RESULTS OF
2018
INSECTICIDE AND ACARICIDE STUDIES IN EASTERN NEW YORK

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Formulation of Insecticides	Materials Tested	Company
	Apple	
Actara 25WDG	…….	Syngenta AG
Altacor WG35	……	FMC Corp.
Assail 30WG	……	United Phosphorus Inc.
Avaunt eVo	……	FMC Corp.
Besiege	……	Syngenta AG
Closer SC	……	Dow AgroScience
Compound A	……	NA
Delegate WG25	……	Dow AgroSciences
Exirel	……	FMC Corp.
Grandevo WDG	……	Marrone Bio Innovations
Harventa 50SL	…….	ISK / Summit Agro USA
Lorsban 4EC	……	Dow AgroScience
Minecto Pro	……	Syngenta AG
Movento 240SC	……	Bayer CropScience
Sivanto Prime	……	Bayer CropScience
Sivanto HL	……	Bayer CropScience
Venerate XC	……	Marrone Bio Innovation
Voliam Flexi	…….	Syngenta
	Pear	
BioCover MLT (NIS)	……	Crop Protection Services
BotaniGard ES	……	Laverlam International Corporation
Certis CX-10282	……	Certis USA
Grandevo WDG	……	Marrone Bio Innovations
Surround WP	……	Tessenderlo Kerley
Venerate XC	……	Marrone Bio Innovation

Factors Contributing To The 2018

Hudson Valley Insect Pest Management Anomalies.

Rainfall accumulations: The start of the 2018 season began very dry in March increasing to exceed the average through April with rainfall accumulations of 2.73" in March (3.6" Ave.), 5.08" in April (3.8" Ave.), and 3.48" in May (4.4" Ave.). The month of June saw a significant increase in rain events totaling 3.18" (4.4" Ave.), with ample rain to produce moderate levels of apple scab and fire blight infection, especially in newly planted blocks. The first two weeks in July had less than 0.2" of rain with 6 days above 90^{o}F requiring weekly irrigation. The latter days in July had significant rain with 4.48" of accumulated rain over the entire month (4.7" Ave.). August experienced above average rainfall with accumulations of 7.79" (4.2" Ave.). Total rainfall for the March 1st through September 1st growing season totaled 26.74" of rain, above the seasonal average of 25.1". Rain events over the region were dramatic with high winds in small cell tornados ravaging farms in lower Ulster and Dutchess County, suffering heavy losses with thousands of young trees toppled and dozens snapped at the scion rootstock union.

Tree phenology: Bud development was hampered in 2018 by lingering cold temperatures. The season began as one of the latest seasons on record. However, by petal-fall, the season was one-week later then the latest day of the 38-year phenology mean, 10 days earlier then the latest recorded date.

McIntosh green tip (18 April) occurred 19 days later than the 38-year historical mean (see McIntosh phenology), the earliest recorded day at the HVRL. King bloom on McIntosh began on the 9th of May. Day length and predominately mild temperatures prevailed ranging between 49.9^{o}F and 79.2^{o}F, setting the stage for a short bloom period lasting 5 days, 4 days shorter then the mean of 9.4 days with $\geq$ 80% **PF in McIntosh occurred on 14th May**. Degree-day accumulations of 514.1_{43} and 274.6_{50} were mid-range relative to the 38-year average up to PF. A moderate temperature range of 49 ^{o}F to 88^{o}F followed PF. There was ample sunlight and temperature for pollinators yielding strong pollination and strong fruit set requiring significant thinning for a marketable crop. Early water stress was a concern for tree fruit growers during early June and Early July with ample rain fall moisture available during most the season. By the 21st of May, 100% of McIntosh fruit had set with king fruit sized $\geq$ 5 mm, with 5% plum curculio injury noted in the untreated Ginger Gold control plots on that date.

Tarnished Plant Bug (TPB) presence and fruit injury was slightly above average this season, requiring timely applications for management in orchards with historical fruit damage. Significant injury occurred during the post bloom period this season as cool temperatures prior to bloom were not conducive for TPB activity. Injury from this pest at fruit set was recorded to be below 0.5%, yet injury one week later was observed to be at 8.0% by the 21st of May in the UTC Ginger Gold this season. Relatively dry conditions during the pre-bloom period favor TPB activity, often requiring insecticide applications at both TC and P that, in many years, show numeric reduction in fruit injury. Low levels of injury in higher valued fruit such as Sweetango, Honeycrisp, Gala and Fuji typically require TPB management if culls from this insect exceed economic threshold. We observed TPB injury at 39.0% in Ginger Gold on 4 June in untreated plots with similiar damage noted in these plots at harvest.

Plum Curculio (PC) damage levels were initially low with slow development with first observation of ovipositional injury on 14th May (0.5% at PF in Ginger Gold) in early varieties and moderate later into the season (34% by the 29th May and 77% by the 4th of June). *The predictive model using $308DD_{50}$ calculated the completion of PC migration and need for residual insecticide until the 3rd of June using the HVRL NEWA station.*

This season required three applications in most orchards beginning at 80% PF to control PC based on early reapplications following significant rain events during 1st and 2nd cover for most mid to late varieties. Rains after PF on the 15th, 19th

May and 4th of June prompted a 1st and 2nd cover re-application within shorter spray intervals. PC damage began shortly after fruit set with temperatures exceeding 70°F. Overall high pressure was observed this season with PC injury observations prior to *June Drop* exceeding 75% in Red Delicious. In early harvest assessments after 'June Drop' damage was assessed at 52.6% in untreated Ginger Gold.

European apple sawfly (EAS) activity occurred in very low numbers again this season with early varieties showing a range from 1.8% to 10% injury in Ginger Gold and McIntosh cluster fruit evaluations with early harvest assessments at < 1.0%. This was the forth year in which EAS populations were at very low fruit damage levels.

Spotted Tentiform Leafminer (STLM) populations remain at very high levels in seasonal pheromone trapping with two distinct flights. Since the planting of our semi-dwarf test plots that correlate with the onset and use of the neonicotinoid class of insecticides employed in apple and reduced broad spectrum OP use, the STLM has not been observed to cause injury to foliage to a degree requiring insecticide management. Parasitism of early larval stages continue to be observed during the season.

San Jose scale (SJS) crawler emergence was predicted to occur during the first week of June (4th June) based on the 1st adult capture on the 18th of May using 400 DD_{51} model. Nymphs were observed on fruit on the 16th of June, 12 days after the predicted emergence date. In general SJS scale levels were high in infested trees. The infestation means ranged from 22.3% to 64.0% injury observed in HVRL research plots on 28th August. In conventionally treated orchards, the SJS has become a major insect pest to manage in apple, requiring targeted applications for multiple generations. In 2015 we observed a 3rd generation in late September.

