Agriscience, Gowan Co, Loveland Products, Inc, Marrone Bio Innovations, Nichino, Summit Agro USA, Syngenta, United Phosphorus Limited, Valent USA. Additional support for both research and operations was received from Sustainable Ag. Research Initiative (SARE) the New York State Apple Research and Development Program (ARDP), NYS Specialty Crops Research Initiative (SCRI) through New York State Ag. & Markets, Federal HATCH Program, Federal Multi-State USDA-NIFA SCRI #2016-51181-25409 for BMSB Research.


Apple Maggot Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2020


Black Stem Borer Pheromone Trap Captures
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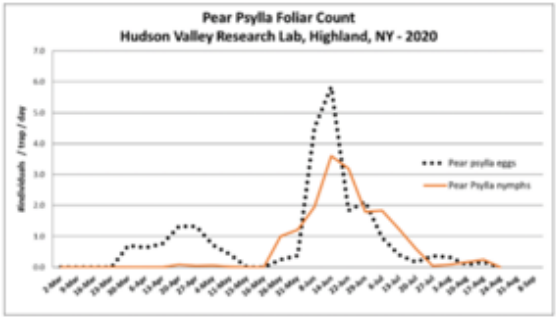
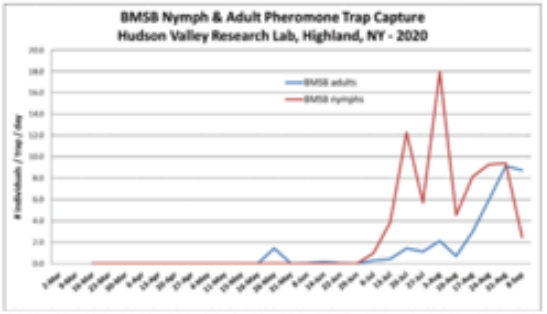
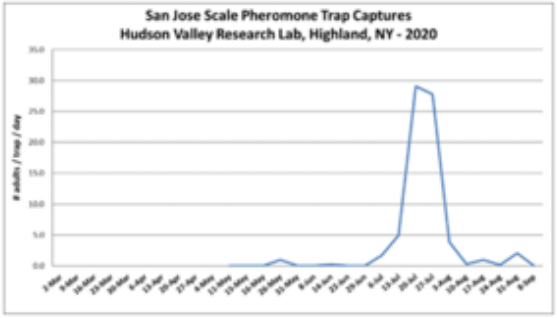
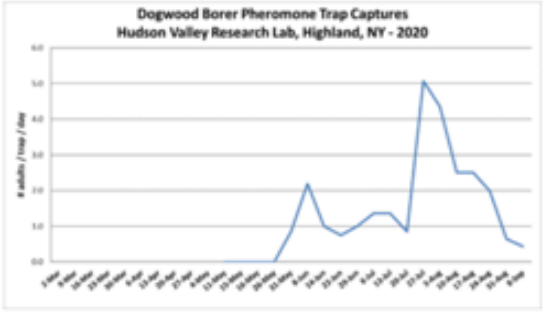
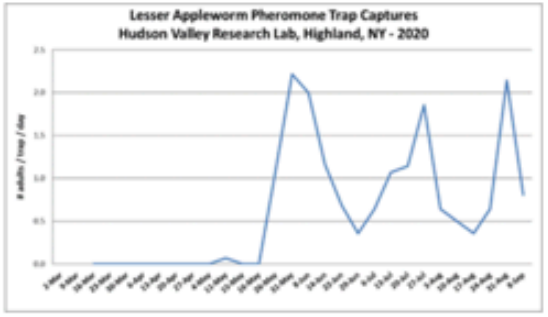

Pear Psylla Foliar Count
Hudson Valley Research Lab, Highland, NY - 2020
Pear psylla eggs
Pear Psylla nymphs


BMSB Nymph & Adult Pheromone Trap Capture
Hudson Valley Research Lab, Highland, NY - 2020
BMSB adults
BMSB nymphs


Codling Moth Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2020


San Jose Scale Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2020


Dogwood Borer Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2020


Lesser Appleworm Pheromone Trap Captures
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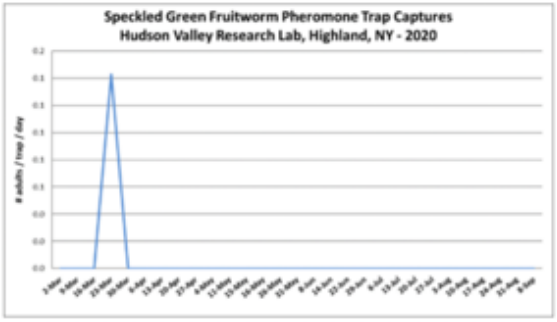
Speckled Green Fruitworm Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2020

Table 20 **Evaluation of Drape Net for Controlling Insect Complex on Apple**
Hudson Valley Research Laboratory, Highland, NY - 2020

		Incidence (%) of insect damaged fruit					
Trmt.	Net App. Date	PC	EAS	TPB	MPB	Ext. Lep	Clean
1. Drape Net	29 April	4.0	0.0	0.0	0.0	1.3	94.7
2. Drape Net	21 May	5.8	0.3	0.3	0.0	1.0	92.8
3. Unnetted		2.5	0.0	0.0	0.0	2.5	95.0
P value		0.5273	0.5283	0.5283	NA	0.4924	0.6175

Rating of insect damage taken on 16 June on 'Crimson Crisp'.

Table 21 **Evaluation of Drape Net for Controlling Insect Complex on Apple**
Hudson Valley Research Laboratory, Highland, NY - 2020

		Incidence (%) of insect damaged fruit							
Trmt.	Net App. Date	PC	EAS	TPB	AMP	AMT	SB	SJS	Clean
1. Drape Net	29 April	24.1	0.0	0.6	1.9 b	0.6 b	11.3	1.1	61.5 a
2. Drape Net	21 May	14.0	0.0	4.2	5.4 b	5.5 b	11.5	0.0	67.1 a
3. Unnetted		35.0	0.0	3.9	46.7 a	51.7 a	29.4	1.1	20.6 b
P value		0.2279	NA	0.2829	0.0001	0.0001	0.1529	0.3361	0.0004

Assessments from apples harvested 9 and 11 September from 'Honeycrisp', 'Crimson Crisp', and 'Liberty'.
Data were analyzed by ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

