RESULTS OF
2017
INSECTICIDE AND ACARICIDE STUDIES IN EASTERN NEW YORK

P. J. Jentsch
Senior Extension Associate Entomologist

Cornell University's Hudson Valley Research Laboratory
P.O. Box 727 Highland, NY 12528

Tel: 845-691-6516
FAX: 845-691-2719
Mobile: 845-417-7465
e-mail: pjj5@cornell.edu

Research Support Technician	Lydia Brown
Field Research Support Technician	Tim Lampasona
Support Technician Insect Colonies …………………	Dana Acimovic
Research Assistant	Christopher Leffelman
Research Assistant	Lucas Canino
Research Assistant	Ben Lee
Research Assistant	Addie Kurchin
Summer Research Intern	Cameron Fuhr
Farm Manager …………………………….……...	Albert Woelfersheim
Administrative Assistant ……………………………	Erica Kane
Administrative Assistant ……………………………	Christine Kane
HRVL & NEWA Weather Data……………………..	Christopher Leffelman, Albert Woelfersheim

TABLE OF CONTENTS

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. Bayer CropScience, Dow AgroSciences, E.I. DuPont De Nemours & Co., United Phosphorus Inc, Syngenta, Gowan. Additional support for both research and operations was received from The New York State Apple Research and Development Program (ARDP), NYS Speciality Crops Research Initiative, New York State Ag. & Markets and Federal HATCH Program, NESARE and New York Farm Viability Institute, National SCRI - BMSB.

Formulation of Insecticides	Materials Tested	Company
	Apple	
Actara 25WDG		Syngenta
Altacor		E.I. DuPont De Nemours & Co.
Assail 30WG		United Phosphorus Inc.
Bifenthrin		United Phosphorus Inc.
Carbaryl 4L		United Phosphorus Inc.
Closer SC		Dow AgroScience
Danitol 2.4EC		Valant
Lorsban 4EC		Dow AgroScience
Asana XL		E.I. DuPont De Nemours & Co.
Delegate		Dow AgroSciences
Exirel		E.I. DuPont De Nemours & Co.
Grandevo WDG		Marrone Bio Innovations
Movento 240SC		Bayer CropScience
Sivanto		Bayer CropScience
Venerate XC		Marrone Bio Innovation
	Pear	
Actara 25WDG		Syngenta
AgriMek SC		Syngenta
Asana XL		E.I. DuPont De Nemours & Co.
BioCover MLT (NIS)		Crop Protection Services
Delegate		Dow AgroSciences
Esteem 35WP		Dow AgroSciences
Exirel		E.I. DuPont De Nemours & Co.
Movento 240SC		Bayer CropScience
Surround WP		Tessenderlo Kerley

EVALUATION OF INSECTICIDES FOR CONTROLLING FRUIT FEEDING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2017
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

European apple sawfly (EAS): *Hoplocampa testudinea* (Klug)
Green fruitworm (GFW*): Lithophane antennata* (Walker)
Mullein plant bug & apple red bug; (MPB): *Campylomma verbasci* (Meyer), (ARB) *Lygidea mendax* (Reuter)
Obliquebanded leafroller (OBLR): *Choristoneura rosaceana* (Harris)
Plum curculio (PC): *Conotrachelus nenuphar* (Herbst)
Redbanded leafroller (RBLR): *Argyrotaenia velutinana* (Walker)
Tarnished plant bug (TPB): *Lygus lineolaris* (P. de B.)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
Oriental fruit moth (OFM): *Grapholitha molesta* (Busck)
Codling moth (CM): *Cydia pomonella* (Linnaeus)
Potato leafhopper (PLH): *Empoasca fabae* (Harris)
Rose leafhopper (RLH): *Edwardsiana rosae* (Linnaeus)
White apple leafhopper (WALH): *Typhlocyba* pomaria McAtee
Apple rust mite (ARM): *Aculus schlechtendali* (Nalepa)
European red mite (ERM): *Panonychus ulmi* (Koch)
Two spotted spider mite (TSM): *Tetranychus urticae* Koch
A predatory stigmaeid (ZM): *Zetzellia mali* (Ewing)
A predatory phytoseiid (AMB): *Neoseiulus (=Amblyseius) fallacies* (Garman)

Treatments were applied to four-tree plots of two varieties replicated four times in a randomized complete block design (RCB). Treatments were applied concentrate using a Slim Line tower sprayer operated at 100 psi, delivering 0.69 to 0.75 gal/tree traveling at 2.5-2.86 mph averaging 100 gal/A. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Trees on the M.26 rootstock are 22 yr.-old, maintained at approximately 10 ft. height, and planted to a research spacing of 10' x 30'. Calculations for applications were based on 16' tree row spacing as found in conventional production planting utilizing M.26. Alternate rows of unsprayed trees adjacent to treated plots are maintained for drift reduction, increased insect distribution, and increased population pressure in yearly alternating plot placement.

Insecticide programs (Table 1) applied to manage the insect complex were assessed during fruit development of cluster fruit damage before 'June drop' by randomly selecting 50 fruitlets from each tree and scoring for external damage. The 'E. LEP' (external lepidopteran) category includes combined pre-bloom to 1C damage from the green fruitworm, redbanded leafroller, and obliquebanded leafroller complex. Evaluations of codling moth (CM) injury assessed 100 fruit in each of two varieties using calyx end frass and 'bulls-eye sting' of fruit as evidence of CM activity. San Jose scale (SJS) injury to fruit was assessed by scoring fruit as injured with 3 or more 'red haloed' markings. Phytophagous and predacious mite populations were evaluated by sampling 25 leaves from each plot. Leaves were removed to the laboratory, brushed onto glass plates using a mite-brushing machine, and examined using a binocular scope (>18X) for eggs, motiles, and adults. Assessment of foliage for the complex of leafhopper nymph presence comprised of WALH, PLH, and RLH, by examining 5 distal and 5 apical leaves on 5 shoots per tree for nymphs while subjectively rating foliage for percent injury from PLH feeding injury to apical leaves. Fruit at harvest was assessed from 100 fruit per tree in each of two varieties, 25% interior, 75% exterior, examined for external and quartered for internal insect presence and injury.

To stabilize variance, percent data were transformed using arcsine(Sqrt(x)) conducted prior to analysis. For numeric data such as foliar mite counts, $\log_{10}(x+1)$ transformation was used. Mean separation by Fishers Protected LSD ($P \leq 0.05$) unless noted for specific tables. Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 1 Treatment Schedule for 2017 Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment/Formulation	Rate	Timing	Application Dates
1. Sivanto	10.5 oz./A	P	24 April
Danitol 2.4 EC	16.0 oz./A	PF	8 May
2. Sivanto	14.0 oz./A	P	24 April
Danitol 2.4 EC	16.0 oz./A	PF	8 May
3. Sivanto	10.5 oz./A	P, 1C	24 April, 18 May
Danitol 2.4 EC	16.0 oz./A	PF	8 May
4. Sivanto	10.5 oz./A	P	24 April
Danitol 2.4 EC	16.0 oz./A	PF	8 May
Movento + LI700	9.0 oz./A	1C	18 May
5. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Movento + LI700	9.0 oz./A	1C	18 May
6. Lorsban 4 EC	1.0 pt./100 gal.	P	24 April
Danitol 2.4 EC	16.0 oz./A	PF	8 May
Altacor	4.0 oz./A	SJS Emg. + 14 d.	15 June, 29 June
7. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Venerate XC	2.0 qt./A	SJS Emg. + 14d.	15 June, 29 June
8. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Grandevo WDG	2.0 lb./A	SJS Emg. + 14d.	15 June, 29 June
9. Exirel	20.5 fl. oz./A	P, PF, 1C	24 April, 8 & 18 May
		SJS Emg. + 14d.	15 June, 29 June
10. Untreated Check (UTC)			

The entire block except the UTC was treated for apple maggot on 19 July and 8 August with Assail (acetamiprid) at 9.0 oz./A

Table 2 **Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple** [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

		Incidence (%) of insect damaged cluster fruit							
Trmt. / Formulation	Rate	PC	TPB	EAS	MPB	E. LEP	CM	SJS	Clean
1. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	10.9 a	0.9 ab	0.9 a	0.0	1.3 abc	3.0 ab	22.5 ab	62.3 ab
2. Sivanto Danitol 2.4EC	14.0 oz./A 16.0 oz./A	15.5 ab	1.0 ab	0.8 a	0.0	2.4 abc	5.1 b	7.5 ab	69.7 ab
3. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	14.5 a	0.8 a	0.5 a	0.0	0.0 a	3.8 ab	40.0 b	47.5 ab
4. Sivanto Danitol 2.4EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	18.5 ab	2.8 ab	0.5 a	0.0	2.3 abc	1.5 ab	2.3 a	74.2 b
5. Danitol 2.4EC Movento + LI700	16.0 oz./A 9.0 oz./A	9.9 a	1.2 ab	0.9 a	0.0	0.3 ab	1.0 ab	0.0 a	64.9 ab
6. Lorsban 4EC Danitol 2.4EC Altacor	1.0 pt./100 16.0 oz./A 4.0 oz./A	14.8 ab	1.5 ab	0.8 a	0.0	2.0 abc	0.0 a	5.3 ab	76.8 b
7. Danitol 2.4EC Venerate XC	16.0 oz./A 2.0 qts./A	11.0 a	2.8 ab	2.0 a	0.0	4.0 c	3.5 ab	3.8 ab	75.3 b
8. Danitol 2.4EC Grandevo WDG	16.0 oz./A 2.0 lbs./A	37.5 ab	1.1 a	0.3 a	0.0	3.8 bc	3.5 ab	1.8 a	51.4 ab
9. Exirel	20.5 fl.oz./A	18.7 ab	1.5 ab	0.3 a	0.0	1.5 abc	0.3 ab	21.9 ab	59.6 ab
10. UTC		47.3 b	4.0 b	0.4 a	0.0	3.4 bc	2.0 ab	30.0 ab	24.9 a
P value for transformed data		0.2741	0.5015	0.779	-	0.1631	0.273	0.3186	0.433

[a] Evaluation made on 16 June on 'Red Delicious' cultivar.

Table 3 Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit: PC	TPB	EAS	MPB	E.LEP	CM	SJS	Clean
1. Sivanto	10.5 oz./A	17.3 ab	1.0 a	1.3 a	0.0	2.5 ab	1.3 a	16.5 ab	60.5 ab
Danitol 2.4EC	16.0 oz./A								
2. Sivanto	14.0 oz./A	20.0 ab	1.5 ab	1.8 a	0.0	6.0 bc	1.8 a	4.5 ab	46.3 ab
Danitol 2.4EC	16.0 oz./A								
3. Sivanto	10.5 oz./A	27.3 ab	1.5 a	2.3 a	0.0	4.3 abc	0.8 a	23.3 b	46.5 ab
Danitol 2.4EC	16.0 oz./A								
4. Sivanto	10.5 oz./A	28.5 ab	4.8 b	2.0 a	0.0	2.3 ab	0.3 a	0.5 a	64.0 b
Danitol 2.4EC	16.0 oz./A								
Movento + LI700	9.0 oz./A								
5. Danitol 2.4EC	16.0 oz./A	23.3 ab	1.3 a	2.8 a	0.0	1.3 ab	0.8 a	1.8 ab	73.0 b
Movento + LI700	9.0 oz./A								
6. Lorsban 4EC	1.0 pt./100	17.8 ab	2.8 ab	2.0 a	0.0	2.3 ab	0.0 a	0.3 a	77.0 b
Danitol 2.4EC	16.0 oz./A								
Altacor	4.0 oz./A								
7. Danitol 2.4EC	16.0 oz./A	18.3 a	4.3 ab	3.5 a	0.0	1.5 ab	1.0 a	1.3 a	72.8 b
Venerate XC	2.0 qt./A								
8. Danitol 2.4EC	16.0 oz./A	35.3 ab	3.5 ab	3.3 a	0.0	3.3 abc	2.8 a	2.0 a	50.0 ab
Grandevo WDG	2.0 lb./A								
9. Exirel	20.5 fl.oz./A	30.0 ab	2.5 ab	1.5 a	0.0	0.5 a	0.0 a	3.5 ab	64.5 b
10. UTC		53.0 b	5.3 b	0.5 a	0.0	9.3 c	2.0 a	11.8 ab	27.3 a
P value for transformed data		0.6408	0.1017	0.8375	-	0.072	0.8705	0.2664	0.1303

[a] Evaluation made on 16 June on 'Ginger Gold' cultivar.