Lepidopteran complex: Overwintering larvae of the spotted green fruit worm (SGFW), red banded leafroller (RBLR) and OBLR larva during the pre-bloom period through fruit set remain a concern for most Hudson Valley and Lake Champlain pome fruit growers. The tools for use against the Lepidoptera complex are diverse in mode of action, very effective with excellent residual activity. Relatively low levels of infestation was observed in the pre bloom and early season leafroller complex.

Codling moth (CM) *1st generation sustained adult flight occurred on 14th May with larval emergence predicted for 29th May using 220 DD_{50} from CM biofix.* The internal lepidopteran complex, lesser apple worm (LAW), oriental fruit moth (OFM) and CM showed moderate levels of damage to apple, with frass produced by the internal lep. complex appearing during mid-late June through early July. Moderate levels of damage from the internal Lepidopteran complex was observed from 1st generation evaluated on 29th June on Ginger Gold and Red Delicious. The 2nd generation adult sustained catch for the CM biofix occurred on 12th July with management for larval emergence prediction using 250 DD_{50} to occur on 24th July.

Obliquebanded leafroller (OBLR) monitoring and management by tree fruit growers continues to be a high priority. Targeting up to three seasonal application windows while employing a single mode of action for each period, growers can achieve successful management of the OBLR larva. These include the pre-bloom through Petal Fall period for the overwintering generation, often using IGR's such as Proclaim and Intrepid, the Summer generation using either Altacor or Delegate, and later in August applying either Altacor or Delegate. Recommendations for applications were made using insect phenology predictions for early emergence, using 340 DD_{50} from biofix to manage emergence of larvae, predicted to occur on mid June. In general, low-levels of leafroller feeding was observed on developing foliage and fruitlets this spring. Trap captures began on 4th June were moderate for 1st generation OBLR averaging 7.6 / day during the peak periods (25th June). The 2nd generation flight of OBLR biofix was low during August. We are seeing a trend of

increasingly high levels of RBLR with mixed populations of **tufted apple bud moth** (TABM) and ***sparganothis fruitworm*** (SFW) during the season, contributed to the overall leafroller damage each year.

Apple maggot (AM) emergence was late this season with first emergence on 2nd July. Threshold of 5 flies per trap per block was observed on the 9th of July. AM density was low to moderate throughout the region with reduced emergence due to the lack of late season rainfall in July and early August. Highest populations occurred late in the season as rainfall in August providing more ideal emergence conditions for the adult fly.

The **brown marmorated stink bug** (BMSB), *Halyomorpha halys,* has been observed throughout the southern Hudson Valley for the past 7 years with the first BMSB confirmation in December 2008. Since that time increasing populations have been documented in urban environments and present on many farms throughout the season in the lower to mid-Hudson Valley region. We have observed a second generation over the past two years, developing in mid-late August in HVRL voltinism studies. However, in 2018 we did not find adult egg laying after the development of 1st generation in the field.

Although there appears to be stink bug feeding in apple this season, both BMSB and the **green stink bug**, *Acrosternum hilare* BMSB was found from mid-season through harvest on pome fruit in lower to mid-Hudson Valley with increasing northern observations and fruit injury occurring in Columbia County in 2013. It has been found reproducing in deciduous trees such as Sugar Maple, *Acer saccharum*, White Ash, *Fraxinus americana*, Tree of Heaven, *Ailanthus altissima*, and eastern black walnut *Juglans nigra* in high numbers with lower numbers observed in Staghorn Sumac, *Rhus typhina,* and wild grape, *V. vinifera.* Late season nymphs and adult trap captures of BMSB using Tedders traps employing traditional black light traps, the USDA #10 lure and the *Plaudi stali* aggregation pheromone lure, *methyl (E,E,Z)-2,4,6-decatrienoate,* was observed along the orchard edges in Orange, Ulster, Dutchess and Columbia Counties throughout the season. In 2018 we monitored the population throughout NYS in 44 tree fruit orchard sites, employing a trap threshold of 10 total BMSB adults per trap to recommend management timing for tree fruit production. We are presently recommending that growers access https://www.eddmaps.org/bmsbny/ for weekly updates on BMSB monitoring of adults and fruit injury requiring management.

Spotted wing drosophila (SWD), *Drosophila suzukii*, (Matsumura) (Diptera: Drosophilae) were first observed in NY by late August, 2011. We monitored SWD in four counties throughout the lower to mid-Hudson Valley this season using baited traps across small fruit, grape and tree fruit. The first SWD trap captures were found at the HVRL on the week of the 5th of July. Growers who harvested frequently and kept to a 3-7 day spray program were able to maintain low infestations levels (<15%) this season. We are presently recommending that growers access http://www.eddmaps.org/project/project.cfm?proj=9 for weekly updates on BMSB monitoring of adults and fruit injury for early season management.

EVALUATION OF INSECTICIDES FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2018
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

Codling moth (CM): *Cydia pomonella* (Linnaeus)
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)
Oriental fruit moth (OFM): *Grapholitha molesta* (Busck)
Plum curculio (PC): *Conotrachelus nenuphar* (Herbst)
Potato leafhopper (PLH): *Empoasca fabae* (Harris)
Redbanded leafroller (RBLR): *Argyrotaenia velutinana* (Walker)
Rose leafhopper (RLH): *Edwardsiana rosae* (Linnaeus)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
Stink Bug: Green and Brown Marmorated Stink Bug (SB): *Chinavia halaris*, *Halyomorpha halys* Stål
Tarnished plant bug (TPB): *Lygus lineolaris* (P. de B.)
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
Stigmaeid (ZM): *Zetzellia mali* (Ewing)
Acarina: Phytoseiidae (AMB): *Neoseiulus (=Amblyseius) fallacies* (Garman), or *Galendromus (=Typhlodromus) pyri*

Trees on the M.26 rootstock, 23 yr.-old, maintained 10' ft., planted on research spacing of 10' x 30'. Calculations for applications based on 16' tree row spacing as found in conventional production utilizing M.26. Alternate unsprayed rows adjacent to treated plots are maintained for drift reduction, increased insect distribution and population pressure in yearly plot rotation. Treatments applied to four-tree varietal plots, replicated four times in a randomized complete block design (RCBD). Treatments were applied concentrate using a Slim Line tower sprayer using 100 psi, delivering 0.69 to 0.75 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 300 gal/A . Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Maintenance applications for disease management began on April 23rd using 3 lbs./A Manzate, 5 oz./A Vanguard, on 1st and 9th of May, using 3 lbs./A Manzate, 12.0 oz./A Inspire Super, 8.0 oz./A Agri-mycin 1.5 pts./100 gal Regulaid for fireblight control; on the 14th May using 3 lbs./A Manzate, 16 fl.oz./A Luna Tranquility, 24 fl.oz./100 gal Li700, 2.5 oz./A Flint, 8 oz./A Agri-Mycin; on 21st May 5.5 oz/A Merivon, 8 oz/A Rally, 3 lbs/A Manzate and 24 fl.oz./100 gal. of LI700.