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Your Purchased Guidelines

2020 Tree Fruit

2020 Cornell Pest Management Guidelines for Commercial Tree Fruit Production

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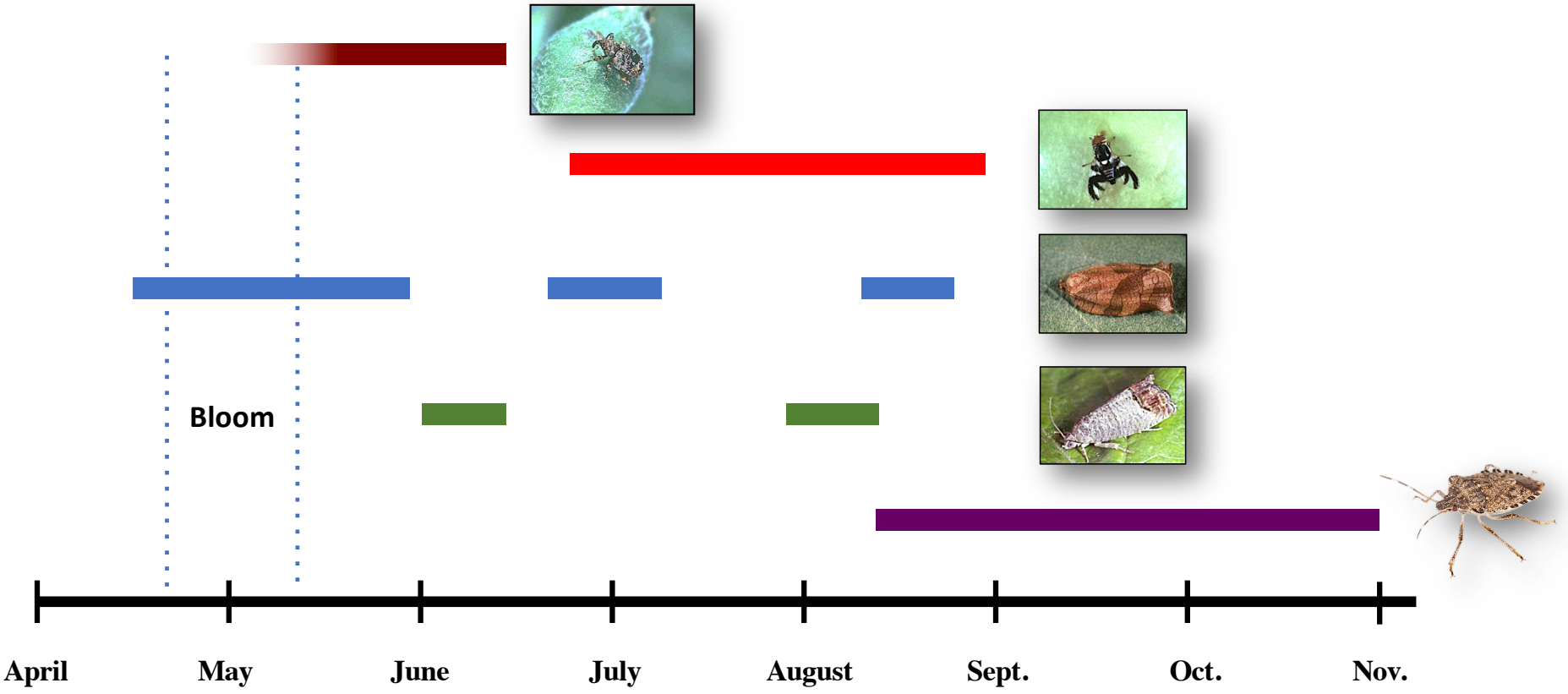
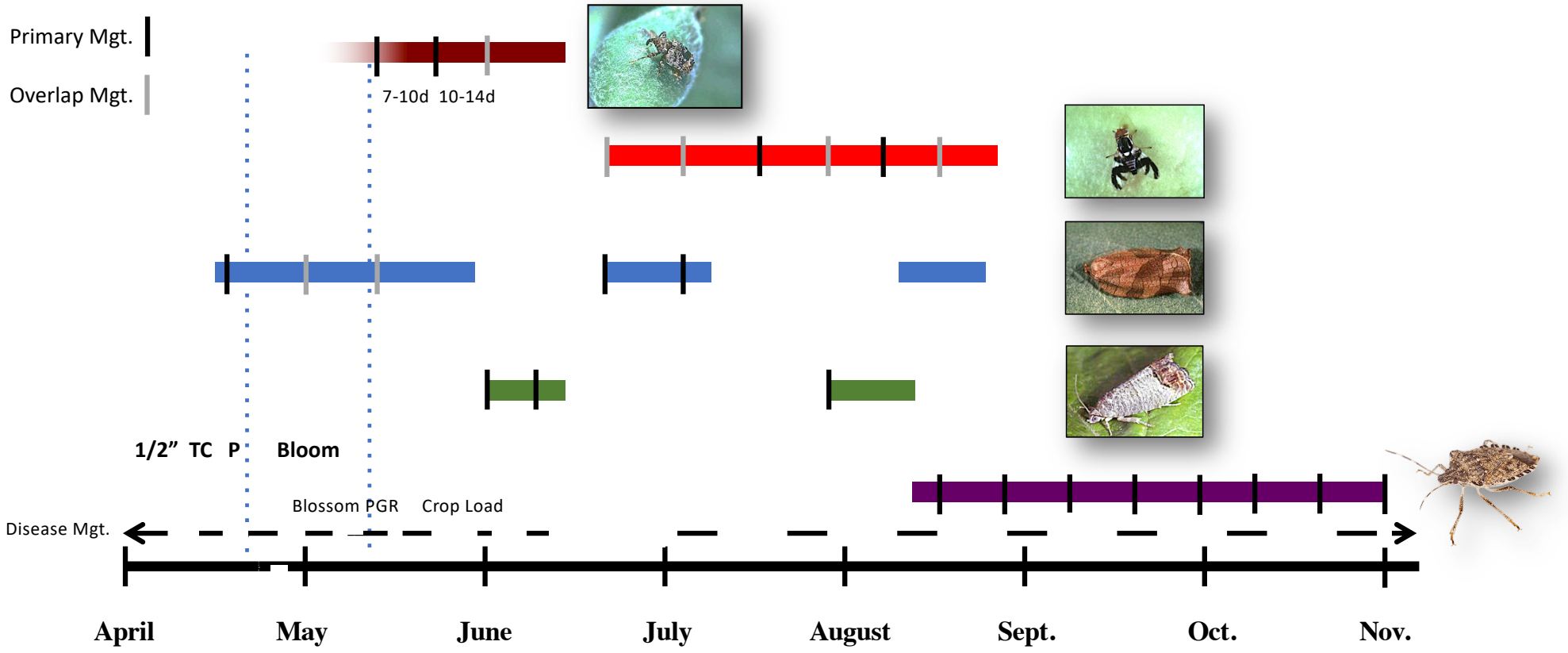
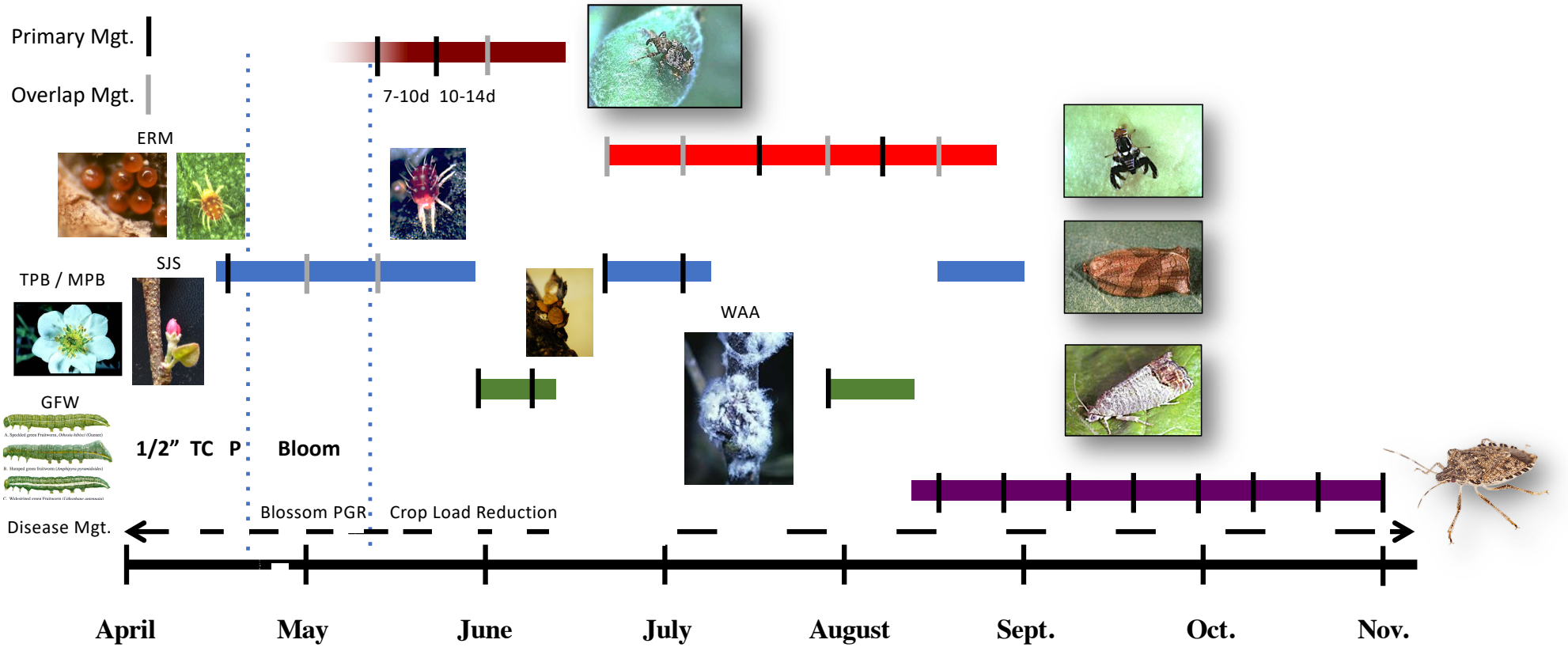
Seasonal Activity Of Major Pests Of Apples In The Hudson Valley Of New York State



Seasonal Activity Of Major Pests Of Apples In The Hudson Valley Of New York State



Seasonal Activity Of Major & Secondary Pests Of Apples In The Hudson Valley Of New York State



Apple / Pear Orchard Insect Pest Complex
Pheromone Captures Timing

Pest	Earliest 1st Catch	Average 1st Catch	Latest 1st Catch
SGFW	11-Mar	26-Mar	10-Apr
Pear psylla eggs	14-Mar	27-Mar	10-Apr
RBLR	14-Mar	29-Mar	20-Apr
STLM	27-Mar	15-Apr	11-May
OFM	29-Mar	19-Apr	7-May
Pear Psylla nymphs	26-Mar	20-Apr	5-May
Black Stem Borer	22-Apr	28-Apr	4-May
FTLR	16-Apr	2-May	18-May
LAW	17-Apr	5-May	31-May
CM	6-May	13-May	20-May
BMSB adults	14-Apr	14-May	6-Jul
SJS	11-May	22-May	24-Jun
VLR	19-May	26-May	5-Jun
DWB	16-May	29-May	19-Jun
OBLR	23-May	1-Jun	16-Jun
TABM	21-May	11-Jun	27-Jul
LPTB		14-Jun	
SPAR	31-May	18-Jun	22-Jul
AM	14-Jun	1-Jul	13-Jul
BMSB nymphs		6-Jul	
SWD	14-Jun	10-Jul	4-Aug

Pre-Bloom Management Driven Pests

Spotted Green Fruit Worm (SGFW) – Larva emergence - Pink

Red Banded Leafroller – Larval Emergence
Tarnish Plant Bug – Adult & nymph (3d @ 70F (TC-1C)
Rosy Apple Aphid – TC/Pink to 1st C

Black Stem Borer – Adult Female – 1st attack – Trunk Mgt.

Dogwood Borer – OW larva – Trunk Mgt.
Oblique Banded Leafroller – OW Larval Emergence

Insect population and damage differ regionally, by orchard and often block by block

OMRI Organic Insect Pest Management Program
Pome Tree Fruit

Stage of Growth+GS	Chemical Name	Dosage Rate	Target Pest	Active ingredient(s)
Tight Cluster	JMS Stylet-Oil	1.5 gal/100 gal	Mites, SJS	Oil
OR				
Late TC - early Pink	JMS Stylet-Oil	1 gal/100 gal	Mites, SJS	Oil
Early Pink	Cidetrak OFM-L Meso	35 disp/A	OFM	Pheromone
Late Pink	Surround WP	50 lbs/100 gal	PC	Kaolin Clay
Full Bloom	Dipel (2 @ 7d)	1 lb/100 gal	Leafrollers	B.t.
Full Bloom	Cidetrak CMDA+LR Dual Meso	36 disp/A	CM	Pheromone Mating Distruption
Petal Fall	Surround WP	50 lbs/100 gal	PC, CM, OFM	Kaolin Clay
Petal Fall	Dipel	1 lb/100 gal	Leafrollers	B.t.
1st Cover	Surround WP	50 lbs/100 gal	PC, CM, OFM	Kaolin Clay
1st Cover	DiPel	1 lb/100 gal	Leafrollers	B.t.
1st Cover	Madex HP	3.0 fl oz/A	CM, OFM	Granulosis Virus
2nd Cover	Surround WP	50 lbs/100	PC, CM, OFM	Kaolin Clay
2nd Cover	Entrust SC	7 oz/100 gal	CM, OFM	Spinosad
2nd Cover	Madex HP	3.0 fl oz/A	CM, OFM	Granulosis Virus
3rd Cover	Neemix	5.0-7.0 oz/A	Aphids	Azadirachtin
4th Cover	Entrust SC	7 oz/100 gal	CM, OFM	Spinosad
4th Cover	Madex HP	3.0 fl oz/A	CM, OFM	Granulosis Virus
5th Cover	Entrust SC	7 oz/100 gal	CM, OFM	Spinosad
5th Cover	Madex HP	3.0 fl oz/A	CM, OFM	Granulosis Virus
5th Cover	Grandevo	2-3 lb/A	CM, OFM, AM	*Chromobacterium subtsugae*
6th Cover	Entrust SC	7 oz/100 gal	CM, OFM, AM	Spinosad
6th Cover	Grandevo	2-3 lb/A	CM, OFM, AM	*Chromobacterium subtsugae*