Table 4a **Insect Injury Means at Harvest from Apple Insecticide Screen Hudson Valley Research Laboratory, Highland, NY - 2017**

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		PC	EAS	TPB	E. LEP.	LR	L. LEP	Clean
1. Sivanto Danitol 2.4 EC	10.5 oz./A 16.0 oz./A	60.0 ab	2.1	2.9	3.2	0.8 b	0.5	12.0 b
2. Sivanto Danitol 2.4 EC	14.0 oz./A 16.0 oz./A	30.1 ab	3.3	7.6	0.5	0.5 b	3.5	24.9 ab
3. Sivanto Danitol 2.4 EC	10.5 oz./A	42.4 ab	5.2	6.2	0.8	1.0 ab	1.3	11.1 b
4. Sivanto Danitol 2.4 EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	52.9 ab	1.3	3.1	1.0	2.3 ab	1.0	23.2 ab
5. Danitol 2.4 EC Movento + LI700	16.0 oz./A 9.0 oz./A	12.3 b	3.0	9.3	0.5	1.3 ab	5.3	46.1 a
6. Lorsban Danitol 2.4 EC Altacor	1.0 pt./A 16.0 oz./A 4.0 oz./A	22.8 ab	3.3	9.1	2.3	0.0 b	1.3	46.3 a
7. Danitol 2.4 EC Venerate XC	16.0 oz./A 2.0 qt./A	41.3 ab	4.1	9.5	0.0	1.0 ab	2.3	29.3 ab
8. Danitol 2.4 EC Grandevo WDG	16.0 oz./A 2.0 lb./A	51.6 ab	4.1	2.8	0.0	0.0 b	1.5	11.6 b
9. Exirel	20.5 fl.oz./A	27.0 ab	5.3	7.3	0.3	0.3 b	0.0	19.8 ab
10. UTC		69.5 a	0.3	4.3	0.8	5.5 a	7.3	4.5 b
P value for transformed data		0.0441	NS	NS	NS	0.0019	NS	0.0002

Harvest evaluation of 'Ginger Gold' on 31 July. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. 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.

Table 4b Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		CM1	CM2	AMP	AMT	SJS	SB	Clean
1. Sivanto	10.5 oz./A	5.4 a	11.0	6.8	1.1	29.0	1.5	12.0 b
Danitol 2.4 EC	16.0 oz./A							
2. Sivanto	14.0 oz./A	5.9 a	6.5	9.3	7.0	42.6	3.3	24.9 ab
Danitol 2.4 EC	16.0 oz./A							
3. Sivanto	10.5 oz./A	2.8 a	8.0	11.1	6.7	55.7	6.1	11.1 b
Danitol 2.4 EC	16.0 oz./A							
4. Sivanto	10.5 oz./A	2.3 a	2.3	12.4	5.5	3.0	3.8	23.2 ab
Danitol 2.4 EC	16.0 oz./A							
Movento + LI700	9.0 oz./A							
5. Danitol 2.4 EC	16.0 oz./A	1.3 a	1.8	15.3	12.3	19.3	3.3	46.1 a
Movento + LI700	9.0 oz./A							
6. Lorsban	1.0 pt./A	0.8 a	0.0	15.4	4.0	7.9	3.0	46.3 a
Danitol 2.4 EC	16.0 oz./A							
Altacor	4.0 oz./A							
7. Danitol 2.4 EC	16.0 oz./A	1.8 a	3.9	11.6	7.6	17.9	4.3	29.3 ab
Venerate XC	2.0 qt./A							
8. Danitol 2.4 EC	16.0 oz./A	3.3 a	5.3	9.4	4.8	38.8	3.5	11.6 b
Grandevo WDG	2.0 lb./A							
9. Exirel	20.5 fl.oz./A	0.5 a	6.3	13.5	19.3	39.0	8.0	19.8 ab
10. UTC		2.0 a	1.8	30.0	26.5	61.5	5.5	4.5 b
P value for transformed data		0.0423	NS	NS	NS	NS	NS	0.0002

Harvest evaluation of ‘Ginger Gold’ on 31 July. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. 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.

Table 5a Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

		Mean incidence (%) of insect damaged fruit						
Trmt/ Formulation	Rate	PC	EAS	TPB	E. LEP.	LR	L. LEP	Clean
1. Sivanto Danitol 2.4 EC	10.5 oz./A 16.0 oz./A	36.5	2.8	2.8	0.5 b	5.8 a	4.8	17.5 ab
2. Sivanto Danitol 2.4 EC	14.0 oz./A 16.0 oz./A	29.0	1.9	8.4	1.6 ab	3.0 ab	4.3	29.1 ab
3. Sivanto Danitol 2.4 EC	10.5 oz./A 16.0 oz./A	27.0	3.0	7.0	0.4 ab	5.4 ab	6.0	19.0 ab
4. Sivanto Danitol 2.4 EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	34.0	0.3	5.5	0.5 ab	6.3 a	4.8	36.3 ab
5. Danitol 2.4 EC Movento + LI700	16.0 oz./A 9.0 oz./A	49.0	1.0	3.3	4.1 a	3.3 ab	0.5	30.9 ab
6. Lorsban Danitol 2.4 EC Altacor	1.0 pt./A 16.0 oz./A 4.0 oz./A	27.5	3.0	7.3	0.0 b	0.0 b	0.8	40.5 a
7. Danitol 2.4 EC Venerate XC	16.0 oz./A 2.0 qt./A	22.5	1.3	6.8	0.5 b	7.0 a	5.3	23.8 ab
8. Danitol 2.4 EC Grandevo WDG	16.0 oz./A 2.0 lb./A	36.3	1.5	5.5	0.0 b	3.2 ab	4.5	24.0 ab
9. Exirel	20.5 fl.oz./A	28.0	2.0	6.2	0.3 b	0.0 b	0.0	33.4 ab
10. UTC		70.6	0.8	1.8	0.0 b	6.3 a	5.3	2.6 b
P value for transformed data		NS	NS	NS	0.0040	0.0004	NS	0.0418

Harvest evaluation of 'Red Delicious' on 21 September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. Data were transformed using arcsine(sqrt(x)) prior to ANOVA ($P \leq 0.05$). Means separation by Tukey-Kramer HSD ($P \leq 0.05$); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 5b **Insect Injury Means at Harvest from Apple Insecticide Screen**
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		CM1	CM2	AMP	AMT	SJS	SB	Clean
1. Sivanto Danitol 2.4 EC	10.5 oz./A 16.0 oz./A	3.0 a	12.5 a	7.0	6.0	43.3 ab	9.5	17.5 ab
2. Sivanto Danitol 2.4 EC	14.0 oz./A 16.0 oz./A	3.4 a	3.8 a	6.2	5.2	26.6 ab	9.6	29.1 ab
3. Sivanto Danitol 2.4 EC	10.5 oz./A 16.0 oz./A	2.1 a	9.9 a	8.7	8.3	50.9 ab	10.1	19.0 ab
4. Sivanto Danitol 2.4 EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	2.0 a	8.0 a	7.3	5.3	12.5 ab	9.0	36.3 ab
5. Danitol 2.4 EC Movento + LI700	16.0 oz./A 9.0 oz./A	3.3 a	13.1 a	6.3	1.5	1.8 b	12.0	30.9 ab
6. Lorsban Danitol 2.4 EC Altacor	1.0 pt./A 16.0 oz./A 4.0 oz./A	0.3 a	0.3 a	1.0	0.5	23.0 ab	5.0	40.5 a
7. Danitol 2.4 EC Venerate XC	16.0 oz./A 2.0 qt./A	3.5 a	5.5 a	8.8	8.0	42.0 ab	8.0	23.8 ab
8. Danitol 2.4 EC Grandevo WDG	16.0 oz./A 2.0 lb./A	1.0 a	2.7 a	9.7	8.7	37.6 ab	11.7	24.0 ab
9. Exirel	20.5 fl.oz./A	0.0 a	1.6 a	3.7	3.0	40.6 ab	8.3	33.4 ab
10. UTC		3.3 a	9.2 a	8.5	8.3	68.0 a	10.7	2.6 b
P value for transformed data		0.0291	0.0248	NS	NS	0.0120	NS	0.0418

Harvest evaluation of ‘Red Delicious’ on 21 September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. 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.

Table 6 Evaluations of Acaricides for Controlling Early Season Mite Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment / Formulation	Rate	Number of Adult Mites / Leaf				
		ERM	TSM	ZM	AMB	ARM
1. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	0.0 a	0.6 abc	0.4 ab	0.2 c	24.3 ab
2. Sivanto Danitol 2.4EC	14.0 oz./A 16.0 oz./A	0.0 a	0.3 ab	0.5 b	0.1 ab	17.4 ab
3. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	0.0 a	0.0 a	0.4 ab	0.0 ab	7.1 a
4. Sivanto Danitol 2.4EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	0.0 a	0.1 a	0.0 a	0.0 a	2.4 a
5. Danitol 2.4EC Movento + LI700	16.0 oz./A 9.0 oz./A	0.0 a	0.1 a	0.0 a	0.0 ab	0.8 a
6. Lorsban 4EC Danitol 2.4EC Altacor	1.0 pt./100 16.0 oz./A 4.0 oz./A	0.0 a	0.5 abc	0.3 ab	0.1 bc	29.6 abc
7. Danitol 2.4EC Venerate XC	16.0 oz./A 2.0 qt./A	0.0 a	0.2 ab	0.5 b	0.1 bc	26.1 ab
8. Danitol 2.4EC Grandevo WDG	16.0 oz./A 2.0 lb./A	0.0 a	0.2 ab	0.2 ab	0.1 abc	65.9 c
9. Exirel	20.5 fl. oz./A	0.0 a	1.2 c	0.1 ab	0.2 c	26.9 ab
10. UTC		0.0 a	1.0 bc	0.1 ab	0.0 ab	49.8 bc
P value for transformed data		0.5286	0.0843	0.1588	0.0051	0.041

[a] Evaluation made on 'Red Delicious' cultivar on 11 July. Data were transformed using $\log_{10}(x+1)$ using Fishers Protected LSD ($P \le 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 7 Evaluations of Acaricides for Controlling Early Season Mite Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment / Formulation	Rate	Number of Adult Mites / Leaf				
		ERM	TSM	ZM	AMB	ARM
1. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	0.0 a	0.0 a	0.0 ab	0.1 ab	7.8 ab
2. Sivanto Danitol 2.4EC	14.0 oz./A 16.0 oz./A	0.0 a	0.0 a	0.0 a	0.0 a	0.3 a
3. Sivanto Danitol 2.4EC	10.5 oz./A 16.0 oz./A	0.0 a	0.0 ab	0.1 ab	0.0 a	8.3 ab
4. Sivanto Danitol 2.4EC Movento + LI700	10.5 oz./A 16.0 oz./A 9.0 oz./A	0.0 a	0.0 a	0.0 ab	0.0 a	2.7 ab
5. Danitol 2.4EC Movento + LI700	16.0 oz./A 9.0 oz./A	0.0 a	0.2 b	0.0 ab	0.0 a	0.2 a
6. Lorsban 4EC Danitol 2.4EC Altacor	1.0 pt./100 16.0 oz./A 4.0 oz./A	0.0 a	0.0 ab	0.0 ab	0.0 ab	10.2 ab
7. Danitol 2.4EC Venerate XC	16.0 oz./A 2.0 qts./A	0.0 a	0.1 ab	0.0 ab	0.0 a	10.7 ab
8. Danitol 2.4EC Grandevo WDG	16.0 oz./A 2.0 lbs./A	0.0 a	0.0 a	0.1 b	0.1 b	15.0 b
9. Exirel	20.5 fl.oz./A	0.0 a	0.0 a	0.1 ab	0.0 ab	10.9 ab
10. UTC		0.0 a	0.0 a	0.0 ab	0.1 ab	4.8 ab
P value for transformed data		0.6171	0.3878	0.6098	0.2161	0.3587

[a] Evaluation made on ‘Red Delicious’ cultivar on 13 June. Data were transformed using $\log_{10}(x+1)$ using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

EVALUATION OF INSECTICIDES FOR CONTROLLING FRUIT FEEDING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2017
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

European apple sawfly (EAS): *Hoplocampa testudinea* (Klug)
Green fruitworm (GFW*): Lithophane antennata* (Walker)
Mullein plant bug & apple red bug; (MPB): *Campylomma verbasci* (Meyer), (ARB) *Lygidea mendax* (Reuter)
Obliquebanded leafroller (OBLR): *Choristoneura rosaceana* (Harris)
Plum curculio (PC): *Conotrachelus nenuphar* (Herbst)
Redbanded leafroller (RBLR): *Argyrotaenia velutinana* (Walker)
Tarnished plant bug (TPB): *Lygus lineolaris* (P. de B.)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
Oriental fruit moth (OFM): *Grapholitha molesta* (Busck)
Codling moth (CM): *Cydia pomonella* (Linnaeus)
Potato leafhopper (PLH): *Empoasca fabae* (Harris)
Rose leafhopper (RLH): *Edwardsiana rosae* (Linnaeus)
White apple leafhopper (WALH): *Typhlocyba* pomaria McAtee
Apple rust mite (ARM): *Aculus schlechtendali* (Nalepa)
European red mite (ERM): *Panonychus ulmi* (Koch)
Two spotted spider mite (TSM): *Tetranychus urticae* Koch
A predatory stigmaeid (ZM): *Zetzellia mali* (Ewing)
A predatory phytoseiid (AMB): *Neoseiulus (=Amblyseius) fallacies* (Garman)

Treatments were applied to four-tree plots of two varieties replicated four times in a randomized complete block design (RCB). Treatments were applied concentrate using a Slim Line tower sprayer operated at 100 psi, delivering 0.69 to 0.75 gal/tree traveling at 2.5-2.86 mph averaging 100 gal/A. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Trees on the M.26 rootstock are 22 yr.-old, maintained at approximately 10 ft. height, and planted to a research spacing of 10' x 30'. Calculations for applications were based on 16' tree row spacing as found in conventional production planting utilizing M.26. Alternate rows of unsprayed trees adjacent to treated plots are maintained for drift reduction, increased insect distribution, and increased population pressure in yearly alternating plot placement.