Insecticide programs (Tables -) applied to manage the insect complex were assessed during late fruit development of fruit damage after '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 50 harvested fruit using calyx end frass and 'bulls-eye sting' of fruit as evidence of CM activity combined with sliced assessment of the seed cavity to determine seed feeding as evidence of CM. San Jose scale (SJS) injury to fruit was assessed by scoring fruit as injured with '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 stippling while subjectively rating foliage for percent injury from PLH feeding to apical leaves. Fruit at harvest was assessed from 50 or 100 fruit per tree in each of two varieties depending on harvest date, 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 or Tukey ($P \leq 0.05$) unless noted.

Table 1 Treatment Schedule for 2018 Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2018

Treatment/Formulation	RateTiming	Application Dates
1. Actara	5.5 oz./A	16th May, 25th May
Compound A*	1x	3rd July, 15th July, 21st July, 12 Aug.
2. Actara	5.5 oz./A	16th May, 25th May
Compound A *	1.5x	3rd July, 15th July, 21st July, 12 Aug.
3. Actara	5.5 oz./A	16th May, 25th May
Compound A *	2.0x	3rd July, 15th July, 21st July, 12 Aug.
4. Actara	5.5 oz./A	16th May, 25th May
Lorsban Advanced	4.0 pts./A	7 May
Imidan 70WP*	3.0 lb./A	3rd July, 15th July, 21st July, 12 Aug.
5. Actara	5.5 oz./A	16th May, 25th May
Venerate XC**	2.0 qt./A	18th June 3rd July, 15th July, 21st July, 12 Aug
6. Actara*	5.5 oz./A	16th May, 25th May
Grandevo**	2.0 lbs./A	18th June 3rd July, 15th July, 21st July, 12 Aug.
7. Actara*	5.5 oz./A	16th May, 25th May
Sivanto Prime	10.5 oz./A	7 May
Movento + LI700	9.0 oz./A	24 May
Assail 70WP	3.4 oz./A	3rd July, 15th July, 21st July, 12 Aug.
8. UTC		
9. Actara*	5.5 oz./A	16th May, 25th May
Sivanto HL	10.5 oz./A	7 May
Movento + LI700	9.0 oz./A	24 May
Assail 70WP	3.4 oz./A	3rd July, 15th July, 21st July, 12 Aug.
10. Actara*	5.5 oz./A	16th May, 25th May
Movento + LI700	9.0 oz./A	24 May
Assail 70WP	3.4 oz./A	3rd July, 15th July, 21st July, 12 Aug.

Table 2 Evaluations of Insecticides for Controlling Mid-Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit								
		PC	EAS	TPB	LR	Int. LEP	Ext. LEP	CM	SJS	Clean
1. Compound A*	1x	19.8 ab	0.5	17.8	6.9 ab	40.9 ab	9.1	30.6 a	53.2 ab	5.5 b
2. Compound A *	1.5x	15.3 ab	1.5	13.7	7.6 ab	40.6 ab	11.6	22.8 ab	43.5 abc	9.7 b
3. Compound A *	2.0x	16.0 ab	0.5	11.0	5.5 ab	47.5 a	9.0	22.0 ab	64.0 a	7.5 b
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	12.0 b	0.5	14.5	3.0 b	12.0 b	8.5	3.5 B	17.5 abc	36.5 a
5. Venerate XC**	2.0 qt./A	23.0 ab	0.5	9.5	17.0 ab	45.0 ab	14.5	29.0 a	13.5 bc	15.5 ab
6. Grandevo**	2.0 lbs./A	18.4 ab	1.0	15.8	25.3 a	56.8 a	16.2	36.3 a	46.1 abc	5.2 b
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	8.1 b	0.0	12.6	7.1 ab	53.0 a	8.1	36.8 a	0.5 c	20.2 ab
8. UTC		52.6 a	0.5	9.7	8.6 ab	51.5 a	22.0	32.4 a	31.3 abc	2.5 b
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	33.3 ab	0.0	7.7	18.5 ab	35.6 ab	14.2	19.9 ab	3.1 c	13.8 ab
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	20.8 ab	2.7	15.4	14.3 ab	45.6 ab	17.0	32.7 a	1.5 c	15.3 ab
P value for transformed data		0.0242	0.1181	0.6453	0.015	0.8401	0.8401	0.0002	0.0002	0.0015

[a] Evaluation made on on 'Ginger Gold' cultivar on 29 July. Applications specifically timed for emergence of SJS nymph and apple maggot.
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. 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 2 cont Evaluations of Insecticides for Controlling Mid-Season Insect Complex on Apple
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged foliage AMP	AMT	SJS	SB	Clean
1. Compound A*	1x	32.2 a	19.2 a	53.2 ab	17.0 a	5.5 b
2. Compound A *	1.5x	15.9 a	11.3 a	43.5 abc	9.7 a	9.7 b
3. Compound A *	2.0x	18.0 a	9.0 a	64.0 a	12.0 a	7.5 b
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	18.0 a	7.0 a	17.5 abc	11.0 a	36.5 a
5. Venerate XC**	2.0 qt./A	25.0 a	19.0 a	13.5 bc	15.0 a	15.5 ab
6. Grandevo**	2.0 lbs./A	23.3 a	13.6 a	46.1 abc	21.4 a	5.2 b
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	18.7 a	10.6 a	0.5 c	11.1 a	20.2 ab
8. UTC		22.7 a	17.1 a	31.3 abc	15.0 a	2.5 b
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	24.3 a	11.1 a	3.1 c	35.5 a	13.8 ab
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	23.0 a	12.6 a	1.5 c	18.8 a	15.3 ab
P value for transformed data		0.7853	0.7349	0.0002	0.0788	0.0015