OMRI Organic Fungicides

Sulfur – Apple Scab (Fungus)
Copper – Fire Blight (bacteria)
Regalia – Cedar Apple Rust
Rot Organisms

Venerate XC – BMSB Feeding

Exclusion Insect Pest Management Program
Employing 'Drape Net' in Pome Tree Fruit

Treatment/Formulation	RateTiming	Application Dates
Early Season IPM		
Actara	5.5 oz/A	18th May
Avaunt	6.0 oz/A	25th May
Entrust SC	10.0 fl oz/A	8th June
Venerate	2.0 gal/A	21st June
Season Long IPM		
Actara	5.5 oz./A	18th May
Avaunt	6.0 oz./A	25th May
Imidan 70W	4.9 lbs/A	7th June
Esteem 35WP	5.0 oz/A	21st June
Assail 30SG	4.0 oz/A	21st June
Altacor	4.5 oz/A	21st June
Assail 30SG	4.0 oz/A	10th July
Exirel	20.5 oz/A	24st July
Exirel	20.5 oz/A	31st July
Exirel	20.5 oz/A	6th Aug.
Bifenture 10DF	32.0 oz/A	6th Aug.

1. Treatments were applied concentrate using a Slim Line tower sprayer using 100 psi, delivering 0.05 to 0.07 gal/tree traveling at 2.5-2.86 mph averaging 74 gal/A. Insecticide calculations (presented as amt/A) are based on a standard dilution of 100 gal/A . Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Rows were treated with Drape net shortly after fruit set.

Exclusion Insect Pest Management Program
Employing 'Drape Net' in Pome Tree Fruit

Management of the Apple Insect Complex Using 'Drape Net' IPM / Organic Split and Season Long IPM Management .
Hudson Valley Research Laboratory, Highland, NY - 2018

Net Type / Treatment / Rate	Incidence (%) of insect damaged cluster fruit											
	PC	EAS	TPB	Lf.Rlr	Int. Lep	Ext.Lep	CM	AM.P	AM.T	SJS	SB	Clean
1. Black Drape Early Season IPM	3.0 a	0.6 a	4.4 a	10.9 bc	2.2 b	18.8 b	11.3b	0.6 b	0.6 b	96.3 a	0.3 b	1.3 c
2. White Drape Early Season IPM	4.7 a	0.0 a	4.4 a	11.9 b	3.1 b	20.3 b	12.5 b	0.9 b	0.9 b	95.6 a	0.9 b	0.6 c
3. No Drape Early Season IPM	**10.8 a**	**0.8 a**	**4.6 a**	**22.9 a**	**6.7 a**	**37.1 a**	**23.8 a**	**7.5 a**	**4.2a**	**83.8 b**	**3.8 a**	**1.3 c**
4. Black Drape Season Long IPM	5.6 a	1.3 a	7.8 a	0.3 d	0.0 c	1.6 c	0.3 c	0.0 bc	0.0 b	6.6 d	0.0 b	82.5 a
5. White Drape Season Long IPM	7.8 a	0.9 a	7.8 a	0.3 d	0.0 c	0.6 c	0.0 c	0.3 b c	0.3 b	20.0 c	0.0 b	65.9 b
6. No Drape Season Long IPM	**5.6 a**	**0.9 a**	**5.0 a**	**0.6 cd**	**0.3 c**	**1.3 c**	**0.0 c**	**0.6 b c**	**0.3 b**	**6.3 d**	**0.9 b**	**81.3 a**
P value	0.2062	0.6565	0.5998	0.0001	0.0001	0.0001	0.0001	0.0001	0.0135	0.0001	0.0154	0.0001

[a] Evaluation made on 'Crimson Crisp, Honey Crisp & Gold Rush cultivars harvested on 29 September. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Fisher Protected (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Biological Pesticides (Insecticides)

I. **Biological control organisms:**
   I. **Predators:** Nematodes, Parasitoids,

   II. **Biopesticides:** Microbial organisms such as bacteria, fungi, viruses, protozoa, or oomycetes or the toxins produced by organisms, laboratory reared and manufactured.

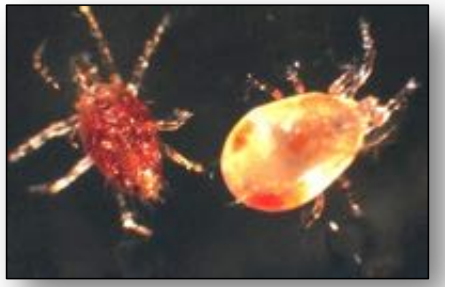
III. **Plant-Incorporated Protectants (PIPs)**: chemicals produced by plants after genetic modification (GMO or through breeding) to produce compounds resistant to insect or disease pests. Genes alter the manufacture of proteins increase plant defense mechanisms to improve resistance to pests. Ex. Bt Corn and Round-up Ready Corn

IV. **Natural products** such as hort. oils, fatty acid soaps, mineral repellents

V. **Attractants**: Synthetic or natural products to lure and trap pests or by mating confusion.

VI. **Barrier Film:** Inert coating to reduce attractiveness of host plant

Biological Insecticides



I. Biological control organisms:

- **Predators:** feed directly on host pest life stages

  egg, larva, nymph and adult
- Predators are **immature or adult forms**
- Use host finding chemical cues ‘footprints’ such as host pheromones, plant host of pest, visual - color, sounds
- Predatory populations rise and fall based on prey populations, environmental conditions and agrochemical applications and residue

Biological Insecticides

I. Living organisms such as **biological control organisms**.
Predatory organisms of pests

a. Aphids

- Lacewing adults and larva
- Ladybird beetle adult and larva
- Cecidomyiidae larve (fly – gall midge)
- Syrphid larva (fly)

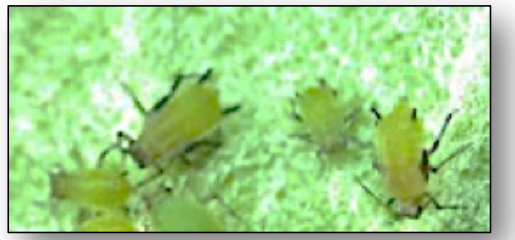
b. European Red Mite

- Phytoseiid Mite
  T. pyri, A. fallacius
- Stigmaid Mite
  Z. mali

Do They work: YES, Through <u>Conservation</u>

Insecticides (Pyrethroids) and fungicides (Manzate) significantly reduce predatory beneficials. 'Soft' programs and reduced rates of pesticides allow for higher field populations of predators.

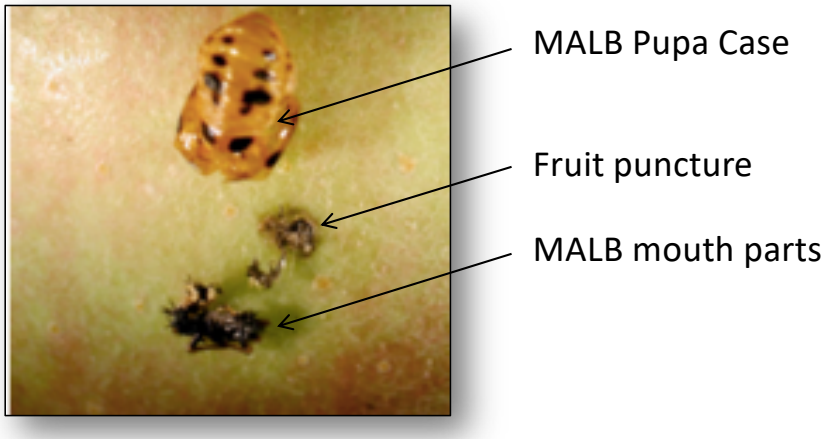
Biological Insecticides



I. Living organisms such as **biological control organisms**.
Predatory organisms of pests

Aphids can build near apple harvest with fall rains and new growth.

Multicolored Asian Ladybird Beetle will also increase and feed on aphid, yet may begin to pupate on fruit, causing fruit injury.



Organic Insecticide Groups
OMRI Approved Options

Repellents
Surround WP (Kaolinite clay - alumina silicate mineral clay. $(Al_2Si_2O_5(OH)_4)$

Plant Based Chemicals
Neem products

Biological Insecticides

Burkholderia spp. strain A396 (**Venerate**) *Marrone Bio Innovations*

Chromobacterium subtsugae (**Grandevo**) *Marrone Bio Innovations*

Granulosis Virus (**Carpovirusine, Cyd-X, Madex**) Codling Moth only

Bacillus theringensis

Beauveria bassiana

Biological Insecticides

II. **Biopesticides:** Viruses (Granulosis virus)

Advantages in using microbial viruses

- Safety for humans and other nontarget organisms
- Reduction of pesticide residues
- No secondary pest outbreak and no preharvest interval is required
- Many are OMRI approved

Disadvantages

- Host specificity or narrow spectrum of a single species
- Long period of lethal infection is required
- Inactivated by environmental factors (ultraviolet light, high temp.)
- Often more expensive then conventional pesticides
- Resistance by codling moth: Madex, Carpovirusine, Cyd-X
- New strains: **Virosoft CP4** (BioTEPP), **Carpovirusine Evo 2** (NPP/Arysta LifeScience) **Madex Max and Madex Plus** (Andermatt Biocontrol AG) to inhibit resistance.