Insecticide programs (Table 1) applied to manage the insect complex were assessed during fruit development of cluster fruit damage before 'June drop' by randomly selecting 50 fruitlets from each tree and scoring for external damage. The 'E. LEP' (external lepidopteran) category includes combined pre-bloom to 1C damage from the green fruitworm, redbanded leafroller, and obliquebanded leafroller complex. Evaluations of codling moth (CM) injury assessed 100 fruit in each of two varieties using calyx end frass and 'bulls-eye sting' of fruit as evidence of CM activity. San Jose scale (SJS) injury to fruit was assessed by scoring fruit as injured with 3 or more 'red haloed' markings. Phytophagous and predacious mite populations were evaluated by sampling 25 leaves from each plot. Leaves were removed to the laboratory, brushed onto glass plates using a mite-brushing machine, and examined using a binocular scope (>18X) for eggs, motiles, and adults. Assessment of foliage for the complex of leafhopper nymph presence comprised of WALH, PLH, and RLH, by examining 5 distal and 5 apical leaves on 5 shoots per tree for nymphs while subjectively rating foliage for percent injury from PLH feeding injury to apical leaves. Fruit at harvest was assessed from 100 fruit per tree in each of two varieties, 25% interior, 75% exterior, examined for external and quartered for internal insect presence and injury.

To stabilize variance, percent data were transformed using arcsine(Sqrt(x)) conducted prior to analysis. For numeric data such as foliar mite counts, $\log_{10}(x+1)$ transformation was used. Mean separation by Fishers Protected LSD ($P \leq 0.05$) unless noted for specific tables. Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

**Table 8 Treatment Schedule for Seasonal Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017**

Treatment/Formulation	Rate	Timing	Application Dates
1. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Actara	5.5 oz./A	200_{DD} CM, 7-8C	31 May, 19 July, 8 August
2. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Carbaryl	96 fl. oz./A	200_{DD} CM, 7-8C	31 May, 19 July, 8 August
3. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Delegate	6.0 oz./A	200_{DD} CM	31 May
Exirel	20.5 fl. oz./A	7-8C	19 July, 8 August
4. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Altacor	4.5 oz./A	200_{DD} CM	31 May
Assail	8.0 oz./A	7-8C	19 July, 8 August
5. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Altacor	4.5 oz./A	200_{DD} CM, 7-8C	31 May, 19 July, 8 August
6. Danitol 2.4 EC	16.0 oz./A	PF	8 May
Exirel	20.5 fl. oz./A	200_{DD} CM, 7-8C	31 May, 19 July, 8 August
7. Danitol 2.4 EC	16.0 oz./A	PF, 200_{DD} CM, 7-8C	8 May, 31 May, 19 July, 8 August
8. Untreated Check (UTC)			

Table 9 Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

		Incidence (%) of insect damaged cluster fruit							
Trmt. / Formulation	Rate	PC	TPB	EAS	MPB	E.LEP	CM	SJS	Clean
1. Danitol 2.4EC Actara	16.0 oz./A 5.5 oz./A	6.3 ab	5.3 a	0.3 a	0.0 a	2.3 ab	2.3 abc	14.5 b	72.5 ab
2. Danitol 2.4EC Carbaryl	16.0 oz./A 96 fl.oz./A	7.3 ab	4.0 a	1.0 a	0.0 a	2.3 ab	1.0 abc	2.8 a	84.3 b
3. Danitol 2.4EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl.oz./A	6.3 a	7.3 a	0.0 a	0.0 a	1.8 ab	0.3 ab	4.5 ab	81.0 ab
4. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	6.3 a	4.0 a	0.8 a	0.0 a	1.0 ab	1.8 bc	7.3 ab	82.0 ab
5. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	12.5 ab	6.5 a	0.0 a	0.0 a	0.5 a	0.0 a	10.5 ab	74.0 ab
6. Danitol 2.4EC Exirel	16.0 oz./A 20.5 fl.oz./A	8.0 ab	3.0 a	1.3 a	0.0 a	0.3 a	0.0 a	13.0 b	75.8 ab
7. Danitol 2.4EC	16.0 oz./A	7.3 a	6.3 a	0.3 a	0.0 a	1.8 ab	1.8 bc	16.5 b	67.3 ab
8. UTC		24.5 b	3.5 a	2.0 a	0.0 a	3.0 b	3.0 c	6.0 ab	60.5 a
P value for transformed data		0.4375	0.4756	0.3911	-	0.0897	0.0452	0.1997	0.3703

[a] Evaluation made on 16 June on 'Red Delicious' cultivar for 1st generation Codling Moth (CM).

Table 10 Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2017

		Incidence (%) of insect damaged cluster fruit							
Trmt. / Formulation	Rate	PC	TPB	EAS	MPB	E.LEP	CM	SJS	Clean
1. Danitol 2.4EC Actara	16.0 oz./A 5.5 oz./A	14.5 ab	14.5 a	2.3 bc	0.0	2.3 a	1.8 a	0.3 ab	68.0 a
2. Danitol 2.4EC Carbaryl	16.0 oz./A 96 fl.oz./A	12.5 ab	13.0 a	3.1 bc	0.0	0.8 a	1.0 a	0.0 a	72.7 a
3. Danitol 2.4EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl.oz./A	22.0 ab	14.9 a	5.4 c	0.0	2.2 a	0.3 a	0.3 ab	58.8 a
4. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	13.8 ab	12.3 a	1.3 ab	0.0	3.0 a	1.0 a	1.0 ab	69.5 a
5. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	21.3 ab	12.0 a	0.0 a	0.0	0.8 a	1.5 a	0.3 ab	65.8 a
6. Danitol 2.4EC Exirel	16.0 oz./A 20.5 fl.oz./A	16.0 ab	12.3 a	1.0 ab	0.0	0.5 a	0.5 a	5.0 b	66.3 a
7. Danitol 2.4EC	16.0 oz./A	15.1 a	9.9 a	0.8 ab	0.0	3.5 a	2.0 a	0.7 ab	69.3 a
8. UTC		31.3 b	14.3 a	2.6 bc	0.0	3.1 a	1.5 a	0.5 ab	49.5 a
P value for transformed data		0.4776	0.9194	0.0308	-	0.4549	0.7766	0.4792	0.5889

[a] Evaluation made on 16 June on ‘Ginger Gold’ cultivar for treatments timed for Codling Moth.

Table 11a Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		PC	EAS	TPB	E. LEP.	LR	L. LEP	Clean
1. Danitol 2.4 EC	16.0 oz./A	33.9	4.7	7.7	0.0	0.7	2.3	18.5
Actara	5.5 oz./A							
2. Danitol 2.4 EC	16.0 oz./A	37.7	5.3	10.3	0.0	1.5	4.8	28.5
Carbaryl	96 fl. oz./A							
3. Danitol 2.4 EC	16.0 oz./A	58.1	3.5	7.5	0.0	0.0	1.8	18.7
Delegate	6.0 oz./A							
Exirel	20.5 fl. oz./A							
4. Danitol 2.4 EC	16.0 oz./A	62.0	6.3	11.1	0.0	0.0	0.3	9.0
Altacor	4.5 oz./A							
Assail	8.0 oz./A							
5. Danitol 2.4 EC	16.0 oz./A	49.7	2.3	10.0	0.0	0.3	1.8	19.3
Altacor	4.5 oz./A							
6. Danitol 2.4 EC	16.0 oz./A	22.3	4.8	11.3	0.0	0.3	0.8	17.5
Exirel	20.5 fl. oz./A							
7. Danitol 2.4 EC	16.0 oz./A	67.4	3.2	4.3	0.0	1.8	1.8	6.9
8. UTC		65.6	2.9	4.5	0.0	1.8	3.8	9.2
P value for transformed data		NS	NS	NS	NS	NS	NS	NS

Harvest evaluation of 'Ginger Gold' on 1 August. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. Data were transformed using arcsine(sqrt(x)) prior to ANOVA ($P \leq 0.05$). Means separation by Tukey-Kramer HSD ($P \leq 0.05$); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 11b Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		CM1	CM2	AMP	AMT	SJS	SB	Clean
1. Danitol 2.4 EC Actara	16.0 oz./A 5.5 oz./A	1.4 abc	1.0	1.7	1.7	46.8	5.0	18.5
2. Danitol 2.4 EC Carbaryl	16.0 oz./A 96 fl. oz./A	1.5 abc	2.3	4.5	4.3	17.5	7.0	28.5
3. Danitol 2.4 EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl. oz./A	0.5 bc	2.0	4.3	3.8	30.7	4.3	18.7
4. Danitol 2.4 EC Altacor Assail	16.0 oz./A 4.5 oz./A 8.0 oz./A	2.3 ab	2.5	3.5	3.5	39.4	4.3	9.0
5. Danitol 2.4 EC Altacor	16.0 oz./A 4.5 oz./A	1.8 abc	2.8	9.5	8.5	41.9	5.3	19.3
6. Danitol 2.4 EC Exirel	16.0 oz./A 20.5 fl. oz./A	0.0 c	0.0	9.0	8.0	71.3	8.3	17.5
7. Danitol 2.4 EC	16.0 oz./A	3.0 a	3.2	6.0	5.0	53.9	4.0	6.9
8. UTC		0.8 abc	5.4	9.7	7.6	28.9	6.5	9.2
P value of transformed data		0.0051	NS	NS	NS	NS	NS	NS

Harvest evaluation of 'Ginger Gold' on 1 August. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. Data were transformed using arcsine(sqrt(x)) prior to ANOVA ($P \leq 0.05$). Means separation by Tukey-Kramer HSD ($P \leq 0.05$); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 12a Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

		Mean incidence (%) of insect damaged fruit						
Trmt/ Formulation	Rate	PC	EAS	TPB	E. LEP.	LR	L. LEP	Clean
1. Danitol 2.4 EC Actara	16.0 oz./A 5.5 oz./A	31.0	1.0 ab	7.3	0.8	2.0 ab	2.0 ab	24.2 a
2. Danitol 2.4 EC Carbaryl	16.0 oz./A 96 fl. oz./A	32.3	2.3 ab	10.3	1.3	4.5 a	4.5 ab	23.0 a
3. Danitol 2.4 EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl. oz./A	45.9	2.5 ab	8.6	0.3	1.5 abc	1.5 ab	12.5 abc
4. Danitol 2.4 EC Altacor Assail	16.0 oz./A 4.5 oz./A 8.0 oz./A	40.3	4.3 ab	5.5	0.0	0.3 bc	0.3 b	20.5 ab
5. Danitol 2.4 EC Altacor	16.0 oz./A 4.5 oz./A	40.5	1.5 ab	7.0	0.3	0.0 c	0.0 ab	1.3 c
6. Danitol 2.4 EC Exirel	16.0 oz./A 20.5 fl. oz./A	17.5	5.0 a	13.7	0.0	0.0 c	0.0 ab	3.5 bc
7. Danitol 2.4 EC	16.0 oz./A	33.8	0.5 b	6.5	1.0	4.0 a	4.0 a	0.5 c
8. UTC		44.3	2.0 ab	4.8	0.3	5.3 a	5.3 ab	5.8 bc
P value for transformed data		NS	0.0267	NS	NS	0.0001	0.0032	0.0001

Harvest evaluation of ‘Red Delicious’ on 21 September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. Data were transformed using arcsine(sqrt(x)) prior to ANOVA ($P \leq 0.05$). Means separation by Tukey-Kramer HSD ($P \leq 0.05$); treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 12b Insect Injury Means at Harvest from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged fruit						
		CM1	CM2	AMP	AMT	SJS	SB	Clean
1. Danitol 2.4 EC Actara	16.0 oz./A 5.5 oz./A	1.3	7.0 ab	5.3	5.0	41.8	5.0	24.2 a
2. Danitol 2.4 EC Carbaryl	16.0 oz./A 96 fl. oz./A	2.0	7.0 ab	7.5	5.5	50.0	9.0	23.0 a
3. Danitol 2.4 EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl. oz./A	0.3	4.6 ab	2.0	1.0	56.0	2.0	12.5 abc
4. Danitol 2.4 EC Altacor Assail	16.0 oz./A 4.5 oz./A 8.0 oz./A	0.3	2.3 ab	2.8	1.8	47.8	1.0	20.5 ab
5. Danitol 2.4 EC Altacor	16.0 oz./A 4.5 oz./A	0.3	2.5 ab	3.0	1.8	89.8	5.3	1.3 c
6. Danitol 2.4 EC Exirel	16.0 oz./A 20.5 fl. oz./A	0.3	0.5 b	2.3	1.5	71.8	25.8	3.5 bc
7. Danitol 2.4 EC	16.0 oz./A	4.3	12.0 a	6.8	6.3	96.8	6.0	0.5 c
8. UTC		3.0	8.3 ab	13.0	12.3	75.5	5.5	5.8 bc
P value for transformed data		NS	0.0302	NS	NS	NS	NS	0.0001

Harvest evaluation of ‘Red Delicious’ on 21 September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions based on 300 GPA. 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.