Harvest evaluation of 'Ginger Gold' on 29 July. 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. 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 3 Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple at Harvest [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit							
		PC	EAS	TPB	LR	Ext LEP	CM	SJS	Clean
1. Compound A*	1x	14.0 b	0.3 b	3.5 a	6.0 a	2.0 a	12.0 a	82.8 a	4.5 c
2. Compound A *	1.5x	18.5 b	0.3 b	5.5 a	8.0 a	3.3 a	8.5 a	63.5 a	8.5 c
3. Compound A *	2.0x	9.0 b	0.8 ab	5.9 a	8.1 a	3.4 a	11.6 a	78.9 a	7.5 c
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	8.3 b	0.0 b	2.5 a	17.3 a	7.2 a	11.6 a	51.5 a	15.9 bc
5. Venerate XC**	2.0 qt./A	9.0 b	0.0 b	2.8 a	26.4 a	14.7 a	15.4 a	50.9 a	7.8 c
6. Grandevo**	2.0 lbs./A	9.3 b	0.5 ab	4.5 a	12.0 a	5.3 a	16.8 a	60.5 a	8.0 c
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	9.3 b	0.8 ab	8.0 a	9.3 a	4.8 a	14.8 a	6.8 b	31.3 ab
8. UTC		46.8 a	1.5 a	4.0 a	15.3 a	11.5 a	18.3 a	58.8 a	1.3 c
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	17.3 b	0.0 b	6.5 a	12.0 a	5.5 a	8.0 a	10.8 b	30.5 ab
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	17.8 b	1.5 a	8.3 a	9.8 a	2.8 a	10.5 a	3.8 b	37.5 a
P value for transformed data		0.0003	0.0507	0.4651	0.8009	0.3731	0.2560	0.0002	0.0002

[a] Evaluation made on on 'Red Delicious' cultivar on 7th Sept. Applications specifically timed for emergence of SJS nymph and apple maggot.
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. 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 3 cont. Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple at Harvest [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged foliage AMP	AMT	SB	Clean
1. Compound A*	1x	23.3 a	19.5 a	11.0 a	4.5 c
2. Compound A *	1.5x	16.5 a	11.3 a	5.5 a	8.5 c
3. Compound A *	2.0x	12.1 a	9.3 a	3.7 a	7.5 c
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	19.9 a	14.8 a	9.1 a	15.9 bc
5. Venerate XC**	2.0 qt./A	19.6 a	12.3 a	3.0 a	7.8 c
6. Grandevo**	2.0 lbs./A	19.5 a	16.5 a	7.0 a	8.0 c
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	19.8 a	15.5 a	8.8 a	31.3 ab
8. UTC		26.5 a	25.5 a	8.8 a	1.3 c
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	17.5 a	14.0 a	11.3 a	30.5 ab
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	19.3 a	17.3 a	5.8 a	37.5 a
P value for transformed data		0.9871	0.9674	0.7507	0.0002

Harvest evaluation of 'Red Delicious' cultivar on 7th Sept. 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. 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 4 Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple at Harvest [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit							
		PC	EAS	TPB	LR	Ext LEP	CM	SJS	Clean
1. Compound A*	1x	19.8 a	0.5 a	17.8 a	6.9 ab	9.1 a	30.6 a	53.2 ab	5.5 b
2. Compound A *	1.5x	15.3 a	1.5 a	13.7 a	7.6 ab	11.6 a	22.8 ab	43.5 ab	9.7 b
3. Compound A *	2.0x	16.0 a	0.5 a	11.0 a	5.5 ab	9.0 a	22.0 ab	64.0 a	7.5 b
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	12.0 b	0.5 a	14.5 a	3.0 b	8.5 a	3.5 b	17.5 abc	36.5 a
5. Venerate XC**	2.0 qt./A	23.0 a	0.5 a	9.5 a	17.0 ab	14.5 a	29.0 a	13.5 bc	15.5 ab
6. Grandevo**	2.0 lbs./A	18.4 a	1.0 a	15.8 a	25.3 a	16.2 a	36.3 a	46.1 a	5.2 b
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	8.1 b	0.0 a	12.6 a	7.1 ab	8.1 a	36.8 a	0.5 c	20.2 ab
8. UTC		52.6 a	0.5 a	9.7 a	8.6 ab	22.0 a	32.4 a	31.3 abc	2.5 b
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	33.3 a	0.0 a	7.7 a	18.5 ab	14.2 a	19.9 ab	3.1 c	13.8 ab
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	20.8 a	2.7 a	15.4 a	14.3 ab	17.0 a	32.7 a	1.5 c	15.3 ab
P value for transformed data		0.0242	0.1181	0.6453	0.018	0.8401	0.0002	0.0002	0.0015

[a] Evaluation made on on 'Ginger Gold' cultivar on 31st July, prior to 2nd gen SJS. Applications specifically timed for emergence of SJS nymph and apple maggot. 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. 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 4 cont. Evaluations of Insecticides for Controlling Early Season Insect Complex on Apple at Harvest [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt/ Formulation	Rate	Mean incidence (%) of insect damaged foliage AMP	AMT	SB	Clean
1. Compound A*	1x	32.2 a	19.2 a	17.0 a	5.5 b
2. Compound A *	1.5x	15.9 a	11.3 a	9.7 a	9.7 b
3. Compound A *	2.0x	18.0 a	9.0 a	12.0 a	7.5 b
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	18.0 a	7.0 a	11.0 a	36.5 a
5. Venerate XC**	2.0 qt./A	25.0 a	19.0 a	15.0 a	15.5 a
6. Grandevo**	2.0 lbs./A	23.3 a	13.6 a	21.4 a	5.2 b
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	18.7 a	10.6 a	11.1 a	20.2 a
8. UTC		22.7 a	17.1 a	15.0 a	2.5 b
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	24.3 a	11.1 a	35.5 a	13.8 a
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	23.0 a	12.6 a	15.3 a	15.3 a
P value for transformed data		0.7853	0.7349	0.0788	0.0015

Harvest evaluation of 'Ginger Gold cultivar on 7th August. 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. 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 5 Evaluations of Insecticides for Controlling Insect Complex on Apple Foliage [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence (%) of insect damaged to foliage PLH	WALH/RLH	RAA	LR	JB	OFM
1. Compound A*	1x	2.1 bcd	0.0 a	0.0 a	6.8 a	1.5 b	2.3 b
2. Compound A *	1.5x	1.9 bcd	0.0 a	0.0 a	6.3 a	7.0 ab	2.0b
3. Compound A *	2.0x	3.2 ab	0.0 a	0.0 a	3.0 a	1.5 b	2.0 b
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	2.7 abcd	0.0 a	0.0 a	7.3 a	2.0 ab	2.0 b
5. Venerate XC**	2.0 qt./A	3.1 abc	0.0 a	0.0 a	6.5 a	3.3 ab	3.3 ab
6. Grandevo**	2.0 lbs./A	3.8 ab	0.0 a	0.0 a	7.3 a	7.8 a	6.3 ab
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	1.0 d	0.0 a	0.0 a	6.0 a	1.5 b	1.8 b
8. UTC		4.4 a	0.0 a	0.0 a	12.8 a	7.0 ab	9.3 a
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	1.2 cd	0.0 a	0.0 a	7.0 a	5.0 ab	2.3 b
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	2.1 bcd	0.0 a	0.0 a	9.5 a	2.8 ab	3.0 ab
P value for transformed data		0.0001	-	-	0.1053	0.0024	0.0097