Biological Insecticides

Incidence of insect damage on disease resistant varieties at harvested fruit 9 Aug. 2010

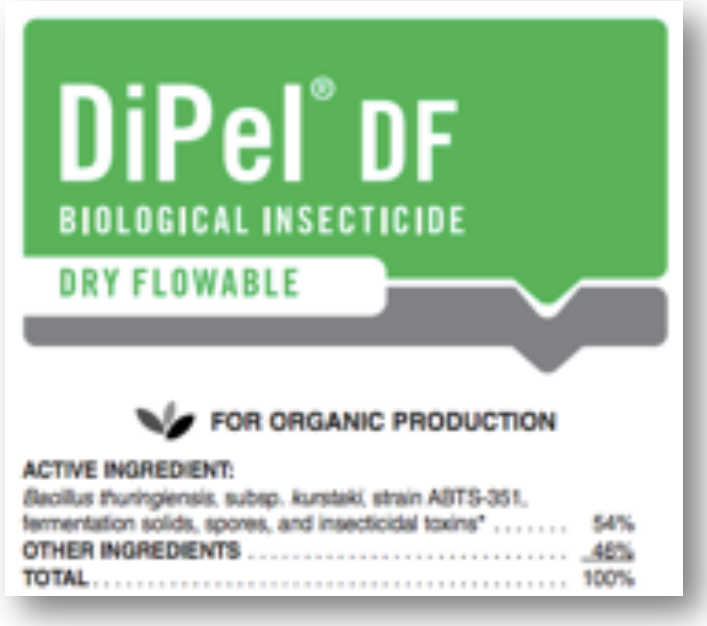
Material and rate of formulated product per A		Plum curc.	Tarnish plant bug	Stink bug complex	Internal lep OFM/CM	European apple sawfly	Apple maggot tunnel	No insect damage
Edge	Clark: CB.....	0.0	0.0	0.0	0.0	0.0	2.0	91.3
Interior	Clark: CB.....	2.0	0.5	0.5	0.0	0.0	2.0	86.7
Edge	Clark: Et + GF120.....	5.2	1.3	3.3	0.0	0.7	0.0	85.0
Interior	Clark: Et + GF120.....	3.2	0.7	6.4	0.4	0.1	0.0	84.9
Combined	Clark Block.....	3.7	0.9	4.4	0.4	0.3	0.3	85.5
Edge	Grower Standard.....	0.0	8.0	0.0	0.0	0.0	0.0	92.0
Interior	Grower Standard.....	0.0	4.0	0.0	0.0	0.0	0.0	96.0
Combined	WestWind.....	77.0	4.0	0.3	68.0	14.0	47	14.0
Untreated	Clark Block.....	64.3	3.3	5.3	23.0	0.0	17.7	13.7

Clark block received 4 trmts. Of Surround WP at 50 lbs./A, 200 Isomate twin ties for CM & OFM mating disruption and Cyd-X @ 4.0 oz./A. Split block East received CB= 'Curve Ball' at 1 per tree; Split block west received Et = Entrust 80WP @ 4.0 oz./A and GF120 at 64 oz./A.

Biological Insecticides

II. Biopesticides: Toxins produced by organisms, laboratory reared and manufactured.

Bacteria: *Bacillus thuringiensis*/B.t. is a fermented toxin used at low rates using 5 day intervals is an excellent materials for OBLR, and can be used during bloom.



- Immature larval stages
- UV sensitive
  Best use during overcast sky
- **Low rates using short re-application intervals**
- Can be used during bloom
- Pollinator safe

Biological Insecticides

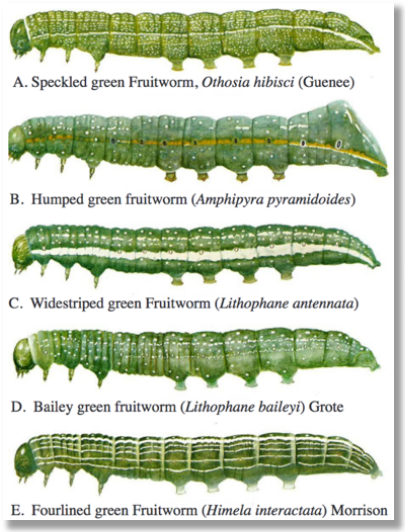
II. Biopesticides: Toxins produced by organisms, laboratory reared and manufactured.

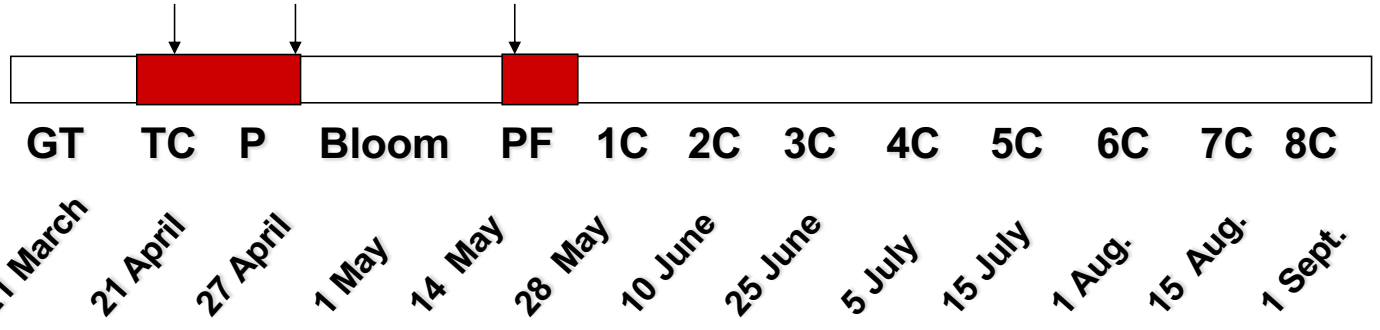
Bacteria: Venerate, *Burkholderia* spp. strain A396, a genus of Proteobacteria manufactured by Marrone Bioscience

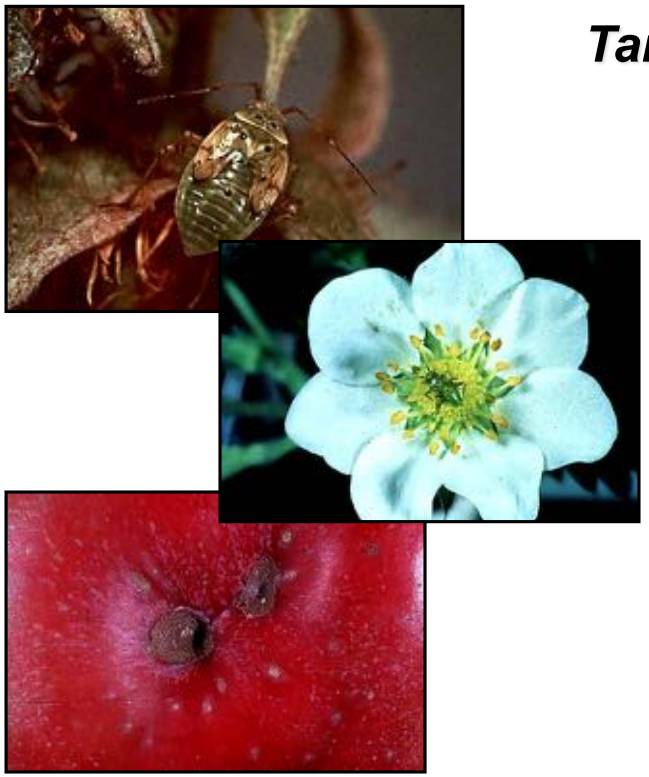
Venerate acts as an anti-feedent against San Jose Scale (SJS) and Brown Marmorated Stink Bug (BMSB).

- Target the crawler stage of San Jose scale according to scouting using two applications at 7-day intervals, using minimum of 75 gal,.A to achieve full coverage of foliage and fruit.
- Use of a nonpenetrating spreader-sticker to improve coverage and rain fastness.

Green Fruit Worm Complex- Management







Tarnished Plant Bug - Management

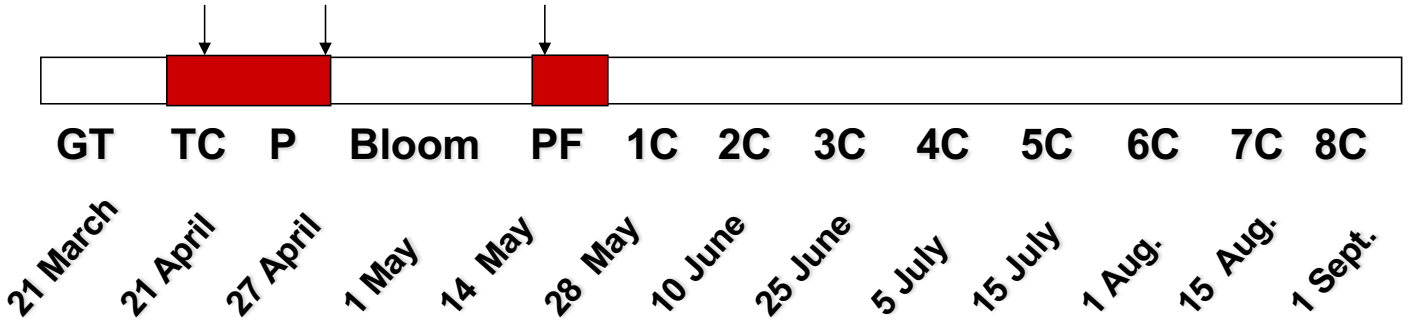
Begin scouting at tight cluster *and* note observation of TPB activity. Movement from flowering broadleaf weeds to apple.

Treatment for TPB should be considered during periods of increasing and prolonged temperatures above 65°F.

Bleeding sites on buds and developing fruit are indicators of TPB injury.