Table 13 Evaluations of Acaricides for Controlling Early Season Mite Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment / Formulation	Rate	Number of Adult Mites / Leaf				
		ERM	TSM	ZM	AMB	ARM
1. Danitol 2.4EC Actara	16.0 oz./A 5.5 oz./A	0.0 a	0.4 a	0.2 a	0.1 a	69.8 ab
2. Danitol 2.4EC Carbaryl	16.0 oz./A 96 fl.oz./A	0.0 a	0.4 a	0.1 a	0.0 a	13.0 a
3. Danitol 2.4EC Delegate Exirel	16.0 oz./A 6.0 oz./A 20.5 fl.oz./A	0.0 ab	0.9 a	0.3 a	0.1 a	128.6 bc
4. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	0.0 a	0.4 a	0.2 a	0.1 a	132.3 bc
5. Danitol 2.4EC Altacor	16.0 oz./A 4.5 oz./A	0.0 a	0.1 a	0.2 a	0.1 a	231.2 c
6. Danitol 2.4EC Exirel	16.0 oz./A 20.5 fl.oz./A	0.1 ab	1.9 a	0.2 a	0.2 a	109.0 ab
7. Danitol 2.4EC	16.0 oz./A	0.1 ab	0.3 a	0.2 a	0.1 a	85.3 ab
8. UTC		0.2 b	0.4 a	0.5 a	0.1 a	147.4 bc
P value for transformed data		0.1955	0.6028	0.8614	0.5505	0.0243

[a] Evaluation made on ‘Red Delicious’ cultivar on 11 July. Data were transformed using $\log_{10}(x+1)$ using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported

COMPARISON OF LATE SEASON APPLICATION OF INSECTICIDES FOR CONTROLLING BROWN MARMORATED STINK BUG IN APPLE
Hudson Valley Research Laboratory 2017
Apple: *Malus domestica*, cv. 'Red Delicious'
Brown marmorated stink bug (BMSB): *Halyomorpha halys* Stål

The brown marmorated stink bug (BMSB), *Halyomorpha halys*, has been observed throughout the southern Hudson Valley for the past 9 years with the first BMSB confirmation in December 2008. Since that time, increasing BMSB populations have been documented in urban environments and are now present on many lower to mid-Hudson Valley fruit and vegetable farms throughout the season. In three of the past four years, a second generation developed in mid-late August. The rise of a second generation of BMSB from mid-August through mid-November has caused significant injury to late season fruit. The industry is in need of insecticide tools with a short pre-harvest interval to prevent injury from this insect pest.

In 2017 we conducted a field examination of Bifenture EC (bifenthrin), Closer SC (sulfoxaflor), Actara 25WDG (thiamethoxam), and Venerate XC (killed *Burkholderia* spp. strain A396) to determine the impact of these insecticides on adult feeding and survival on late season apple. Insecticide treatments were applied to 8-tree plots replicated six times in a RCB design. Each plot employed six trees of 9-year-old 'Red Delicious' cultivars bordered by guard trees to inhibit drift, spaced at 3' x 12' ft., 10 ft. in height, comprising 1210 trees per acre. All dilutions are based on 300 gallons/acre with plot requirements ranging from 12 to 15 gallons increasing seasonally with developing canopy. Treatments were applied dilute to runoff using a tractor-mounted high-pressure handgun sprayer operated at 300 psi delivering approximately 378.1 GPA.

Red Delicious on dwarfing rootstock strains were sprayed with Bifenture EC (25% bifenthrin, UPI, EPA Reg. No. 70506-227), Closer SC (sulfoxaflor, Dow AgroSciences; EPA Reg. No. 62719-623), Actara 25WDG (thiamethoxam, Syngenta; EPA Reg. No. 100-938), or Venerate XC (killed *Burkholderia* spp. strain A396 and spent fermentation media, Marrone Bio Innovations; EPA Reg. No. 84059-14) at highest labeled rates on 20 September (Table 14). BMSB adults were caged on apples at three intervals after insecticide application, 24 hr, 48 hr and 72 hr, and left to feed for one week. BMSB adults were placed onto the north side of fruit in the shaded canopy of the apple for each exposure date. A 1 oz screened cup was placed over each insect and secured with a single #30 rubber band (ULINE 2" x 1/8") (Image 1). After 7d and prior to insect removal, a circle was scored with black 'Sharpie' around the cup to define the arena perimeter. The circled areas of the fruit were evaluated at harvest for stink bug injury assessing 'Feeding Sites' using 14x microscope of fruit surface, discoloration coined as 'Green Dimples', and, upon skin removal, subsurface 'Corking' was evaluated including undamaged 'Clean' fruit on 27 September (Table 15). After 7d of being caged on apples, BMSB adults were removed to the lab and survival/mortality was observed (Table 16).

Results:
Fruit injury: Overall there were few statistical differences between treatments for residual efficacy to adult stink bug feeding on apple. In 48 hour residues, there were significantly fewer BMSB feeding sites and higher numbers of clean fruit in Closer, bifenthrin, and Actara treatments than in the untreated check (UTC) (Table 15).

Insect survival: There were no significant differences in survival of insects for those exposed 24 or 48 hours after insecticide application. For those insects that were placed on apples 72 hours after application, only those exposed to bifenthrin had significantly lower survival than other treatments. However, survival of bifenthrin residue-exposed bugs was not significantly lower than the untreated check (UTC) (Table 16).

Table 14 Treatment Rates and Schedule for BMSB Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment/Formulation	Rate	Timing	Application Dates
1. Closer SC	5.75 oz./A	Late season	20 September
2. Bifenthrin SC	32.0 oz./A	Late season	20 September
3. Actara 25WDG	5.5 oz./A	Late season	20 September
4. Venerate XC	4.0 qt./A	Late season	20 September
5. Untreated Check (UTC)			

Table 15 BMSB Fruit Injury after Spray Targeting BMSB
Hudson Valley Research Laboratory, Highland, NY - 2017

		Incidence of insect injured fruit			
Treatment	Hr. Post App.	# Feeding Sites	Green Dimples	Corking	Clean (%)
Closer	24	0.1 a	0.1 a	0.1 a	90.0 a
Bifenthrin	24	0.0 a	0.0 a	0.0 a	100.0 a
Actara	24	0.0 a	0.0 a	0.0 a	100.0 a
Venerate	24	0.0 a	0.0 a	0.0 a	100.0 a
UTC	24	0.7 a	0.0 a	0.0 a	50.0 a
P value		0.0115	0.8123	0.8123	0.0136
Closer	48	0.1 b	0.1 a	0.1 a	90.0 a
Bifenthrin	48	0.0 b	0.0 a	0.0 a	100.0 a
Actara	48	0.1 b	0.1 a	0.1 a	90.0 a
Venerate	48	0.2 ab	0.0 a	0.0 a	80.0 ab
UTC	48	1.2 a	0.4 a	0.4 a	20.0 b
P value		0.0001	0.4313	0.4313	0.0002
Closer	72	0.2 a	0.2 a	0.2 a	90.0 a
Bifenthrin	72	0.2 a	0.2 a	0.2 a	90.0 a
Actara	72	0.2 a	0.2 a	0.2 a	90.0 a
Venerate	72	0.1 a	0.0 a	0.0 a	90.0 a
UTC	72	1.2 a	0.1 a	0.1 a	40.0 a
P value		0.0687	0.9254	0.925	0.0006

Means followed by the same letter are not significantly different by Steel-Dwass Method (α=0.05). Trees (Red Delicious) were sprayed on 20 September and were exposed to a single adult stink bug at 24, 48, and 72 hours after application. Apples were rated for injury on 6 October.

Table 16 Comparison of Late Season Insecticide Application for Controlling BMSB, *Halyomorpha halys*, in Apple, HVRL, Highland, NY - 2017

Treatment	Hr. Post App.	Survival (%)	Mortality (%)
Closer SC	24	0.0 a	100.0
Bifenthrin	24	0.0 a	100.0
Actara	24	0.0 a	100.0
Venerate	24	20.0 a	80.0
UTC	24	20.0 a	80.0
P-value		0.3071	
Closer	48	0.0 a	100.0
Bifenthrin	48	10.0 a	90.0
Actara	48	0.0 a	100.0
Venerate	48	40.0 a	60.0
UTC	48	0.0 a	100.0
P-value		0.0873	
Closer	72	80.0 a	20.0
Bifenthrin	72	10.0 b	90.0
Actara	72	100.0 a	0.0
Venerate	72	70.0 a	30.0
UTC	72	30.0 ab	70.0
P-value		0.0687	

Residue bioassay on ‘Red Delicious’ cultivar. Means followed by the same letter are not significantly different by Steel-Dwass Method (α=0.05). Apples were sprayed on 20 September and were exposed to an adult stink bug at 24, 48, and 72 hours after application. Stink bug survival was rated 7 days after placement on fruit (28, 29, and 30 September).

COMPARISON OF TOPICAL APPLICATION OF INSECTICIDES FOR CONTROLLING BROWN MARMORATED STINK BUG
Hudson Valley Research Laboratory 2017
Apple: *Malus domestica*, cv. ‘Red Delicious’
Brown marmorated stink bug (BMSB): *Halyomorpha halys* Stål

The brown marmorated stink bug (BMSB), *Halyomorpha halys*, has been observed throughout the southern Hudson Valley for the past 9 years with the first BMSB confirmation in December 2008. Since that time, increasing BMSB populations have been documented in urban environments and are now present on many lower to mid-Hudson Valley fruit and vegetable farms throughout the season. In three of the past four years, we’ve observed a second generation develop in mid-late August during voltinism studies. The rise of a second generation of BMSB from mid-August through mid-November has caused significant injury to late season fruit. The industry is in need of insecticide tools with a short pre-harvest interval to prevent injury from this insect pest.

Topical treatment followed by caging on a developing apple: In 2017 we conducted a field examination of Bifenture EC (bifenthrin), Closer SC (sulfoxaflor), Actara 25WDG (thiamethoxam), and Venerate XC (killed *Burkholderia* spp. strain A396) to determine the impact of these insecticides on adult feeding and survival on late season apple. Insecticide treatments were applied as 2µl droplets directly to the thorax of each adult BMSB. Concentrations of applied insecticides were equivalent to labeled rates for each insecticide. Each insect was treated with insecticide and then placed on an apple to feed. BMSB adults were placed onto the north side of fruit in the shaded canopy of the apple. A 1 oz screened cup was placed over each insect and secured with a single #30 rubber band (ULINE 2” x 1/8") (Image 1). After 7d and prior to insect removal, a circle was scored with black ‘Sharpie’ around the cup to define the arena perimeter. The circled areas of the fruit were evaluated at harvest for stink bug injury assessing ‘Feeding Sites’ using 14x microscope of fruit surface, discoloration coined as ‘Green Dimples’, and, upon skin removal, subsurface ‘Corking’ was evaluated including undamaged ‘Clean’ fruit (Table 17). After 7d of being caged on apples, BMSB adults were removed to the lab and survival/mortality was observed on 5 October (Table 18).