Harvest evaluation of 'Red Delicious' on 10th August. 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. 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 6 Evaluations of Insecticides for Controlling Mite Complex on Apple Foliage [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence of mite on foliage					
		ARM	TSSM	TSSME	Z.mali	AMB	ERM
1. Compound A*	1x	0.0 a	0.1 a	0.2 a	< 0.1 a	0.0 a	0.0 a
2. Compound A *	1.5x	0.0 a	< 0.1 a	0.0 a	0.0 a	0.0 a	0.0 a
3. Compound A *	2.0x	0.0 a	0.0 a	< 0.1 a	< 0.1 a	0.0 a	0.0 a
4. Lorsban Advanced Imidan 70WP*	4.0 pts./A 3.0 lb./A	0.6 a	< 0.1 a	0.8 a	< 0.1 a	0.0 a	0.0 a
5. Venerate XC**	2.0 qt./A	0.0 a	4.0 a	1.8 a	< 0.1 a	0.0 a	0.0 a
6. Grandevo**	2.0 lbs./A	37.1 a	0.0 a	2.0 a	2.0 a	0.0 a	0.0 a
7. Sivanto Prime Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	0.0 a	26.7 a	35.2 a	< 0.1 a	0.0 a	0.0 a
8. UTC		0.6 a	0.4 a	0.4 a	0.7 a	0.0 a	0.0 a
9. Sivanto HL Movento + LI700 Assail 70WP	10.5 oz./A 9.0 oz./A 3.4 oz./A	0.6 a	11.8 a	25.7 a	0.0 a	0.0 a	< 0.1 a
10. Movento + LI700 Assail 70WP	9.0 oz./A 3.4 oz./A	0.6 a	27.2 a	29.4 a	0.0 a	0.0 a	0.0 a

P value for transformed data

Harvest evaluation of 'Red Delicious' on 21 September. 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. 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.

EVALUATION OF INSECTICIDES FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2018
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

Codling moth (CM): *Cydia pomonella* (Linnaeus)
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)
Oriental fruit moth (OFM): *Grapholitha molesta* (Busck)
Plum curculio (PC): *Conotrachelus nenuphar* (Herbst)
Potato leafhopper (PLH): *Empoasca fabae* (Harris)
Redbanded leafroller (RBLR): *Argyrotaenia velutinana* (Walker)
Rose leafhopper (RLH): *Edwardsiana rosae* (Linnaeus)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
Green and Brown Marmorated Stink Bug (SB): *Chinavia halaris*, *Halyomorpha halys* Stål
Tarnished plant bug (TPB): *Lygus lineolaris* (P. de B.)
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
Stigmaeid (ZM): *Zetzellia mali* (Ewing)
Acarina: Phytoseiidae (AMB): *Neoseiulus (=Amblyseius) fallacies* (Garman), or *Galendromus (=Typhlodromus) pyri*

Trees on the M.26 rootstock are 23 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 plot placement. 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 74 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. Maintenance applications for disease management began on April 23rd using 3 lbs./A Manzate, 5 oz./A Vanguard, on 1st May using 3 lbs/A of Manzate and 5.0 oz./A Vanguard, on 9th May using 3 lbs./A Manzate, 12.0 oz./A Inspire Super, 8.0 oz./A Agri-mycin 1.5 pts./100 gal Regulaid for fireblight control; on the 14th May using 3 lbs./A Manzate, 16 fl.oz./A Luna Tranquility, 24 fl.oz./100 gal Li700, 2.5 oz./A Flint, 8 oz./A Agri-Mycin; on 21st May 5.5 oz/A Merivon, 8 oz/A Rally, 3 lbs/A Manzate and 24 fl.oz./100 gal. of LI700.

Insecticide programs (Table) to manage the insect complex was assessed during late fruit development after '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 using calyx end frass and 'bulls-eye sting' of fruit as evidence of surface LEP activity combined with sliced assessment of the seed cavity to determine seed feeding 'CM'. San Jose scale (SJS) injury was assessed by scoring fruit with 'red halo'. Phytophagous and predacious mite populations were evaluated by sampling 25 red delicious leaves, 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 leafhopper complex comprised of WALH, PLH, and RLH, by examining 5 distal and 5 apical leaves on 5 shoots per tree for stippling while subjectively rating foliage for percent injury from PLH feeding to apical leaves. Fruit at harvest was assessed from 50 or 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 Tukey LSD ($P \leq 0.05$) unless noted.

Table 7 Treatment Schedule for Seasonal Apple Insecticide Screening Hudson Valley Research Laboratory, Highland, NY - 2018

Treatment/Formulation	Rate	Application Dates
1. Avaunt eVo	6.0 oz./A	16th May
Altacor WG35	3.0 oz./A	30th May, 12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
2. Avaunt eVo	6.0 oz./A	16th May
Altacor WG35	3.0 oz./A	30th May
Voliam Flexi	5.25 oz./A	12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
3. Avaunt eVo	6.0 oz./A	16th May
Voliam Flexi	5.25 oz./A	30th May, 12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
4. Avaunt eVo	6.0 oz./A	16th May
Altacor WG35	3.0 oz./A	30th May
Minecto Pro	12.0 fl. oz./A	12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
5. Avaunt eVo	6.0 oz./A	16th May
Minecto Pro	12.0 fl. oz./A	30th May, 12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
6. Avaunt eVo	6.0 oz./A	16th May
Delegate WG25	6.5 oz./A	30th May, 12th June
Altacor WG35	3.0 oz./A	27th June, 22nd July
7. Avaunt eVo	6.0 oz./A	16th May
Delegate WG25	6.5 oz./A	30th May, 12th June
Besiege	10.0 oz./A	27th June, 22nd July
8. Avaunt eVo	6.0 oz./A	16th May
Harvanta	22.0 fl. oz./A	30th May, 12th June
Delegate WG25	6.5 oz./A	27th June, 22nd July
9. Untreated Check (UTC)		