Pyganic

Cool temp. best option for pyrethrum



PyGanic

Crop Protection EC 1.4II

Specimen Label

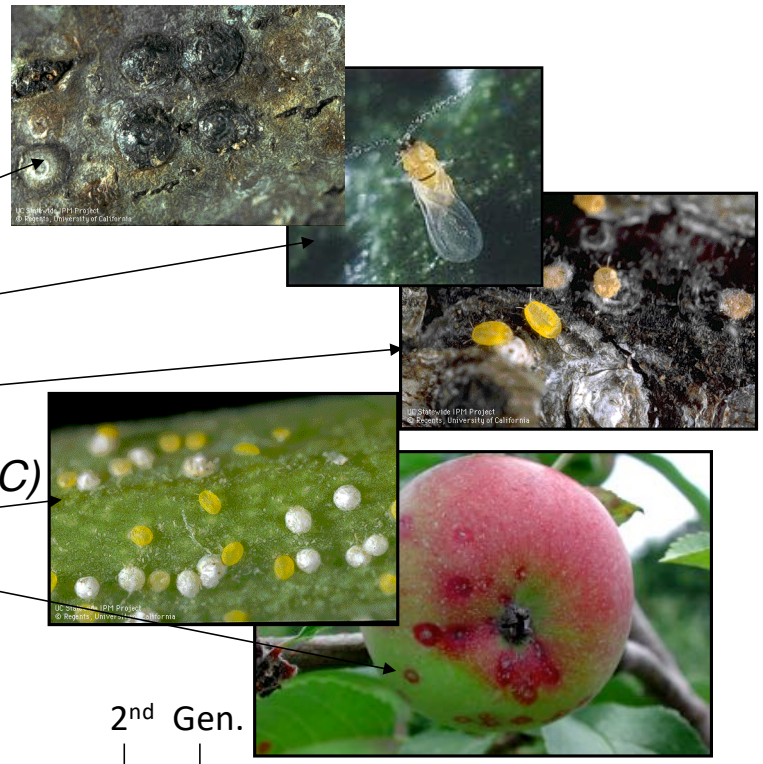
- Contains pyrethrum—a botanical insecticide derived from chrysanthemums
- Provides rapid knockdown and kill of plant pests
- For use on growing crops and ornamentals
- Can be used on day of harvest
- Controls key livestock pests
- Controls more than 100 insects

For Organic Production

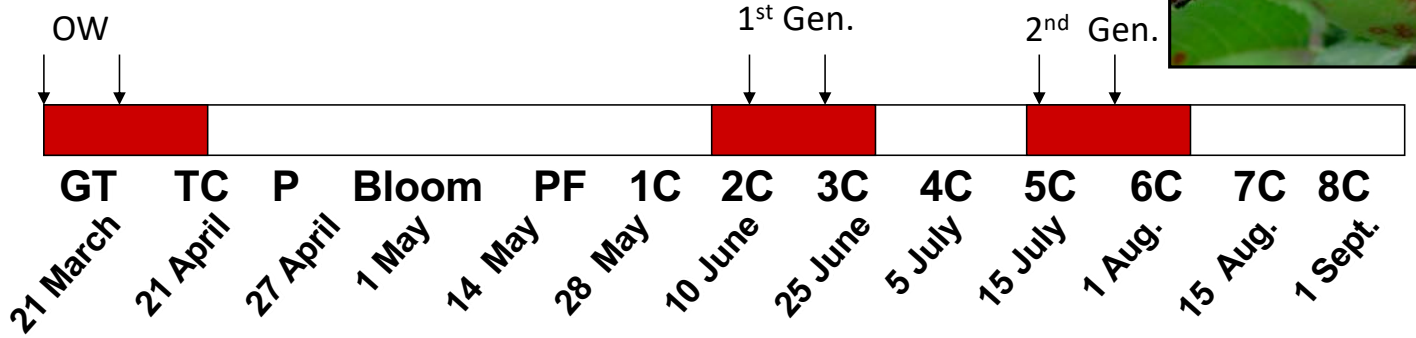
OMRI Listed

ACTIVE INGREDIENT:	
Pyrethrins	1.40%
OTHER INGREDIENTS	98.60%
	100.00%

San Jose Scale (SJS)



- *OW on bark as 'black-cap'*
- *Adult males emerge and mate*
- *Do not lay eggs - produce live crawlers*
- *Crawlers appear 4-6 wk. post bloom (2-3C)*
- *'White cap'→ 'Black cap'*



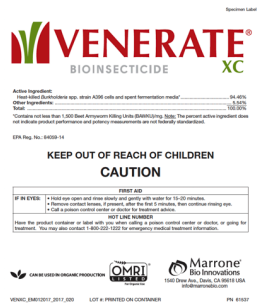
San Jose Scale Management

Pre-Bloom

- Oil – alone @ 3% (Silver Tip), 2% (1/4 GT) 1% (up to TC)
  - Complete coverage is essential
  - Handgun @ 300 psi works best
  - High volume slow tractor speed
  - Foliage produces shadowing of spray material limiting access of the oil to the scale to reduce efficacy

Pre-Bloom / Crawler Emergence

- Venerate XC
  - 2–4 quarts VENERATE® XC per acre
  - NuFilm @ 0.25% (no LI-700)
  - 0 Days to harvest


VENERATE® XC
BIOINSECTICIDE
KEEP OUT OF REACH OF CHILDREN
CAUTION
FIRST AID
IF IN EYES:
• Hold eye open and rinse slowly and gently with water for 15-20 minutes.
• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
• Call a poison control center or doctor for treatment advice.
HOT LINE NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.
CAN BE USED IN ORGANIC PRODUCTION
OMRI LISTED
Marrone Bio Innovations
1540 Drew Ave., Davis, CA 95618 USA

Pre-bloom - San Jose scale

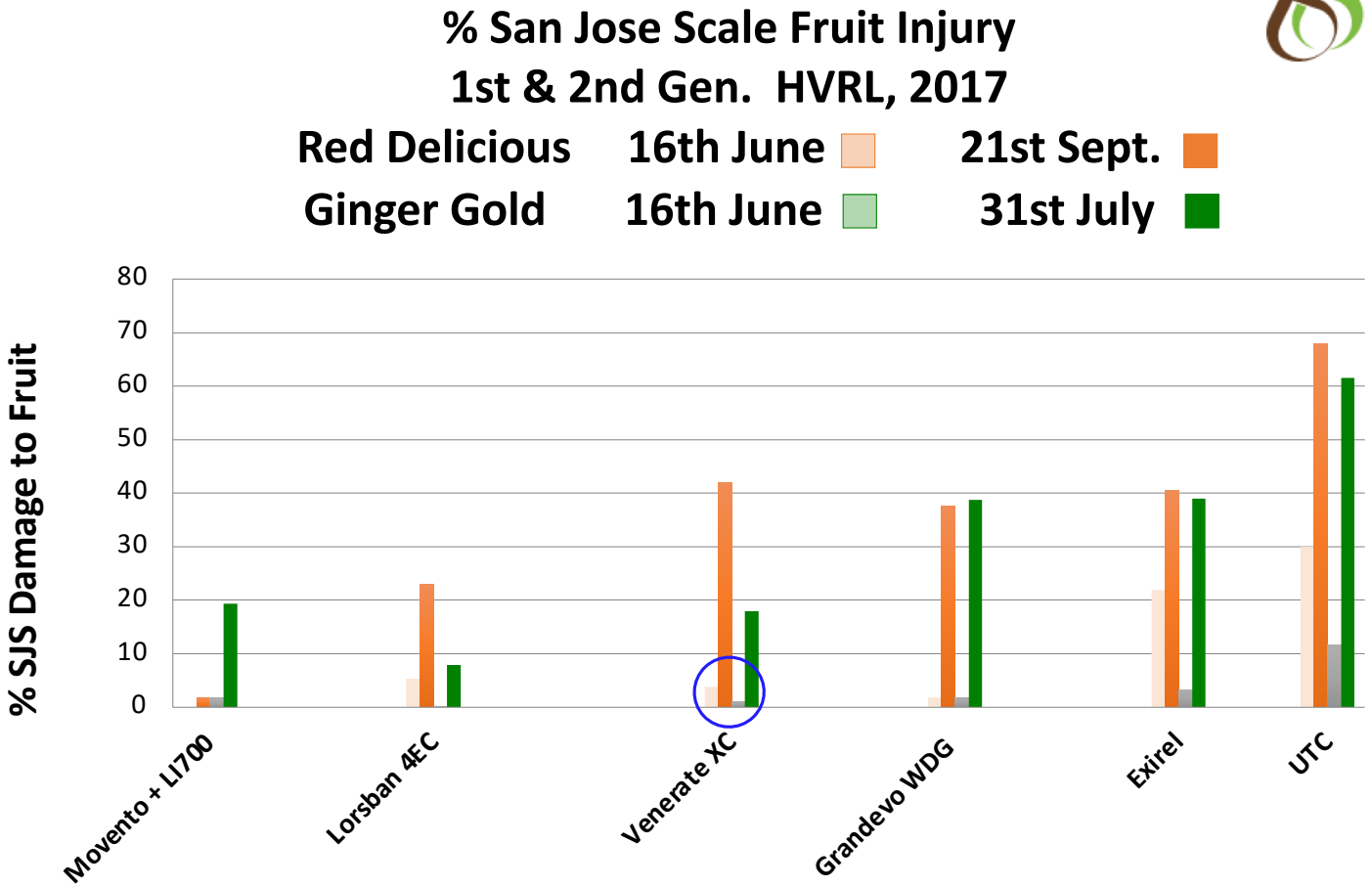
Evaluation of insecticides for controlling San Jose scale on apple, N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y.

Treatment	Quantity	Timing	% mortality per # of days post application				
			7 d	14 d	21 d	28 d	45 d
1. Damoil	3.0 gal. / 100	GT	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
2. Damoil	2.0 gal. / 100	HIG	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
3. Lorsban	1.0 pt. / 100	HIG	100.0 c	100.0 c	100.0 c	100.0 c	100.0 c
4. Esteem	1.25 oz./ 100	HIG	48.5 b	41.3 b	37.5 a	51.4 b	59.4 b
5. Assail	1.25 oz./ 100	HIG	51.6 b	44.6 b	78.4 b	94.1 c	99.9 c
9. Untreated	-	-	2.7 a	23.0 a	37.5 a	36.0 a	34.9 a

Pre-bloom - San Jose scale

Evaluation of insecticides for controlling San Jose scale on apple, N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y.