Topical treatment in the laboratory: In the lab, wild-caught adult stink bugs were treated topically with 2µl droplets of dilute pesticide applied directly to the thorax (Image 2). Insecticides applied were Bifenture EC (bifenthrin), Closer SC (sulfoxaflor), Actara 25WDG (thiamethoxam), and Venerate XC (killed *Burkholderia* spp. strain A396) along with an untreated check (UTC). Insecticide concentrations tested were the full label rate for apples in NYS (1.0x, n=34), half label rate (0.5x, n=34), quarter label rate (0.25x, n=34), and one tenth of label rate (0.1x, n=20). Each treatment included equal numbers of male and female bugs. Treated insects were placed in a 1 oz. screened plastic cup with a small piece of organic green bean for food and moisture and checked for survival status at 24 hr, 48 hr, 72 hr, and 1 week after treatment (Table 19). Green beans were replaced as needed.

Table 17 Fruit Injury after Topical Insecticide Treatment of BMSB
Hudson Valley Research Laboratory, Highland, NY - 2017

	Incidence of insect-injured fruit			
Treatment	# Feeding Sites	Green Dimples	Corking	Clean (%)
Closer SC	0.3 a	0.2 a	0.2 a	90.0 a
Bifenthrin	0.1 a	0.0 a	0.0 a	90.0 a
Actara	0.0 a	0.0 a	0.0 a	100.0 a
Venerate	0.0 a	0.0 a	0.0 a	100.0 a
UTC	0.9 a	0.0 a	0.0 a	60.0 a
Prob>ChiSq	0.1288	0.5348	0.5348	0.1093

BMSB treated topically on 28 September and placed on apples for 7 days. Apples were rated on 6 October. Means followed by the same letter are not significantly different by Steel-Dwass Method at α=0.05.

Table 18 Comparison of Topical Insecticide Application to BMSB, *Halyomorpha halys*, in Apple
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment	Survival (%)	Mortality %
Closer SC	30.0 b	70.0
Bifenthrin	0.0 b	100.0
Actara	10.0 b	90.0
Venerate	100.0 a	0.0
UTC	90.0 a	10.0
P value	<0.0001	

Means followed by the same letter are not significantly different by Steel-Dwass Method (α=0.05). BMSB treated topically on 28 September, 2017 and placed on apples for 7 days. Survival, morbidity, and mortality was observed on 5 October.

Table 18 Comparison of Topical Insecticide Application to BMSB, *Halyomorpha halys*, in the Laboratory. Hudson Valley Research Laboratory, Highland, NY - 2017

		Mortality %				
Trt/Formulation	Exposure	UTC	0.1x	0.25x	0.5x	1.0x
Actara	24 hr		10.0 b	26.1 ab	43.5 a	52.2 a
Bifenthrin	24 hr		62.5 a	40.2 a	44.6 a	60.4 a
Closer	24 hr		7.5 b	11.1 bc	25.0 b	33.3 b
Venerate	24 hr		0.0 b	1.5 c	0.0 c	0.0 c
UTC LI-700	24 hr	0.7	-.- b	-.- c	-.- c	-.- c
p-value			0.0001	0.0001	0.0001	0.0001
Actara	48 hr		12.5 b	40.9 a	48.9 a	52.2 a
Bifenthrin	48 hr		52.5 a	48.9 a	55.4 a	62.5 a
Closer	48 hr		5.0 b	19.4 b	43.1 a	44.4 a
Venerate	48 hr		5.0 b	2.9 bc	0.0 b	4.5 b
UTC LI-700	48 hr	1.4	-.- b	-.- c	-.- b	-.- b
P value			0.0001	0.0001	0.0001	0.0001
Actara	72 hr		20.0 b	45.5 ab	48.9 b	55.4 ab
Bifenthrin	72 hr		52.5 a	56.5 ab	67.4 a	71.9 ab
Closer	72 hr		7.5 bc	31.9 b	48.6 b	51.4 b
Venerate	72 hr		5.0 bc	7.4 c	0.0 c	12.1 c
UTC LI-700	72 hr	3.5	-.- c	-.- c	-.- c	-.- c
P value			0.0001	0.0001	0.0001	0.0001
Actara	1 wk		47.5 ab	33.3 a	41.7 ab	66.7 a
Bifenthrin	1 wk		70.0 ab	83.3 b	83.3 ab	79.2 a
Closer	1 wk		27.5 bc	29.2 b	62.5 b	66.7 a
Venerate	1 wk		5.0 c	8.3 b	0.0 c	0.0 b
UTC LI-700	1 wk	12.5	-.- c	-.- b	-.- c	-.- b
P value			0.0001	0.0001	0.0001	0.0001

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.

CAPTURE AND RELEASE OF THE SAMURAI WASP, *TRISSOLCUS JAPONICUS,* A BIOLOGICAL CONTROL AGENT OF BROWN MARMORATED STINK BUG

Samurai Wasp, *Trissolcus japonicus*
Brown Marmorated Stink Bug, *Halyomorpha halys*

The Samurai Wasp*, Trissolcus japonicus,* is an egg parasitoid of stink bug that utilizes BMSB eggs for its own development and reproduction. It is capable of laying its egg within most of the approximately 28 eggs found in a BMSB egg cluster. Within each stink bug egg, a wasp larva develops and feeds on the developing stink bug nymph, destroying the stink bug within a few weeks. A single adult Samurai Wasp will then emerge from each stink bug egg to repeat the cycle of parasitizing BMSB eggs.

In Eastern Asia (China, Japan, and South Korea), the origin of the BMSB and Samurai Wasp, the wasp is credited for maintaining low levels of the Brown Marmorated Stink Bug. The Samurai Wasp is considered the principal biological control agent for the Brown Marmorated Stink Bug in Asia, with parasitism rates up to 80% and an average annual rate of 50% reduction of the BMSB population observed in the field (Yang et al. 2009). Because of its high parasitism rates and biological adaptations, the Samurai Wasp has the potential to be a strong biological control candidate for BMSB in the US.

Parasitoid Surveys: The adult Samurai Wasp was recently discovered as a non-native or adventive insect species from sentinel egg surveys for native parasitoid populations. The first find of the wasp by Don Weber emerged from BMSB eggs from wild populations in Beltsville, Maryland in 2014 (Talamas et al 2015), with several additional site survey findings in Maryland; Washington, D.C.; and in Winchester, Virginia during 2015 and in New York, Vancouver, Washington, and Oregon in August 2016 (Milnes et al 2016; Jentsch 2017). Researchers speculate that these wild populations of *Trissolcus japonicus* may have arrived within stink bug egg masses on plant cargo shipped from Asia.

Newly Placed (Left) and Parasitized BMSB Sentinel Eggs (Right). Photo Credit: HVRL, Highland, NY

NY Sentinel Egg Studies: Hudson Valley Research Laboratory colonies of Brown Marmorated Stink Bug were provided Jalapeno pepper plants or field collected leaves of Tree of Heaven, *Ailanthus altissima*, to both feed on and deposit eggs. BMSB eggs were flash frozen to -80^{o} C for 4 minutes to kill developing stink bug nymphs and reduce the egg natural defense mechanism for successful native and invasive parasitoid development when parasitized after placement in the field.

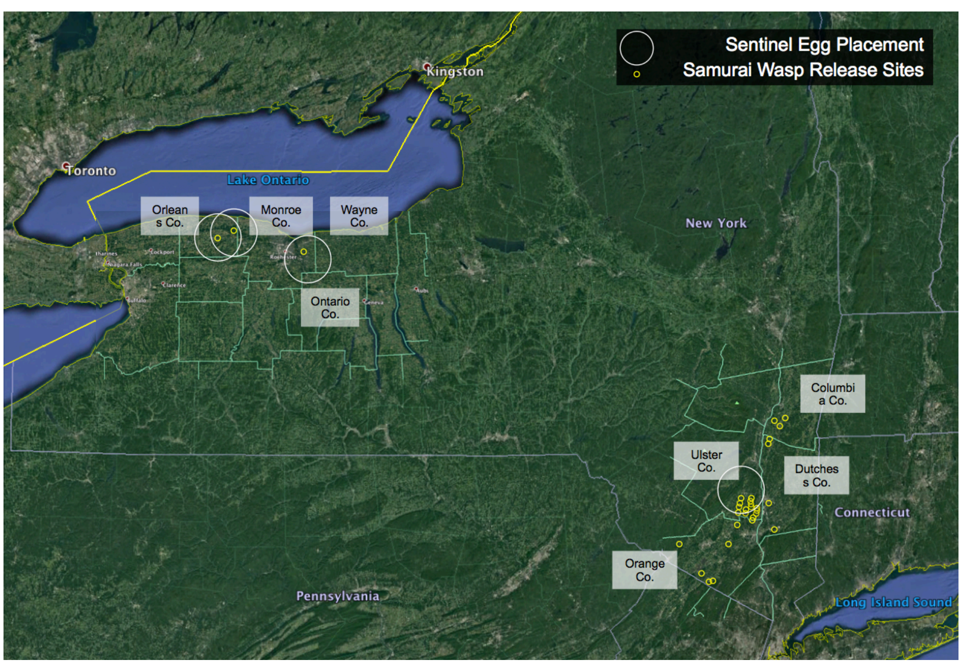
Our initial sentinel survey conducted in the Hudson Valley of NY in 2016 employed individual leaves containing frozen eggs. We fixed the eggs onto a known host plants of Black Walnut (*Juglans nigra*) and Tree of Heaven in two sites on Hepworth Farms in Milton, NY. We began on 1^{st} June, placing and collecting the eggs on a 5-day schedule to the end of September. During the week of August 15^{th}, Samurai Wasp parasitism occurred with adult wasp emergence on the 7^{th} of September. Wasp individuals from sentinel eggs were sent to Elijah Talamas, USDA-ARS and confirmed to be *Trissolcus japonicus*.

In 2017 sentinel BMSB egg clusters were placed and monitored in 9 western New York (WNY) sites by Art Agnello (NYSAES-Geneva), Tessa Grasswitz (CCE- Lake Ontario Fruit Program) and Deborah Breth, (CCE-

LOFT Retired) in Monroe, Ontario, Orleans and Wayne counties and in a northern Ulster county site, mostly along the wooded edge of NYS vegetable fields or orchards beginning on the 23rd of June. During the season we began seeing the Samurai Wasp oviposit in sentinel eggs placed in the field during the week of 7th July, emerging on 23rd July. Yet the only site in which we observed Samurai Wasp was the Ulster county site in Marlboro (Hepworth) where *T. japonicus* is present and captured the previous year.

Native parasitoids were also found in the initial sentinel egg placement. This occurred at the Marlboro site in 2017, in which *Trissolcus euschisti* and *Telenomus podisi* emergence occurred on the 23rd and 30th of May respectively. The use of frozen eggs in the field provided for high levels of successful emergence of *T. euschisti* (73.1%) when compared to fresh BMSB eggs used during laboratory rearing (18.9%). However, offspring of *T. podisi* emerging from frozen BMSB eggs were few (6.9%) compared to *T. euschisti*, suggesting relatively low impact on BMSB by both of these native parasitoids in comparison to *Trissolcus japonicus* emergence from fresh BMSB eggs (68.8%). The parasitoid *Telenomus podisi* were also observed emerging from BMSB sentinel eggs placed in WNY on 24th of August from Kendall, Orleans County, yet none of the WNY sites captured *Trissolcus japonicus* during our 2017 survey.

A female Samurai Wasp, *Trissolcus Japonicus*
Image Credit: Steve Valley, USDA-ARS



Samurai Wasp Release Sites in NYS

Transport and Release of the Samurai Wasp In New York State. The Department of Environmental Conservation (DEC), upon review of our proposal to redistribute *T. japonicus*, responded in a letter issued by Joseph E. Therrien on 28th July of 2017, the DEC concluded that their statutory and regulatory framework around the Liberation of Wildlife Permit regulating release of biological, such as insects, does not generally apply to releasing insects into the wild, so long as the proposed release is not of an insect that is listed on either the endangered and threated or invasive species listings identified in 6 NYCRR Parts 182 & 575. Release of the Samurai Wasp is further constrained by meeting other state, federal or local requirements and landowner permission on all properties in which the wasp is released. With this decision allowing for transport, relocation and use as a biological control agent, we began movement and release of the Samurai Wasp in NY State agricultural locations. We chose 32 NYS sites in proximity to commercial farms in which to place *Trissolcus japonicus* infested eggs. Beginning on 15 September we were able to place 87 BMSB clusters, totaling over 2300 eggs, in 6 NYS counties. A range of one to three egg clusters containing 22 to 86 individual eggs were placed on plant hosts in each site, which included use of *A. altissima* (Tree of Heaven), *Acer saccharum* (sugar maple), *Catalpa speciosa* (Catalpa), *Corylus avellana* (Hazelnut), *Juglans nigra* (eastern black walnut), *Rhus sp*. (Sumac), *Robinia pseudoacacia* (Black Locust) and *Vitis riparia* (Native grape), all known as hosts of BMSB. Additionally, one site included placement onto deer fencing with eggs fixed to a petri dish and hung inverted to mimic the underside of foliage.