Table 8 Evaluations of Insecticides for Controlling the Early Season Insect Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2018

		Incidence (%) of insect damaged cluster fruit										
Trmt. / Form.	Rate	PC	TPB	EAS	LR	Ext. Lep	CM	AMP	AMT	SJS	SB	Clean
1. Avaunt eVo	6.0 oz./A	23.5 b	18.8 a	2.5 a	0.0 b	10.2 ab	12.0 a	29.5 a	11.1 a	14.9 a	27.2 a	19.1 a
Altacor WG35	3.0 oz./A											
Delegate WG25	6.5 oz./A											
2. Avaunt eVo	6.0 oz./A	24.8 ab	20.8 a	0.5 a	0.6 b	14.1 ab	4.5 a	32.4 a	20.4 a	20.8 a	17.8 a	22.7 a
Altacor WG35	3.0 oz./A											
Voliam Flexi	5.25 oz./A											
Delegate WG25	6.5 oz./A											
3. Avaunt eVo	6.0 oz./A	38.8 ab	18.1 a	2.0 a	0.0 b	5.5 b	1.5 a	27.7 a	12.6 a	8.6 a	37.2 a	15.1 a
Voliam Flexi	5.25 oz./A											
Delegate WG25	6.5 oz./A											
4. Avaunt eVo	6.0 oz./A	39.4 ab	20.0 a	0.7 a	0.0 b	12.1 ab	10.5 a	19.8 a	6.3 a	27.4 a	35.1 a	13.4 a
Altacor WG35	3.0 oz./A											
Minecto Pro	12.0 fl. oz./A											
Delegate WG25	6.5 oz./A											
5. Avaunt eVo	6.0 oz./A	31.6 ab	26.1 a	2.0 a	0.0 b	6.5 b	3.0 a	20.6 a	12.5 a	44.8 a	24.1 a	13.1 a
Minecto Pro	12.0 fl. oz./A											
Delegate WG25	6.5 oz./A											
6. Avaunt eVo	6.0 oz./A	32.4 ab	27.0 a	1.0 a	0.0 b	8.7 ab	2.5 a	28.3 a	17.6 a	39.1 a	37.3 a	7.1 a
Delegate WG25	6.5 oz./A											
Altacor WG35	3.0 oz./A											
7. Avaunt eVo	6.0 oz./A	29.5 ab	20.9 a	3.0 a	0.0 b	5.6 b	4.6 a	8.1 a	2.6 a	33.6 a	31.0 a	18.6 a
Delegate WG25	6.5 oz./A											
Besiege	10.0 oz./A											
8. Avaunt eVo	6.0 oz./A	29.2 ab	21.1 a	2.5 a	0.5 b	9.6 a	1.5 a	15.1 a	8.0 a	29.1 a	21.1 a	15.6 a
Harvanta	22.0 fl. oz./A											
Delegate WG25	6.5 oz./A											
9. Untreated Control		62.5 a	7.5 a	0.7 a	11.7a	38.4 a	16.1 a	26.3 a	10.1 a	8.8 a	21.1 a	1.4 a
P value for transformed data		0.0857	0.3325	0.6845	0.0195	0.1882	0.4283	0.4631	0.5725	0.0662	0.8005	0.0680

[a] Evaluation of 1st pick 'Ginger Gold' cultivar on 31st July. Evaluations for internal worm complex were made to assess 1st generation codling moth. 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. 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 8 cont. Evaluations of Insecticides for Controlling the Early Season Insect Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2018

		Incidence (%) of insect damaged cluster fruit										
Trmt. / Form.	Rate	PC	TPB	EAS	LR	Ext. Lep	CM	AMP	AMT	SJS	SB	Clean
1. Avaunt eVo Altacor WG35 Delegate WG25	6.0 oz./A 3.0 oz./A 6.5 oz./A	19.5 a	12.6 a	5.1 a	0.0 b	7.0 a	1.5 a	19.0 a	10.5 a	24.0 c	46.2 a	15.7 a
2. Avaunt eVo Altacor WG35 Voliam Flexi Delegate WG25	6.0 oz./A 3.0 oz./A 5.25 oz./A 6.5 oz./A	26.6 a	12.8 a	2.1 a	0.0 b	12.4 a	4.0 a	51.3	27.2 a	25.7 bc	34.2 a	10.0 a
3. Avaunt eVo Voliam Flexi Delegate WG25	6.0 oz./A 5.25 oz./A 6.5 oz./A	36.4 a	24.8 a	4.4 a	0.0 b	2.5 a	0.5 a	20.6	12.2 a	14.9 c	39.5 a	15.4 a
4. Avaunt eVo Altacor WG35 Minecto Pro Delegate WG25	6.0 oz./A 3.0 oz./A 12.0 fl. oz./A 6.5 oz./A	29.0 a	8.0 a	0.7 a	0.0 b	1.3 a	0.7 a	13.4	10.1 a	35.5 abc	27.3 a	18.8 a
5. Avaunt eVo Minecto Pro Delegate WG25	6.0 oz./A 12.0 fl. oz./A 6.5 oz./A	30.5 a	22.6 a	2.0 a	1.1 b	3.9 a	8.6 ab	34.3	23.7 a	73.3 a	41.3 a	5.2 a
6. Avaunt eVo Delegate WG25 Altacor WG35	6.0 oz./A 6.5 oz./A 3.0 oz./A	31.5 a	20.5 a	3.0 a	0.5 b	4.5 a	2.0 a	18.0	13.0 a	61.0 ab	29.0 a	6.5 a
7. Avaunt eVo Delegate WG25 Besiege	6.0 oz./A 6.5 oz./A 10.0 oz./A	27.9 a	22.5 a	7.1 a	0.5 b	5.7 a	1.5 a	19.8	17.1 a	50.0 abc	14.5 a	15.4 a
8. Avaunt eVo Harvanta Delegate WG25	6.0 oz./A 22.0 fl. oz./A 6.5 oz./A	32.1 a	25.1 a	6.5 a	0.5 b	4.1 a	0.5 a	21.8	16.8 a	43.2 abc	25.2 a	10.5 a
9. Untreated Control		58.0 a	6.2 a	2.8 a	18.4 a	14.3 a	17.5 a	48.4	33.5 a	19.7 c	19.9 a	3.6 a
P value for transformed data		0.2485	0.1373	0.3976	0.0001	0.1423	0.0003	0.0939	0.5218	0.0001	0.7751	0.3546

[a] Evaluation of 2nd pick 'Ginger Gold' cultivar on 7 Sept.. Evaluations for internal worm complex were made to assess 1st generation codling moth. 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. 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 9 Evaluations of Insecticides for Controlling the Late Season Insect Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2018