Treatment	Formulation amt./100 gal.	Timing	% infested Fruit	Ave. # caps / Fruit	Live SJS caps / Fruit
1. Damoil	3.0 gal.	GT	0.0 a	0.0 a	0.3 a
2. Damoil	2.0 gal.	HIG	0.9 a	0.3 ab	1.3 a
3. Lorsban	1.0 pt.	HIG	3.0 ab	1.5 ab	1.2 a
4. Esteem	1.25 oz.	HIG	1.4 ab	1.3 ab	2.6 a
5. Assail	1.25 oz.	HIG	31.2 bc	29.6 cd	6.9 ab
9. Untreated	-	-	95.9 d	277.0 d	142.2 c



Lorsban, Venerate & Grandevo: Single Pre-Bloom Application highest labeled rate
Movento 9.0 oz./A @ PF & 2C; Exirel @ 20.0 FLOZ/A crawler emergence

Treatment/ formulation	Rate amt (AI)/100 gal	STLM No.mines/ cluster Gen 1	STLM No. mines /term Gen 2	% damaged fruit AM Harvest	No. int. lep.[a] Gen 1	No. int. lep.[a] Harvest	PC 30 Jul	PC Harvest	OBLR Early	OBLR Late	SJS Harvest	TPB Harvest	% clean fruit Harvest
Imidan 70 WP[b]	11.2 oz	4.0 b	11.8 c	0.0 a	0.0 a	0.0 a	2.0 a	7.3 a	0.67 a	1.3 a	0.0 a	0.3 ab	90.3 b
Surround WP[c]	50 lb	2.3 ab	2.7 b	0.0 a	4.0 b	6.3 ab	4.0 a	4.6 a	2.3 ab	1.6 a	32.3 b	0.0 a	51.7 a
Orchex 796[c]	128 oz	1.6 a	0.2 a	1.0 a	1.0 ab	17.6 bc	57.7 b	31.3 b	1.0 a	2.3 a	0.0 a	1.0 ab	45.7 a
Aza-Direct EC[c]	1.8 oz	1.7 a	0.0 a	0.3 a	11.0 c	5.6 ab	54.7 b	26.6 b	2.6 ab	3.6 a	2.0 a	0.0 a	58.3 ab
Untreated check		3.8 ab	2.8 b	1.0 a	27.7 d	19.0 c	48.3 b	35.0 b	7.0 b	4.6 a	0.0 a	1.3 b	30.3 a

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Gen., generation; int. lep., internal lepidopterous larvae.

[a] Complex of codling moth, oriental fruit moth and lesser apple worm.

[b] Applied at petal fall and 1-7C.

[c] Applied at petal fall and then every 7 days.

Orchex 796:

* EPA-registered Agricultural Spray Oil
* low phytotoxicity.
* OMRI narrow-range petroleum-based oil for organic production.

TABLE 2.

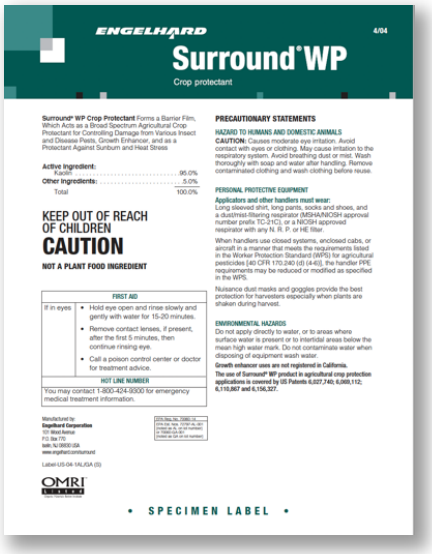
Treatment/ formulation	Rate amt (AI)/100 gal	No. ERM/leaf	No. phytoseiid mites/ 25 leaves
Imidan 70 WP	11.2 oz	0.0 a	30.7 b
Surround WP	50.0 lb	0.1 a	12.7 a
Orchex 796	128.0 oz	0.1 a	15.3 ab
Aza-Direct EC	1.8 oz	0.1 a	24.0 b
Untreated check		0.0 a	35.3 b

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Application time of the treatments same as in Table 1.

Reissig & Combs; Cornell AgriTech 2000

Plum Curculio: Biology

- Management for PC employing **Surround WP** at 50#/A should begin at Pink, followed by 80% PF + 7D intervals
- Complete coverage of fruitlets required. Add Entrust at PF-1C
- Continue beyond the PC migration model has ended using 308 DD base 50F predictive modeling.


ENGELHARD 4/04

Surround® WP

Crop protectant

Surround® WP Crop Protectant Forms a Barrier Film, Which Acts as a Broad Spectrum Agricultural Crop Protectant for Controlling Damage from Various Insect and Disease Pests, Growth Enhancer, and as a Protectant Against Sunburn and Heat Stress

Active Ingredient: Kaolin 95.0%
Other Ingredients: 5.0%
Total 100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

NOT A PLANT FOOD INGREDIENT

FIRST AID

If in eyes
- Hold eye open and rinse slowly and gently with water for 15-20 minutes.
- Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

You may contact 1-800-424-9300 for emergency medical treatment information.

Manufactured by:
Engelhard Corporation
101 Wood Avenue
P.O. Box 770
Iselin, NJ 08830 USA
www.engelhard.com/surround

Label-US-04-VALIGA (0)

OMRI LISTED

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes or clothing. May cause irritation to the respiratory system. Avoid breathing dust or mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT

Applicators and other handlers must wear:
Long sleeved shirt, long pants, socks and shoes, and a dust/mist-filtering respirator (MSHA/NIOSH approval number prefix TC-21C), or a NIOSH approved respirator with any N, R, P, or HE filter.

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d) (4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.

Nuisance dust masks and goggles provide the best protection for harvesters especially when plants are shaken during harvest.

ENVIRONMENTAL HAZARDS

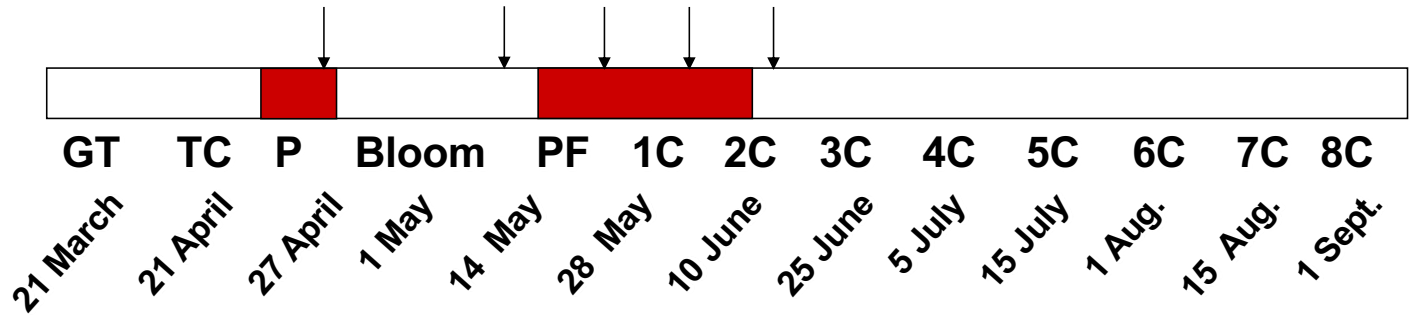
Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water.

Growth enhancer uses are not registered in California.

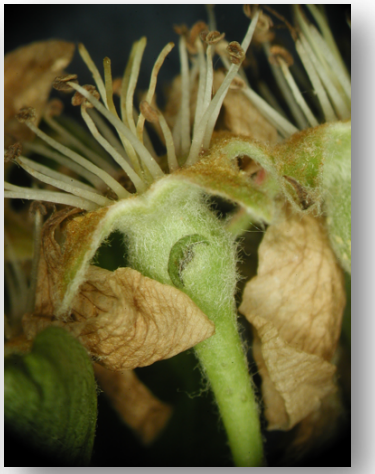
The use of Surround® WP product in agricultural crop protection applications is covered by US Patents 6,027,740; 6,069,112; 6,110,867 and 6,156,327.

• SPECIMEN LABEL •

PC



Plum Curculio: Biology



PC can reduce crop load by 40-100% each year in untreated blocks

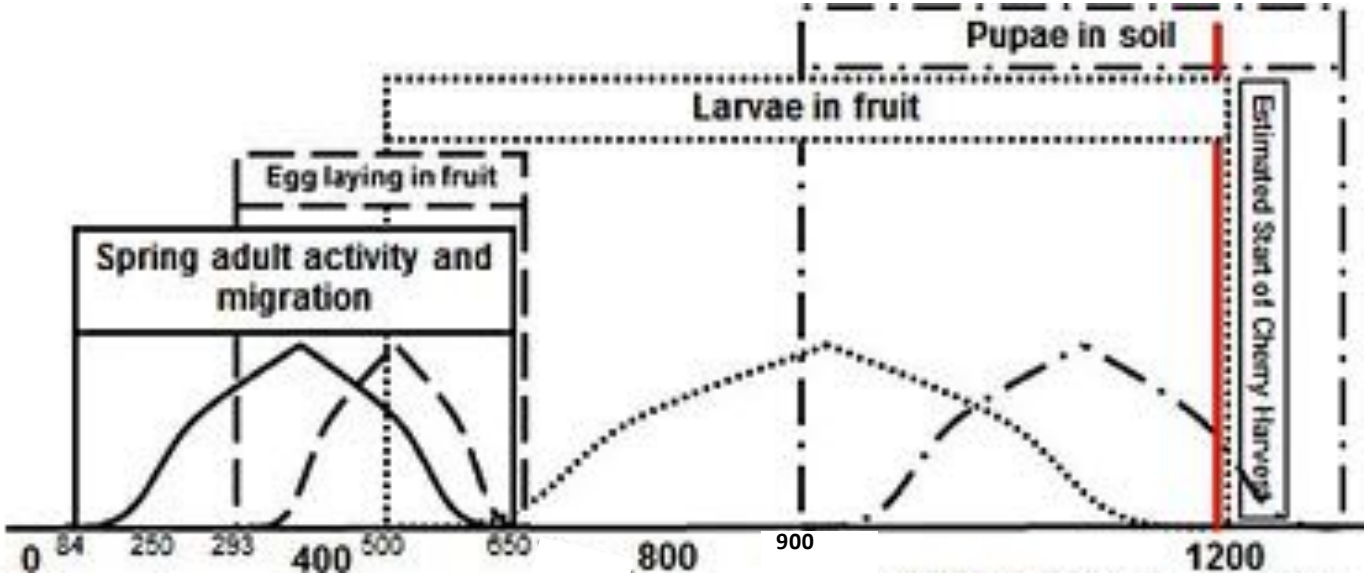
PC Scar Flap Removed Concealing Egg

PC Larva Feeding in Fruit

PC Larva (L) leave fruit to burrow in soil to Pupate (R)

- Adults overwinter in hedgerow and woodland
- **Organic orchards contain endemic populations as mortality is low.**
- Migrate into trees during bloom period
- After mating females carve crescent slit and flap to deposit single egg
- Larva drop to burrow into soil.
- Summer adults emerge from soil to feed on fruit