Successful Release of Samurai Wasp: In three WNY sites in which baseline sentinel eggs data was collected, the placement of *T. japonicus* infested eggs coincided with the placement of sentinel eggs placed 30 meters from the Samurai Wasp release site. In two of the three sites in Orleans and Monroe Counties, newly released *T. japonicus* were found to parasitize these sentinel eggs. Elijah Talamas, entomologist at USDA-ARS, confirmed the specimen wasp to be *Trissolcus japonicus*, verifying the successful release, movement and presence of the wasp in these two sites now moving into their overwintering phase.Upon retrieval of the infested clusters in 11 of the 32 sites this fall, we recovered only 77% of the eggs. This was due in part to abscission of the host leaf, removal of eggs from the leaf and predatory feeding by other insects such as ant species. On 3 of the 11 sites we observed newly emerged Samurai Wasps guarding the egg clusters. This is not unusual for Samurai Wasp behavior as newly emerged males will wait for the emergence of the female while females will often guard parasitized eggs, securing their progenies successful development. During our assessment of *T. japonicus* wasp release eggs we also found 168 or 24.4% (N=719) successfully emerge as adults with 0.7% partially emerged from the egg, while 66.4% of the eggs showing no sign of emergence. These non-emergent eggs were both parasitized and unsuccessful in development (94.6% as a dark hue) or were initially un-parasitized by the laboratory female wasp prior to field deployment (5.4% as white).

Determining the Overwintering Success of the Samurai Wasp: In spring of 2018 we plan to place sentinel eggs weekly in each of the 32 sites in order to recapture the Samurai Wasp. Determining the presence of the wasp next season will confirm successful overwintering of the parasitoid. However, in sites where confirmation is unsuccessful, we plan to re-apply BMSB eggs parasitized by *T. japonicus* to develop the presence of the biological control in that site. We hope to establish further the presence of the wasp in the urban and suburban environment in order to reduce the overwintering populations of BMSB in homes, offices, and storage facilities.

The Down Side. Over the past 100 years classical biological controls have been used to manage agricultural pests. It has experienced both success and yet, is not without its failures. The invasive complex of pests is on the rise, causing significant losses and increased risk from increased use of pest control measures. The recent emergence of the Samurai Wasp may prove to be a very welcomed Asian warrior now in New York State.

The Samurai Wasp has been under lab quarantine for many years, beginning under the direction of Kim Hoelmer, Beneficial Insects Introduction Research Unit, USDA-ARS, who first identified and transported the wasp and studied its host range for parasitism of native stink bugs in the U.S. Studies continue to better understand the host preference capacity of Samurai Wasp. From these initial studies, *Trissolcus japonicus* is known to attack the brown marmorated stink bug, *Halyomorpha halys*, and a native species, *Podisus maculiventris* (Say). Evaluations employing choice tests and field surveys in laboratory studies conducted in China concluded that the ecological host range of *Trissolcus japonicus* does contain several Pentatomidae species other then BMSB, which include *Dolycoris baccarum* (L.) *Erthesina fullo* (Thunberg), *Plautia fimbriata* (Fabr.)(Haye 2014) and *Glaucias subpunctatus* (Walker) (Matsuo et al. 2016).

PEAR: *Pyrus communis* L. 'Bartlett', 'Bosc'
Pear psylla: *Cacopsylla pyricola* (Foerster)
Codling moth (CM): *Cydia pomonella* (Linnaeus)
Pear rust mite (PRM): *Epitrimerus pyri*
Fabraea Leaf Spot (FLS) *Fabraea maculata*

EFFICACY OF INSECTICIDES AGAINST PEAR PSYLLA EGGS AND NYMPHS, 2017: – Cornell University's Hudson Valley Laboratory: Treatments were applied to four-tree plots replicated four times in a RCB design. Each plot contained two trees each of 'Bartlett' and 'Bosc' cultivars, spaced 12 x 18 ft., 12 ft. in height, and 35 years old. All dilutions are based on 400 gallons/acre with plot requirements ranging from 20 to 50 gallons increasing seasonally with developing canopy. Treatments were applied dilute to runoff using a tractor mounted high-pressure handgun sprayer operated at 300 psi delivering approximately 350 GPA.

Treatments were applied on various schedules as shown in Table X. Dates corresponding to tree phenology of 'Bartlett' beginning at delayed dormant (DD) and 1st psylla egg observed on 10 April, bud burst (BB) on 15 April, white bud (WB) on 20 April; full bloom on 24 April, PF on 2 May, >5mm fruit set on 8 May, 10p PF on 9 May. Application dates for the 1st egg application (DD) on 7th April, Bud Burst / green cluster (GC) on 18th April, PF on 2nd May, 1st Cover on 9th May, 2nd Cover on 19th May, 3rd Cover on 2nd June, 4th Cover on 21st June, 5th Cover on 18th of July unless otherwise noted.

Maintenance applications for weed management included Alion and Glystar on 18th April, fireblight management using Harbor at 12.0 oz./A and 0.25% V/V Regulaid on 27th April, Imidan at 5.25 lbs./A, Manzate at 3 lbs./A, Harbor at 12.0 oz./A and 0.25% V/V Regulaid on 2 May for insect and disease management, and to manage fabraea leaf spot and sooty mold, Manzate on 8th , 23rd May, 6th June, Pristine on 18th July and 18th August and Merivon on 4th August.

Scheduled applications were made against the pear insect complex with early applications targeting overwintering adult and first generation of pear psylla and evaluations made to determine the treatment effects on adult, egg and nymph populations. During the period from bud burst through 1st cover, evaluations to determine treatment effects on springform adult ovipositional deterrence, including subsequent 1st generation nymph emergence were conducted. Evaluations made in which 25 fruiting buds or leaves per treatment were evaluated to determine the presence of pear psylla eggs and nymphs, removed to the laboratory where target pests were counted using a binocular scope. Subsequent application schedules were designed to evaluate treatments against the latter 1st and early 2nd generation pear psylla egg, nymph and pear rust mite populations. Psylla nymph, egg and rust mite numbers were assessed by collecting leaf samples on shoots beginning with 25 basal leaves of 5 shoots and continuing for subsequent evaluations by removing 1 distal, 1 proximal and 3 mid-shoot leaves of 5 shoots per treatment through the remainder of the season. The transformation using the Log_{10} (X + 1) was applied for foliar evaluations. To stabilize variance, percentage data were transformed by arcsine *(square root of x) prior to analysis. Fisher's Protected LSD (P=<0.05) was performed on all data; untransformed data are presented in each table.

Pear psylla populations were relatively low this season, providing poor separation between treatments to prevent egg laying. As we have seen in previous years, three pre-bloom and one petal fall application of Surround WP at 50lbs./A followed by 1% horticultural oil continues to provide excellent control of pear psylla presence and subsequent sooty mold from feeding (Tables 1-3).

Table 19 Treatment Schedule for Seasonal Pear Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment / Formulation	Rate	Timing	Application Dates
1. Biocover MLT	128.0 fl.oz./100	DD-EOS @ 14d	7, 18 April, 2, 9, 19 May, 2, 21 June,18 July
2. BioCover Oil	128.0 fl.oz./100	DD, GC, WB – EOS*	7, 18 April, 2, 9, 19 May, 2, 21 June, 18 July
+ Surround	12.5 lbs./100	DD, GC, WB, PF	7, 18 April, 2 May
3. Surround	12.5 lbs./100	DD, GC, WB, PF	7, 18 April, 2 May
BioCover Oil	128.0 fl.oz./100	1C – EOS*	7, 18 April, 2, 9, 19 May, 2, 21 June, 18 July
4. BioCover Oil	128.0 fl.oz./100	DD, GC, 10pPF	7, 18 April, 9 May
AgriMek SC	1.06 fl.oz.100	10pPF, 21 dp	9, 19 May
Actara	5.5 os./A	2-4C	30 May, 19 May, 15 June,
Esteem 35WP	5.0 oz./A	5C	21 June, 18 July
5. BioCover Oil	128.0 fl.oz./100	DD, GC, 10pPF, 21 dp	7, 18 April, 9 May, 19 May
AgriMek SC	1.06 fl.oz.100	10pPF, 21 dp	9, 19 May
Movento 240SC + oil	9.0 fl.oz./A	1-4C	15, 30 May, 19 May, 2 June
Esteem 35WP	5.0 oz./A	5C	21 June ,18 July
6. BioCover Oil	256.0 fl.oz./100	DD, GC	7, 18 April
BioCover Oil	128.0 fl.oz./100	10pPF, 21 dp	9 May, 19 May
AgriMek SC	1.06 fl.oz.100	10pPF, 21 dp	9 May, 19 May
Delegate	7.0 oz./A	3-4C (OBLR/CM)	21 June
Esteem 35WP	5.0 oz./A	5C	21 June ,18 July
7. BioCover Oil	256.0fl.oz./100	DD, GC, WB, PF	7, 18 April, 2 May
BioCover Oil	128.0 fl.oz./100	10pPF	9 May
Exirel	20.5 fl.oz./A	10pPF, 21 dp	9 May, 19 May
Delegate	7.0 oz./A	3-4C (OBLR/CM)	21 June
Esteem 35WP	5.0 oz./A	5C	21 June ,18 July
8. UTC			

All applications calculated using 400 GPA dilute, made using a three-point hitch tractor mounted 'Pack Tank' sprayer and pecan handgun applied at 300 psi. dilute to runoff. All treatments received a PF application of Imidan 70WP for plum curculio.

Table 20 Evaluations of Insecticide Schedules for Controlling Insect Complex on Pear [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

Treatment / Formulation	Rate	Pear psylla eggs per leaf				
		17 April	15 May	31 May	23 June	24 July
1 BioCover Oil	128.0 fl.oz./100	0.5 a	0.1 a	0.4 a	1.4 a	0.1 a
2. BioCover Oil	128.0 fl.oz./100	0.1 a	0.1 a	0.1 a	2.9 a	0.1 a
+ Surround	12.5 lbs./100					
3. Surround	12.5 lbs./100	0.2 a	0.3 a	0.0 a	0.4 a	0.0 a
BioCover Oil	128.0 fl.oz./100					
4. BioCover Oil	128.0 fl.oz./100	0.7 a	0.3 a	0.2 a	1.8 a	0.1 a
AgriMek SC	1.06 fl.oz.100					
Actara	5.5 oz./A					
Esteem 35WP	5.0 oz./A					
5. BioCover Oil	128.0 fl.oz./100	0.7 a	0.1 a	0.2 a	0.9 a	0.1 a
AgriMek SC	1.06 fl.oz.100					
Movento 240SC + oil	9.0 fl.oz./A					
Esteem 35WP	5.0 oz./A					
6. BioCover Oil	256.0 fl.oz./100	0.7 a	0.2 a	0.2 a	2.3 a	0.1 a
BioCover Oil	32.0 fl.oz./100					
AgriMekSC	1.06 fl.oz.100					
Delegate	7.0 oz./A					
Esteem 35WP	5.0 oz./A					
7. BioCover Oil	256.0 fl.oz./100	0.5 a	0.1 a	0.8 ab	1.7 a	0.2 a
BioCover Oil	128.0 fl.oz./100					
Exirel	20.5 fl.oz./A					
Delegate	7.0 oz./A					
Esteem 35WP	5.0 oz./A					
8. UTC		2.3 b	1.9 b	1.8 b	2.3 a	0.2 a
P value for transformed data		0.0033	0.0001	0.0203	0.6035	0.8653

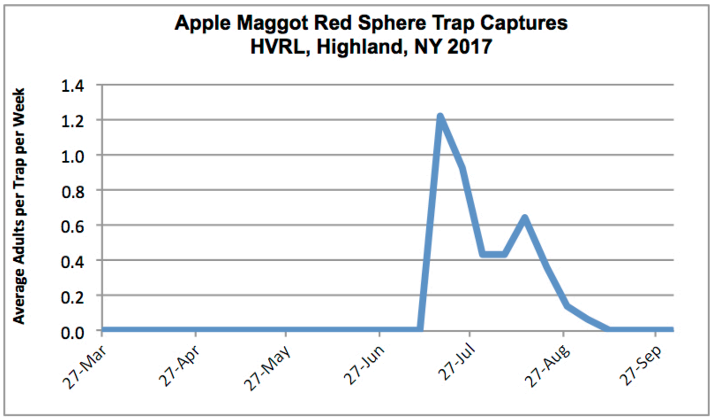
[a] Seasonal evaluations made on 'Bartlett'.
Percent data were transformed using $\log_{10}(x+1)$ conducted prior to analysis. Mean separation by Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported. All applications made using a three-point hitch tractor mounted 'Pack Tank' sprayer and pecan handgun applied at 300 psi. dilute to runoff.