Trmt. / Formulation	Rate	Incidence (%) of insect damaged to foliage PLH	WALH/RLH	RAA	LR	JB	OFM
1. Avaunt eVo	6.0 oz./A	3.9 ab	0.0 b	0.0 a	7.3 b	5.0 a	1.5 b
Altacor WG35	3.0 oz./A						
Delegate WG25	6.5 oz./A						
2. Avaunt eVo	6.0 oz./A	3.1 ab	0.0 b	0.0 a	9.3 ab	2.8 a	0.0 b
Altacor WG35	3.0 oz./A						
Voliam Flexi	5.25 oz./A						
Delegate WG25	6.5 oz./A						
3. Avaunt eVo	6.0 oz./A	1.9 b	0.0 b	0.0 a	6.0 b	7.0 a	1.5 b
Voliam Flexi	5.25 oz./A						
Delegate WG25	6.5 oz./A						
4. Avaunt eVo	6.0 oz./A	3.9 ab	0.0 b	0.0 a	13.7 ab	7.0 a	0.0 b
Altacor WG35	3.0 oz./A						
Minecto Pro	12.0 fl. oz./A						
Delegate WG25	6.5 oz./A						
5. Avaunt eVo	6.0 oz./A	2.5 ab	0.0 b	0.0 a	5.3 c	4.3 a	0.3 b
Minecto Pro	12.0 fl. oz./A						
Delegate WG25	6.5 oz./A						
6. Avaunt eVo	6.0 oz./A	3.4 ab	0.0 b	0.0 a	8.0 bc	3.3 a	0.8 b
Delegate WG25	6.5 oz./A						
Altacor WG35	3.0 oz./A						
7. Avaunt eVo	6.0 oz./A	3.7 ab	0.0 b	0.0 a	6.3 bc	2.3 a	1.0 b
Delegate WG25	6.5 oz./A						
Besiege	10.0 oz./A						
8. Avaunt eVo	6.0 oz./A	4.6 ab	0.0 b	0.0 a	7.0 bc	5.5 a	0.3 b
Harvanta	22.0 fl. oz./A						
Delegate WG25	6.5 oz./A						
9. Untreated Check (UTC)		4.9 a	1.7 a	0.0 a	15.5 a	9.8 a	9.0 a
P value for transformed data		0.0225	0.001	NA	0.006	0.4292	0.0007

[a] Evaluation of 'Ginger Gold' cultivar for treatments timed for 2 generations of codling moth.

Table 10 Evaluations of Insecticides for Controlling the Late Season Mite Complex on Apple [a]. Hudson Valley Research Laboratory, Highland, NY - 2018

		Incidence (%) of insect damaged to foliage							
Trmt. / Formulation	Rate	ERM	ERME	TSSM	TSSME	ZM	ZME	T.pyri	T.pyri Egg
1. Avaunt eVo Altacor WG35 Delegate WG25	6.0 oz./A 3.0 oz./A 6.5 oz./A	0.0 a	0.1 a	0.4 a	0.5 a	0.9 a	0.8 a	0.1 a	0.0 a
2. Avaunt eVo Altacor WG35 Voliam Flexi Delegate WG25	6.0 oz./A 3.0 oz./A 5.25 oz./A 6.5 oz./A	0.0 a	0.0 a	0.9 a	0.3 a	0.7 a	0.7 a	0.3 a	0.0 a
3. Avaunt eVo Voliam Flexi Delegate WG25	6.0 oz./A 5.25 oz./A 6.5 oz./A	0.0 a	0.0 a	0.5 a	0.2 a	1.5 a	2.5 a	0.2 a	0.0 a
4. Avaunt eVo Altacor WG35 Minecto Pro Delegate WG25	6.0 oz./A 3.0 oz./A 12.0 fl. oz./A 6.5 oz./A	0.0 a	0.0 a	0.1 a	0.0 a	0.4 a	1.0 a	0.3 a	0.0 a
5. Avaunt eVo Minecto Pro Delegate WG25	6.0 oz./A 12.0 fl. oz./A 6.5 oz./A	0.0 a	0.0 a	0.0 a	0.1 a	0.4 a	0.6 a	0.4 a	0.1 a
6. Avaunt eVo Delegate WG25 Altacor WG35	6.0 oz./A 6.5 oz./A 3.0 oz./A	0.0 a	0.0 a	0.2 a	0.1 a	0.6 a	0.9 a	0.2 a	0.1 a
7. Avaunt eVo Delegate WG25 Besiege	6.0 oz./A 6.5 oz./A 10.0 oz./A	0.0 a	0.0 a	0.1 a	0.1 a	1.3 a	0.8 a	0.1 a	0.0 a
8. Avaunt eVo Harvanta Delegate WG25	6.0 oz./A 22.0 fl. oz./A 6.5 oz./A	0.0 a	0.0 a	0.9 a	1.3 a	1.1 a	2.7 a	0.2 a	0.0 a
9. Untreated Check (UTC)		0.0 a	0.0 a	0.4 a	0.2 a	1.2 a	2.4 a	0.1 a	0.0 a
P value for transformed data		0.6480	0.3569	0.6798	0.6049	0.1207	0.1409	0.0987	0.7563

[a] Evaluation of 'Red Delicious' cultivar on 28 August.

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, 2018: – 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 36 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 11 Treatment Schedule for Seasonal Pear Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2018