Plum Curculio: Management Window



Insecticide Modes of Action MOA

Contact
Adults

Curative
Egg

Anti-Feedant Contact

Treatment/ formulation	Rate amt (AI)/100 gal	STLM No.mines/ cluster Gen 1	STLM No. mines /term Gen 2	% damaged fruit AM Harvest	% damaged fruit No. int. lep.[a] Gen 1	% damaged fruit No. int. lep.[a] Harvest	% damaged fruit PC 30 Jul	% damaged fruit PC Harvest	% damaged fruit OBLR Early	% damaged fruit OBLR Late	% damaged fruit SJS Harvest	% damaged fruit TPB Harvest	% clean fruit Harvest
Imidan 70 WP[b]	11.2 oz	4.0 b	11.8 c	0.0 a	0.0 a	0.0 a	2.0 a	7.3 a	0.67 a	1.3 a	0.0 a	0.3 ab	90.3 b
Surround WP[c]	50 lb	2.3 ab	2.7 b	0.0 a	4.0 b	6.3 ab	4.0 a	4.6 a	2.3 ab	1.6 a	32.3 b	0.0 a	51.7 a
Orchex 796[c]	128 oz	1.6 a	0.2 a	1.0 a	1.0 ab	17.6 bc	57.7 b	31.3 b	1.0 a	2.3 a	0.0 a	1.0 ab	45.7 a
Aza-Direct EC[c]	1.8 oz	1.7 a	0.0 a	0.3 a	11.0 c	5.6 ab	54.7 b	26.6 b	2.6 ab	3.6 a	2.0 a	0.0 a	58.3 ab
Untreated check		3.8 ab	2.8 b	1.0 a	27.7 d	19.0 c	48.3 b	35.0 b	7.0 b	4.6 a	0.0 a	1.3 b	30.3 a

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Gen., generation; int. lep., internal lepidopterous larvae.

[a] Complex of codling moth, oriental fruit moth and lesser apple worm.

[b] Applied at petal fall and 1-7C.

[c] Applied at petal fall and then every 7 days.

Orchex 796:

* EPA-registered Agricultural Spray Oil
* low phytotoxicity.
* OMRI narrow-range petroleum-based oil for organic production.

TABLE 2.

Treatment/ formulation	Rate amt (AI)/100 gal	No. ERM/leaf	No. phytoseiid mites/ 25 leaves
Imidan 70 WP	11.2 oz	0.0 a	30.7 b
Surround WP	50.0 lb	0.1 a	12.7 a
Orchex 796	128.0 oz	0.1 a	15.3 ab
Aza-Direct EC	1.8 oz	0.1 a	24.0 b
Untreated check		0.0 a	35.3 b

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Application time of the treatments same as in Table 1.

Reissig & Combs; Cornell AgriTech 2000

Treatment/ formulation	Rate amt (AI)/100 gal	STLM No.mines/ cluster Gen 1	STLM No. mines /term Gen 2	% damaged fruit AM Harvest	% damaged fruit No. int. lep.[a] Gen 1	% damaged fruit No. int. lep.[a] Harvest	% damaged fruit PC 30 Jul	% damaged fruit PC Harvest	% damaged fruit OBLR Early	% damaged fruit OBLR Late	% damaged fruit SJS Harvest	% damaged fruit TPB Harvest	% clean fruit Harvest
Imidan 70 WP[b]	11.2 oz	4.0 b	11.8 c	0.0 a	0.0 a	0.0 a	2.0 a	7.3 a	0.67 a	1.3 a	0.0 a	0.3 ab	90.3 b
Surround WP[c]	50 lb	2.3 ab	2.7 b	0.0 a	4.0 b	6.3 ab	4.0 a	4.6 a	2.3 ab	1.6 a	32.3 b	0.0 a	51.7 a
Orchex 796[c]	128 oz	1.6 a	0.2 a	1.0 a	1.0 ab	17.6 bc	57.7 b	31.3 b	1.0 a	2.3 a	0.0 a	1.0 ab	45.7 a
Aza-Direct EC[c]	1.8 oz	1.7 a	0.0 a	0.3 a	11.0 c	5.6 ab	54.7 b	26.6 b	2.6 ab	3.6 a	2.0 a	0.0 a	58.3 ab
Untreated check		3.8 ab	2.8 b	1.0 a	27.7 d	19.0 c	48.3 b	35.0 b	7.0 b	4.6 a	0.0 a	1.3 b	30.3 a

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Gen., generation; int. lep., internal lepidopterous larvae.

[a] Complex of codling moth, oriental fruit moth and lesser apple worm.

[b] Applied at petal fall and 1-7C.

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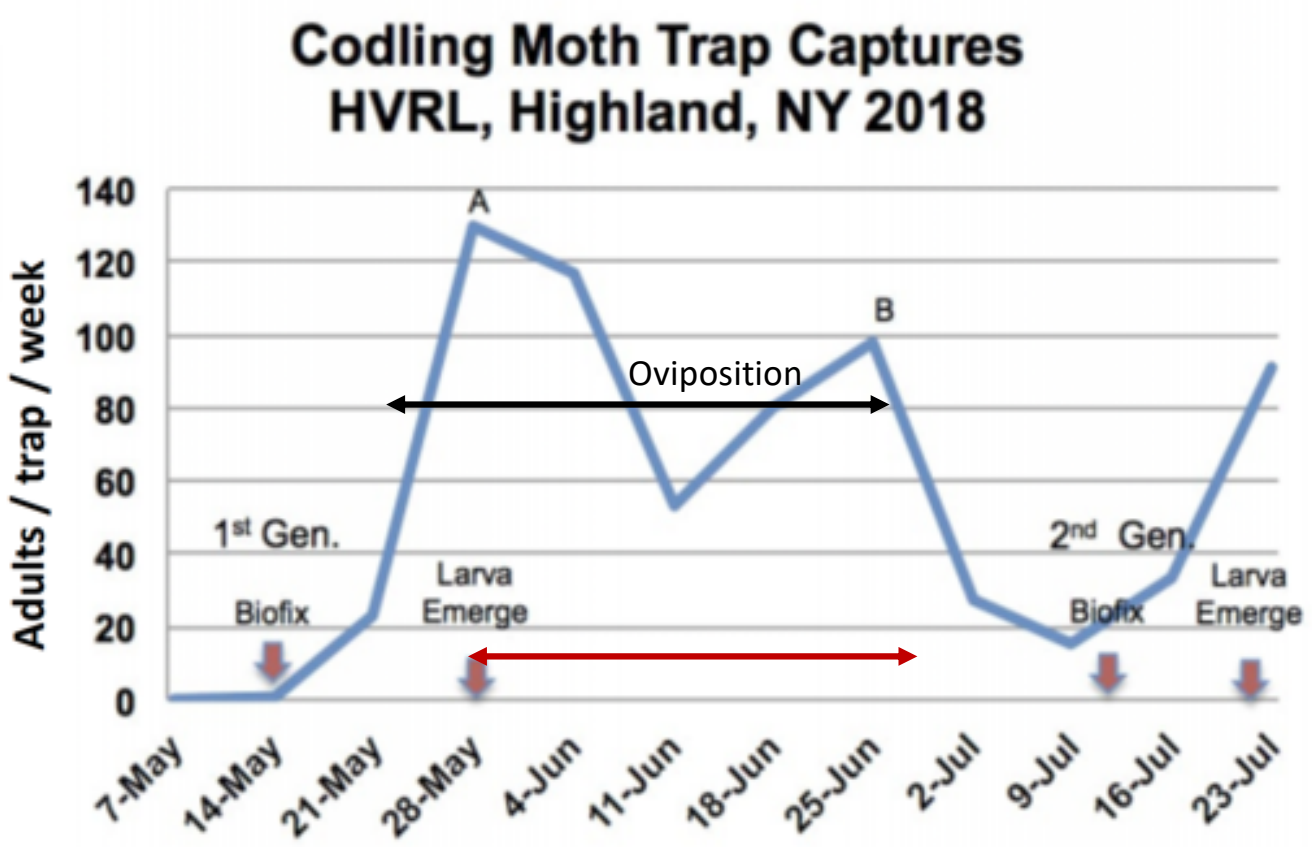
Orchex 796	128.0 oz	0.1 a	15.3 ab
Aza-Direct EC	1.8 oz	0.1 a	24.0 b
Untreated check		0.0 a	35.3 b

Means within a column followed by the same letter are not significantly different (Fisher's protected LSD test, $P < 0.05$). Application time of the treatments same as in Table 1.

Reissig & Combs; Cornell AgriTech 2000

Codling Moth
Biology & Management

Codling Moth
Biology & Management



Codling Moth
Model Based Precision Thresholds

- 1st generation **codling moth** (CM) adult flight occurred on 15th May

Larval emergence predicted for 30th May using **220 DD_{50}** from the biofix.