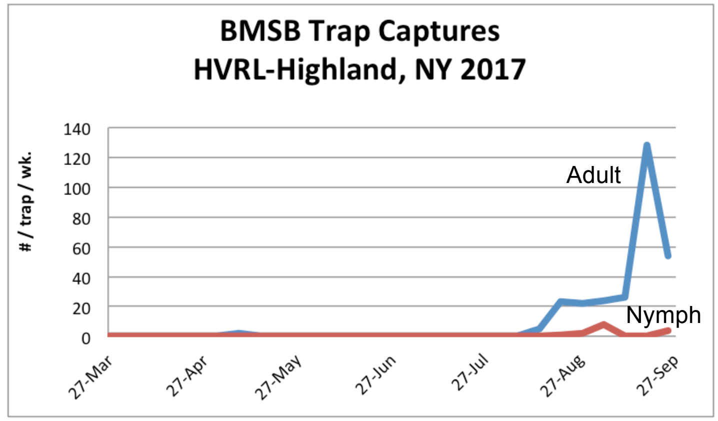
Table 21 Evaluations of Insecticide Schedules for Controlling Insect Complex on Pear [a]
Hudson Valley Research Laboratory, Highland, NY - 2017

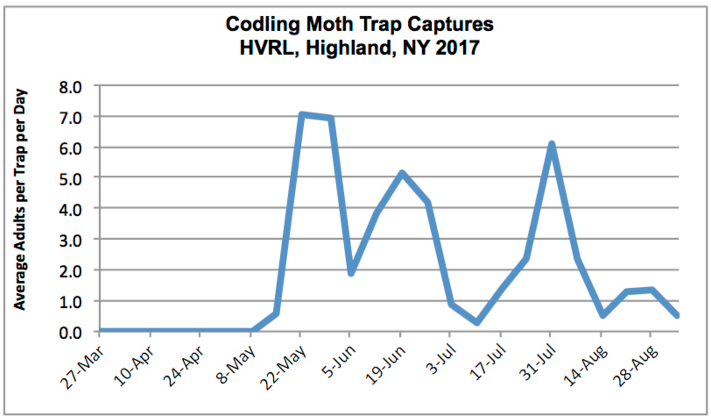
		Pear psylla nymphs per leaf				
Treatment / Formulation	Rate	17 April	15 May	31 May	23 June	24 July
1. BioCover Oil	128.0 fl.oz./100	0.0 a	0.1 a	0.2 abc	1.2 ab	0.1 a
2. BioCover Oil + Surround	128.0 fl.oz./100 12.5 lbs./100	0.0 a	0.0 a	0.0 a	2.6 ab	0.1 a
3. Surround BioCover Oil	12.5 lbs./100 128.0 fl.oz./100	0.0 a	0.0 a	0.2 ab	0.9 ab	0.1 a
4. BioCover Oil AgriMek SC Actara Esteem 35WP	128.0 fl.oz./100 1.06 fl.oz.100 5.5 oz./A 5.0 oz./A	0.0 a	0.1 a	0.2 a	1.5 ab	0.2 a
5. BioCover Oil AgriMek SC Movento 240SC + oil Esteem 35WP	128.0 fl.oz./100 1.06 fl.oz.100 9.0 fl.oz./A 5.0 oz./A	0.0 a	0.3 a	0.5 bc	0.8 a	0.0 a
6. BioCover Oil BioCover Oil AgriMekSC Delegate Esteem 35WP	256.0 fl.oz./100 32.0 fl.oz./100 1.06 fl.oz.100 7.0 oz./A 5.0 oz./A	0.0 a	0.1 a	0.3 abc	1.3 ab	0.1 a
7. BioCover Oil BioCover Oil Exirel Delegate Esteem 35WP	256.0 fl.oz./100 128.0 fl.oz./100 20.5 fl.oz./A 7.0 oz./A 5.0 oz./A	0.0 a	0.2 a	0.4 abc	1.8 ab	0.2 a
8. UTC		0.0 a	0.5 a	0.6 c	4.5 c	0.0 a
P value for transformed data		0.7768	0.1681	0.0457	0.0042	0.5264

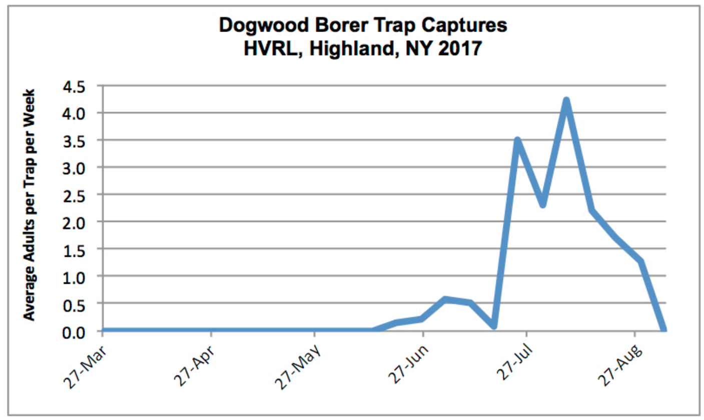
[a] Seasonal evaluations made on ‘Bartlett’.
Percent data were transformed using $\log_{10}(x+1)$ conducted prior to analysis. Untransformed data are presented in each table. Mean separation by Fishers Protected LSD (P ≤ 0.05). Treatment means followed by the same letter are not significantly different. Arithmetic means reported. All applications made using a three-point hitch tractor mounted ‘Pack Tank’ sprayer and pecan handgun applied at 300 psi. dilute to runoff.

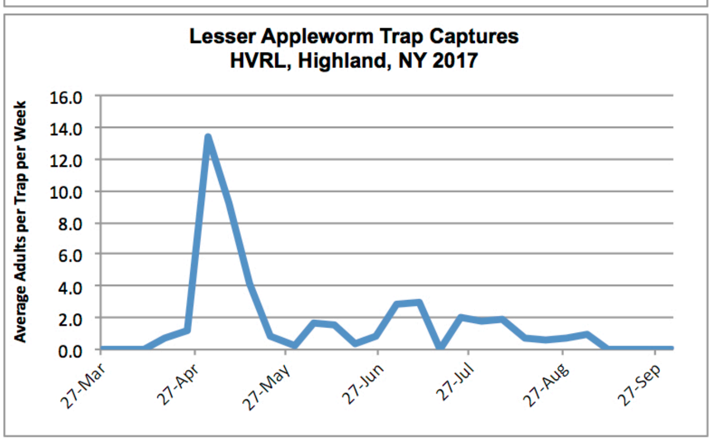
Regional Insect Trap Data – HVRL 2017

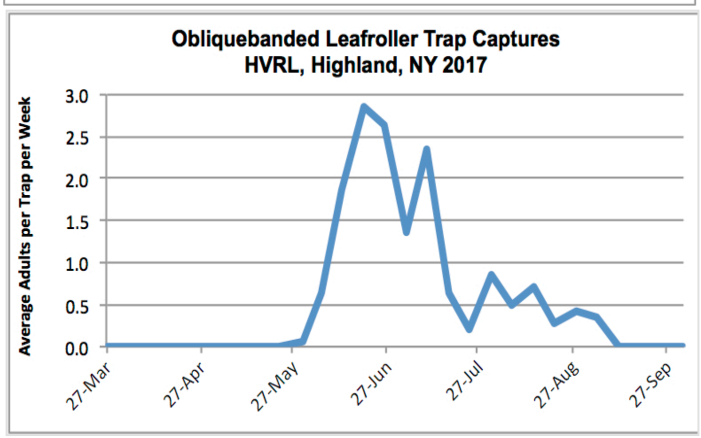


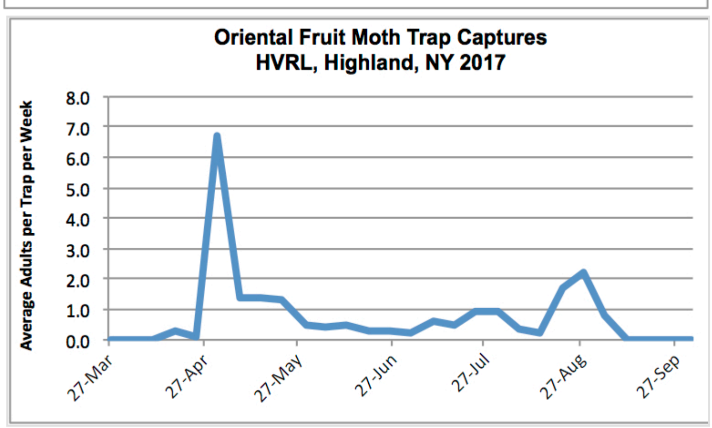


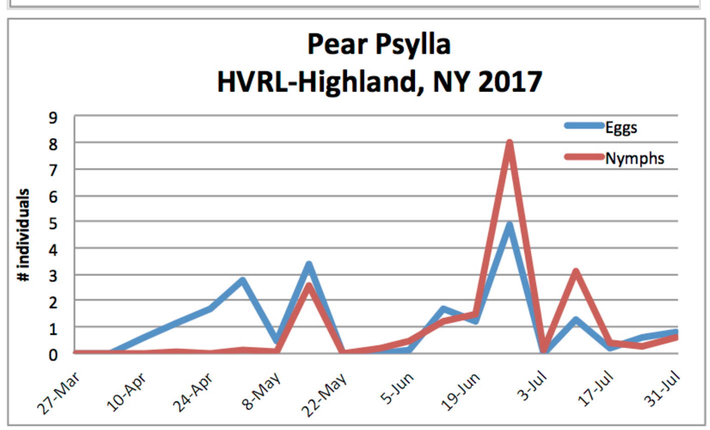


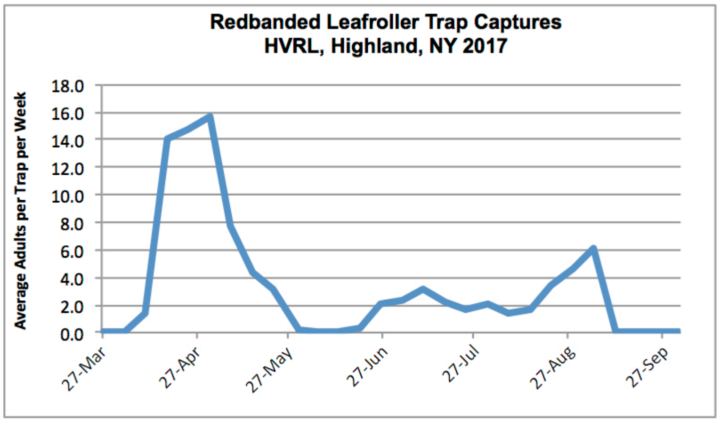


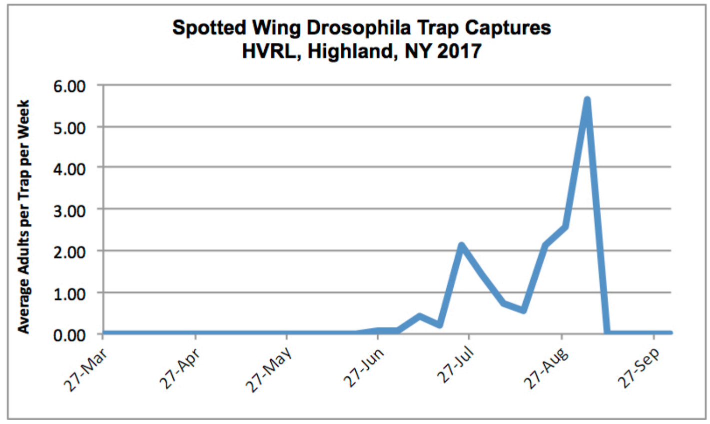


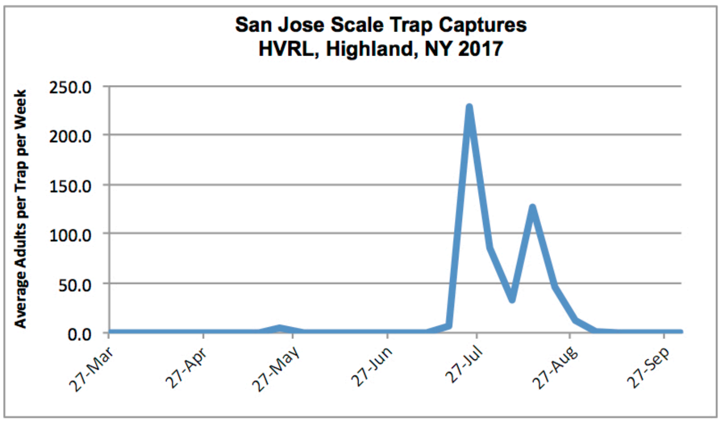


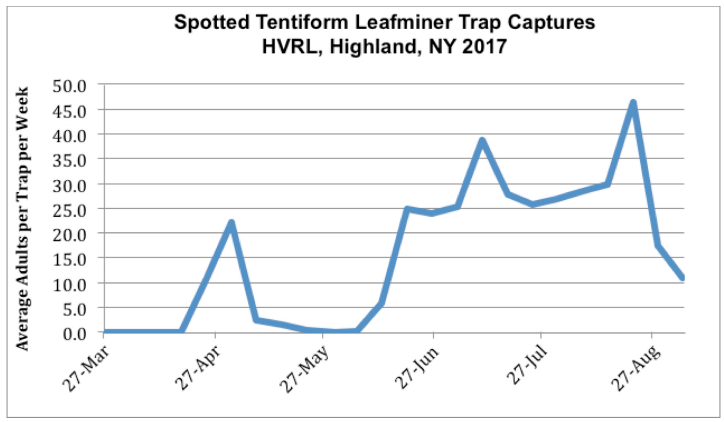


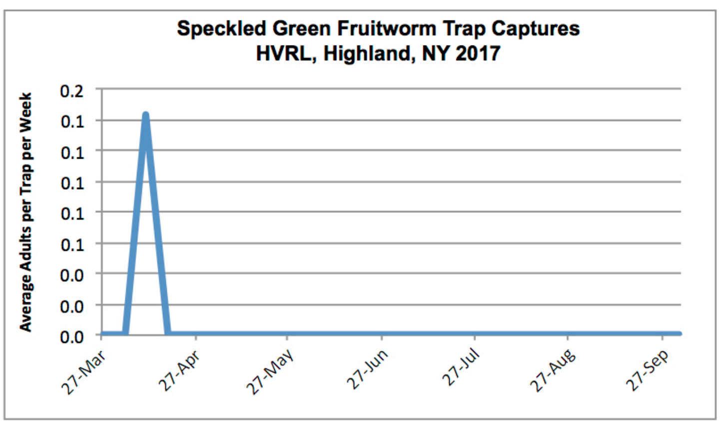


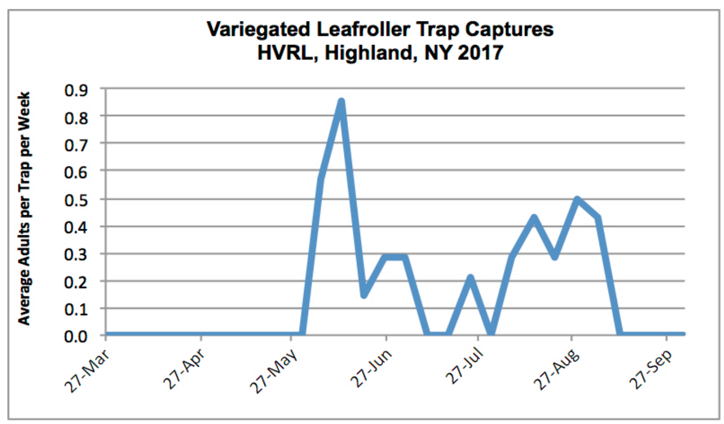

Redbanded Leafroller Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug
27-Sep


Spotted Wing Drosophila Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
6.00
5.00
4.00
3.00
2.00
1.00
0.00
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug
27-Sep


San Jose Scale Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
250.0
200.0
150.0
100.0
50.0
0.0
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug
27-Sep


Spotted Tentiform Leafminer Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug


Speckled Green Fruitworm Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
0.2
0.1
0.1
0.1
0.1
0.1
0.0
0.0
0.0
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug
27-Sep


Variegated Leafroller Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
27-Mar
27-Apr
27-May
27-Jun
27-Jul
27-Aug
27-Sep

Departments of Entomology and Plant Pathology
Cornell's Hudson Valley Lab

Cornell University
College of Agriculture and Life Sciences

McIntosh Phenology

Year	GT	HIG	T.C.	Pink	Bloom	P.F.	PF DD$_{43}$	PF DD$_{50}$
2017	4/2	4/11	4/17	4/24	4/27	5/8	603.0	312.0
2016	3/17	4/04	4/11	5/18	5/25	5/12	597.8	186.0
2015	4/14	4/18	4/27	5/4	5/7	5/14	587.2	353.4
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	**4/15**	**4/27**	**5/4**	**5/7**	**5/16**	**5/24**	595.0	382.0 **High**
Mean	**5 April**	**13 April**	**22 April**	**28 April**	**3 May**	**13 May**	**482.3**	**265.3**

Midrange: **3/31** (+/-15D)
4/7 (+/-20D)
4/14 (+/-20D)
4/22 (+/-14D)
5/1 (+/-15D)
5/7 (+/-17D)

Mean days in bloom 9.5 days
DD beginning 1 Jan. using BE min.

2017 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Laboratory, Highland, NY

All readings were taken from daily Max and Min on the dates indicated from NEWA-HVRL

	MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPTEMBER		
Date	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain
1	63.4	51.1	0.04	43.8	33.0	0.16	69.3	47.0	0.00	75.1	53.9	0.00	83.8	68.5	0.02	87.3	62.4	0.00	68.7	46.4	0.00
2	59.9	31.3	0.01	58.8	35.4	0.00	68.7	57.3	0.31	72.3	47.9	0.00	86.3	67.2	0.19	87.1	64.9	0.33	66.7	45.4	0.08
3	36.3	20.1	0.00	64.1	38.3	0.00	58.9	45.1	0.00	71.4	47.9	0.00	84.5	64.9	0.01	84.9	62.5	0.02	63.7	52.4	1.22
4	24.0	12.5	0.00	49.8	43.2	1.04	64.3	38.5	0.00	67.3	49.0	0.30	80.8	61.2	0.00	82.4	67.0	0.52	78.2	56.1	0.00
5	29.6	8.2	0.00	57.4	42.8	0.03	55.8	45.3	1.01	64.4	55.1	0.57	82.9	60.3	0.00	78.6	63.3	0.18	81.8	63.0	0.10
6	43.6	15.3	0.00	46.8	38.5	0.69	66.2	53.0	0.61	55.6	50.0	0.77	78.4	64.4	0.00	74.8	55.5	0.00	66.8	58.0	0.90
7	46.2	34.5	0.08	49.2	38.8	0.00	53.5	42.9	0.08	69.6	49.5	0.00	81.7	62.7	0.44	66.1	59.7	0.24	71.0	55.7	0.16
8	56.5	43.3	0.05	51.9	36.9	0.00	51.7	39.4	0.01	73.2	49.0	0.00	82.5	66.1	0.02	77.8	62.5	0.02	68.7	52.0	0.00
9	51.9	39.2	0.00	69.5	35.6	0.00	53.5	38.1	0.00	79.0	51.4	0.00	79.7	56.9	0.00	83.0	54.8	0.00	63.6	46.5	0.00
10	37.0	19.9	0.08	79.4	46.8	0.00	56.9	36.8	0.00	83.2	57.2	0.00	81.5	59.4	0.00	85.8	60.6	0.00	69.1	51.8	0.00
11	23.5	12.2	0.00	85.8	58.0	0.00	64.0	36.8	0.00	90.5	65.9	0.00	80.5	67.0	0.23	79.9	63.8	0.87	73.2	47.6	0.00
12	26.3	8.9	0.01	65.6	49.8	0.06	66.0	44.0	0.00	91.8	67.5	0.00	84.4	69.4	0.48	79.3	61.7	0.77	77.7	50.0	0.00
13	31.9	13.3	0.02	59.2	41.3	0.00	50.9	44.9	1.34	90.9	68.1	0.07	85.9	70.0	1.10	80.3	64.0	0.00	78.6	54.1	0.00
14	28.2	20.1	0.00	63.3	41.3	0.00	60.0	42.0	0.19	79.5	63.9	0.00	68.8	61.9	0.26	76.3	58.9	0.00	78.8	65.5	0.20
15	26.1	14.6	0.00	67.6	42.1	0.00	64.9	49.9	0.01	74.1	56.4	0.00	80.1	64.0	0.08	76.0	66.2	0.00	81.0	64.2	0.01
16	36.1	21.3	0.00	84.6	55.0	0.11	77.1	50.0	0.00	68.6	58.1	0.10	83.6	60.9	0.00	81.1	64.0	0.00	83.2	63.3	0.00
17	46.7	23.4	0.00	70.0	55.2	0.00	92.7	55.0	0.00	77.0	62.8	0.00	84.0	66.9	0.00	81.0	58.2	0.00	83.5	62.6	0.00
18	37.8	22.7	0.00	61.6	42.9	0.00	92.8	70.9	0.00	85.8	69.5	0.01	87.1	67.3	0.12	80.4	69.0	0.28	79.5	64.6	0.00
19	43.7	31.1	0.00	55.0	43.2	0.04	87.8	60.3	0.29	83.1	69.7	1.39	90.4	70.8	0.00	83.2	68.8	0.00	78.2	63.9	0.00
20	48.4	27.7	0.00	65.1	45.2	0.24	68.2	52.9	0.00	80.3	67.7	0.01	90.7	66.6	0.05	81.4	62.3	0.00	77.7	66.2	0.00
21	56.5	36.5	0.00	54.9	49.1	0.43	70.5	45.1	0.00	78.7	63.1	0.00	89.2	67.8	0.00	83.8	61.1	0.00	76.9	66.8	0.00
22	42.3	20.4	0.00	55.2	47.5	0.03	57.5	54.1	0.06	82.2	56.8	0.00	84.0	66.0	0.00	88.7	69.4	0.54	78.0	60.7	0.00
23	39.7	15.8	0.00	67.4	37.8	0.00	66.4	50.6	0.01	82.9	70.9	0.02	81.2	68.0	0.01	79.0	62.0	0.03	83.8	59.6	0.00
24	44.2	28.1	0.01	69.3	44.3	0.00	73.5	53.1	0.00	83.3	66.5	0.12	70.1	59.8	1.28	76.1	55.3	0.00	88.6	61.7	0.00
25	42.7	35.0	0.08	57.3	47.1	0.57	58.1	54.3	0.82	80.1	59.3	0.02	65.3	57.5	0.00	74.6	55.9	0.00	91.6	65.7	0.00
26	36.8	30.9	0.07	61.3	49.8	0.12	72.1	53.2	0.25	76.6	54.4	0.00	75.9	58.9	0.00	75.1	50.4	0.00	87.6	66.1	0.00
27	47.5	34.5	0.36	68.5	57.6	0.00	69.6	54.3	0.00	73.7	56.7	0.16	76.3	62.2	0.00	74.9	51.3	0.00	88.2	64.2	0.00
28	44.9	41.5	0.39	85.4	59.2	0.00	72.3	58.3	0.00	77.6	52.3	0.00	79.4	66.9	0.00	73.2	52.0	0.00	72.5	55.5	0.00
29	51.4	39.2	0.01	81.6	63.3	0.00	58.3	54.4	0.47	81.5	61.4	0.00	74.0	62.3	0.00	62.2	56.5	0.00	65.8	45.5	0.00
30	48.5	32.5	0.00	62.2	48.1	0.00	59.8	53.7	0.02	87.2	70.8	0.70	78.5	57.2	0.00	77.8	57.0	0.01	54.0	50.0	0.35
31	38.3	33.1	0.85				76.3	56.3	0.61				85.6	56.3	0.00	75.2	55.8	0.02			
High / Low / Total																					
	63.4	8.2	2.06	85.8	33.0	3.52	92.8	36.8	6.09	91.8	47.9	4.24	90.7	56.3	4.29	88.7	50.4	3.83	91.6	45.4	3.02
Ave Temp.	33.9			54.2			58.1			68.4			72.1			69.4			66.7		