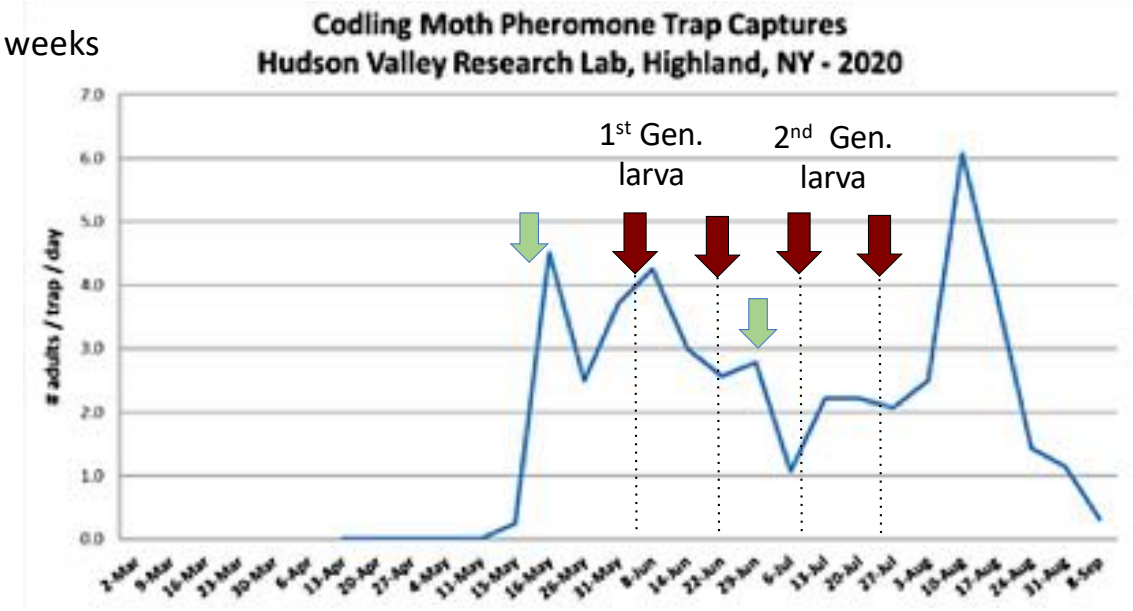
- The 2nd generation CM management adult emergence using 29th June

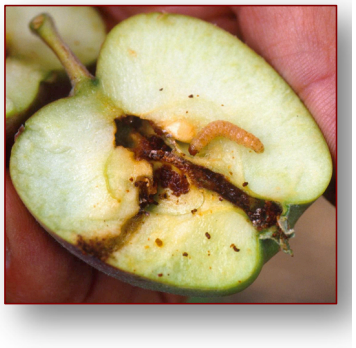
Larval emergence predicted **250 DD_{50}** to occur on 8th July

- Residual for 4-5 weeks

Biofix

Application Date





SPEAR®-LEP

For Control of Lepidopterans

OPEN

GROUP	32	INSECTICIDE

Biological Insecticide

Control of Lepidopteran pests in fruits, vegetables and other high-value field crops.

Active Ingredient: GS-omega/kappa-Hxtx-Hv1a 2.0%
Other Ingredients: 98.0%
Total: 100.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

See back panel for Precautionary Statements, First Aid, and Storage and Disposal.

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 – 20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15 – 20 minutes. • Call a poison control center or doctor for treatment advice.

HOTLINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-535-5053 {and 1-352-323-3500 for International} for emergency medical treatment information.

Produced for:
Vestaron Corporation
600 Park Offices Drive, Suite 117
Research Triangle Park, NC 27709

EPA Reg. No.: 88847-6
EPA Est. No.: Printed on Container
Made in USA

VESTARON
THE POWER OF PEPTIDES™

- Peptide-based Bio-pesticide
- Labeled for pome and stone fruits
- To be tank mixed with a Bt product (Leprotec)

Crop	Insect Pest	Application Rate (Pint/acre)
Pome and Stone fruits **Such as:** Apples, Pears, Quince, Prunes, Apricots, Cherries, Nectarine, Peaches, Plums, Prunes **Nut Trees** **Such as:** Almonds, Filbert, Chestnuts, Walnuts, Pecans	Variegated leafroller Redbanded Leafroller Walnut Caterpillar Coding moth Cutworms Filbert Leafroller Oblique Banded Leafroller Cankerworms Fruitworms Winter moth (Apples only)	1.0 - 2.0
	Pandemis Leafroller European grapevine moth (crymax) Hickory shuckworm Citrus cutworm Navel Orangeworm Redhumped Caterpillar Tent Caterpillar Omnivorous leafroller Tortix Moth Peach twig borer Fruittree leafroller Gypsy moth Tufted Apple Budmoth Fall Webworm	

APPLICATION RATES FOR SPEAR - LEP + *BACILLUS THURINGIENSIS* IN A TANK MIX ON THE FOLLOWING CROPS

Pre-harvest Interval (PHI) = 0 days

LEPROTEC®

OPEN

FOR OUTDOOR FOOD, NON-FOOD, AND GREENHOUSE

AQUEOUS BIOLOGICAL INSECTICIDE

Active Ingredient: *Bacillus thuringiensis* ssp. *kurstaki* strain EVB-113-19 fermentation solids, spores, and insecticidal toxin.....14.49%*

Other Ingredients:.....85.51%

TOTAL:.....100.00%

*Potency: 17,500 Cabbage Looper Units (CLU) per mg of product (equivalent to 76 billion CLU per gallon of product) The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN

CAUTION

See back panel for additional first aid and precautionary statements.

FIRST AID	
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
If in eyes	• Hold eye open, and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
HOTLINE NUMBER - Have the product container or label with you when calling a poison control center or doctor or when going for treatment. You may contact your local poison control center at 1-800-222-1222 for emergency and medical information. For information concerning this product, call the National Pesticide Information Center (NPIC) at 1-800-858-7378. Open from 8:00AM to 12:00PM Pacific Time, Mon-Fri.	

Distributed by:
Vestaron Corporation
4717 Campus Drive
Kalamazoo, MI 49008

EPA Registration No.: 89046-12-88847
EPA Establishment No.: 89046-CAN-2
Use this product within 18 months of the date of manufacture.
Date of Manufacture: _____
Lot number: _____

NET CONTENTS: 1 GALLON (128 FL OZ)

03/14/2019v1

VESTARON
THE POWER OF PEPTIDES™

Treatment Schedule for Seasonal Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

5.	Altacor 35 WG*	4.0 oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
	Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
6.	Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
	Spear-Lep*	32 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
	Leprotec*	16.0 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
	Exirel	20.5 fl.oz./A	2nd gen. CM	23 July 11, 20 Aug
7.	Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
	Spear-Lep*	32.0 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
	Leprotec*	16.0 fl.oz./A	2nd gen CM	23 July 11, 20 Aug
8.	Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
	Exirel	20.5 fl.oz./A	1st & 2nd gen CM	11, 24 June, 3, 23 July, 11, 20 Aug
	UTC			

* LI-700 @ 0.25% was added to spray solution throughout the season

Table 13a **Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple [a]**
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt.	/ Formulation	Rate	Incidence (%) of insect damaged cluster fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
5.	Altacor 35 WG*	4.0 oz./A	24.3	0.8	1.3 cd	4.5 bc	0.0	47.5	39.3 ab
	Actara	4.0 oz./A							
6.	Actara*	4.0 oz./A	24.6	1.0	10.5 bc	14.0 ab	0.0	6.0	45.2 ab
	Spear-Lep	32 fl.oz./A							
	Leprotec	16.0 fl.oz./A							
	Exirel	20.5 fl.oz./A							
7.	Actara*	4.0 oz./A	22.0	2.8	12.8 b	11.0 abc	0.3	6.3	51.5 ab
	Spear-Lep	32.0 fl.oz./A							
	Leprotec	16.0 fl.oz./A							
8.	Actara*	4.0 oz./A	18.9	2.3	2.8 bcd	2.3 bc	0.3	35.3	46.0 ab
	Exirel	20.5 fl.oz./A							
	UTC		36.6	0.8	47.3 a	25.7 a	0.3	19.2	6.1 b
P value for transformed data			0.2827	0.1960	0.0001	0.0001	0.9164	0.3697	0.0235

* Evaluation made on 'Ginger Gold' cultivar on 31 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%.

Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

	Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit					
			Lf. Roller	CM	AMP	AMT	SB	Clean
5.	Altacor 35 WG*	4.0 oz./A	0.0 c	0.5 d	0.8 b	0.3 b	0.0	39.3 ab
	Actara	4.0 oz./A						
6.	Actara*	4.0 oz./A	2.0 abc	7.8 bc	4.5 ab	4.0 ab	0.5	45.2 ab
	Spear-Lep	32 fl.oz./A						
	Leprotec	16.0 fl.oz./A						
	Exirel	20.5 fl.oz./A						
7.	Actara*	4.0 oz./A	3.0 ab	9.5 bc	3.3 ab	2.0 ab	0.0	51.5 ab
	Spear-Lep	32.0 fl.oz./A						
	Leprotec	16.0 fl.oz./A						
8.	Actara*	4.0 oz./A	0.0 c	1.0 cd	0.3 b	0.3 b	0.8	46.0 ab
	Exirel	20.5 fl.oz./A						
	UTC		6.4 a	27.0 a	18.9 a	8.3 a	0.5	6.1 b
P value for transformed data			0.1746	0.0001	0.0038	0.0027	0.6205	0.0235

* Evaluation made on 'Ginger Gold' cultivar on 31 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%.

Treatment/formulation	Rate product/acre	Application timing	CM mean damage (frass) per 30 fruit	CM mean tunnels per 50 fruit	CM mean no. live larvae per 50 fruit
			Mid season eval 5 Jul	Harvest eval 24 Sep	Harvest eval 24 Sep
Untreated Check			6.8a	29a	3.0a
Proclaim 5SG +	4.8 fl oz	ABCDEFG	1ab	11b	0.8a
LI-700 SL	0.25% v: v	ABCDEFG			
Proclaim OPTI 5WG	4.8 fl oz	ABCDEFG	3ab	11.3b	2.3a
LI-700 SL+	0.25% v: v	ABCDEFG			
Altacor 35WG	4 oz	ABCDEFG	3.8ab	3b	1.0a
LI-700 SL +	0.25% v: v	ABCDEFG			
Delegate 25WG	7 oz	ABCDEFG	0.5b	5.8b	0.0a
LI-700 SL +	0.25% v: v	ABCDEFG			
Spear-Lep	1 pt	ABCDEFG	1ab	5.3b	0.3a
Bt-K Leprotec +	1 pt	ABCDEFG			
LI-700 SL +	0.125% v: v	ABCDEFG			
Spear-Lep	2 pt	ABCDEFG	1.5ab	11.8ab	2.0a
Bt-K Leprotec +	1 pt	ABCDEFG			
LI-700 SL +	0.125% v: v	ABCDEFG			

Means followed by same letter do not significantly differ ($P \leq 0.05$, Tukey's HSD). ANOVA performed on arcsine square-root transformed data; data presented are actual counts. ANOVA may not be valid as the data failed Bartlett's test for homogeneity. A = 18 Jun (CM Biofix + 250DD), B = 2 Jul (2C, A + 14 days), C = 17 Jul (3C, B + 14 days), D = 31 Jul (4C, C + 14 days), E = 14 Aug (5C, 2nd Gen CM Biofix + 250DD + 14 days), F = 28 Aug (6C, E + 14 days), G = 11 Sep (7C, F + 14 days).

John Wise, Michigan State, Trever Research Station.