Treatment / Formulation	Rate Timing	Application Dates	
1. BioCover Oil	128.0 fl.oz./100	DD-EOS @ 14d	13, 20 April, 1, 17 May, 1, 15, 29 June, 13, 27 July
2. BioCover Oil	128.0 fl.oz./100	DD, GC, WB – EOS*	13, 20 April, 1, 17 May, 1, 15, 29 June, 13, 27 July
+ Surround	12.5 lbs./100	DD, GC, WB, PF	13, 20 April, 1, 17 May
3. Surround	12.5 lbs./100	DD, GC, WB, PF	13, 20 April, 1, 17 May
BioCover Oil	128.0 fl.oz./100	1C – EOS*	13, 20 April, 1, 17 May, 1, 15, 29 June, 13, 27 July
4. BioCover Oil	128.0 fl.oz./100	DD, GC	13, 20 April
BioCover Oil	32.0 fl. oz./A	WB, PF-EOS	1, 17 May, 1, 15, 29 June, 13, 27 July
Venerate XC	1.0 qt./A	WB, PF-EOS	1, 17 May, 1, 15, 29 June, 13, 27 July
5. BioCover Oil	128.0 fl.oz./100	DD, GC	13, 20 April
BioCover Oil	32.0 fl.oz./A	WB, PF-EOS	1, 17 May, 1, 15, 29 June, 13, 27 July
Venerate XC	2.0 qt./A	WB, PF-EOS	1, 17 May, 1, 15, 29 June, 13, 27 July
6. BioCover Oil	128.0 fl.oz./100	DD, GC	13, 20 April
BioCover Oil	32.0 fl.oz./100	10pPF, 21 dp	9, 17 May, 1, 15, 29 June, 13, 27 July
Grandevo WDG	2.0 lb./A	WB, PF-EOS	1, 17 May, 1, 15, 29 June, 13, 27 July
7. BioCover Oil	256.0fl.oz./100	DD, GC	13, 20 April
BotaniGard ES	2.0 qt./100	WB, PF, PF+2wk	1, 17 May
Certis CX-10282	2.0 qt./100	PF+3wk-EOS	1, 15, 29 June, 13, 27 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 11 cont. Evaluations of Insecticide Schedules for Controlling Pear Psylla on Pear [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Treatment / Formulation	Rate	Pear psylla eggs per leaf				
		19 April	10 May	31 May	14 June	5 July
1 BioCover Oil	128.0 fl.oz./100	0.6	0.2 ab	0.8 cd	1.6 b	3.1
2. BioCover Oil + Surround	128.0 fl.oz./100 12.5 lbs./100	0.8	0.0 b	1.3 bcd	2.2 b	2.1
3. Surround BioCover Oil	12.5 lbs./100 128.0 fl.oz./100	1.0	0.0 b	0.4 d	1.3 b	4.0
4. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 1.0 qt./A	.	0.5 ab	2.6 ab	4.6 ab	3.6
5. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 2.0 qt./A	.	0.8 ab	1.7 bcd	3.0 b	3.0
6. BioCover Oil Grandevo WDG + oil	256.0 fl.oz./100 2.0 lb./A	.	1.3 a	2.2 abc	2.5 b	3.6
7. BioCover Oil BotaniGard Certis CX-10282	256.0 fl.oz./100 2.0 qt./100 2.0 qt./100	0.8	1.0 ab	0.9 bcd	1.8 b	4.3
8. UTC		0.6	1.2 a	3.7 a	9.0 a	1.2
P value for transformed data		NS	0.001	0.0001	0.0001	NS

[a] Seasonal evaluations made on 'Bartlett'.

Mean separation by Tukey-Kramer HSD (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.

Table 11 cont Evaluations of Insecticide Schedules for Controlling Pear Psylla on Pear [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

Treatment / Formulation	Rate	Pear psylla nymphs per leaf				
		19 April	10 May	31 May	14 June	5 July
1. BioCover Oil	128.0 fl.oz./100	0.0	0.1 b	0.4 b	1.3 b	3.1
2. BioCover Oil + Surround	128.0 fl.oz./100 12.5 lbs./100	0.0	0.0 b	0.1 b	1.3 b	2.8
3. Surround BioCover Oil	12.5 lbs./100 128.0 fl.oz./100	0.0	0.0 b	0.2 b	0.7 b	3.6
4. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 1.0 qt./A	0.0	0.0 b	0.7 ab	3.5 b	5.2
5. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 2.0 qt./A	0.0	0.1 b	0.4 b	2.0 b	5.1
6. BioCover Oil Grandevo WDG	256.0 fl.oz./100 2.0 lb./A	0.0	0.1 b	0.5 b	2.0 b	5.8
7. BioCover Oil BotaniGard Certis CX-10282	256.0 fl.oz./100 2.0 qt./100 2.0 qt./100	0.0	0.1 b	0.4 b	1.4 b	4.9
8. UTC		0.0	0.5 a	1.1 a	6.8 a	6.5
P value for transformed data		NS	0.0001	0.0001	0.0001	NS

[a] Seasonal evaluations made on 'Bartlett'.

Mean separation by Tukey-Kramer HSD ($P \leq 0.05$). 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.

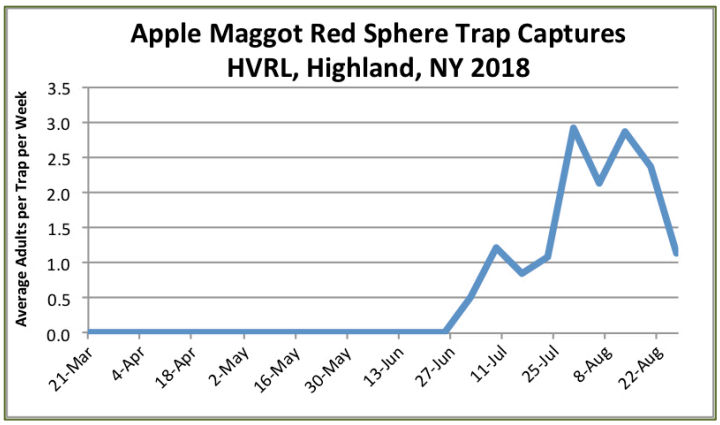
Table 12 Evaluations of Insecticide Schedules for Controlling Pear Psylla on Pear [a]
Hudson Valley Research Laboratory, Highland, NY - 2018

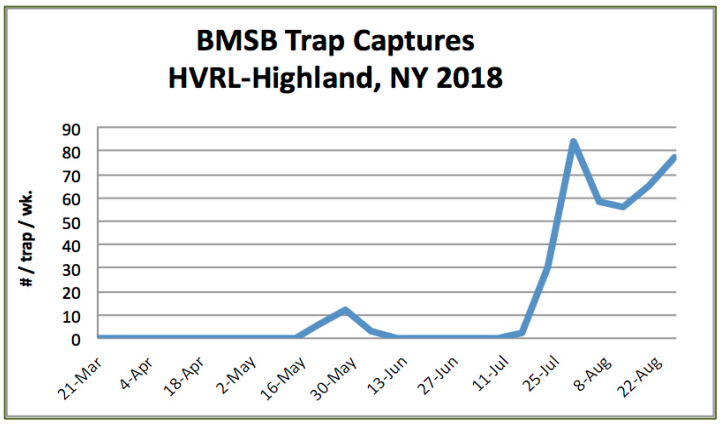
Treatment / Formulation	Rate	Honeydew Phytotoxicity to Bosc Pear Foliage % / shoot	% severity Interior-tree	% severity Mid-Tree	% severity Outer-Tree
1. BioCover Oil	128.0 fl.oz./100	23.3 b	13.1 c	8.8 b	6.8
2. BioCover Oil + Surround	128.0 fl.oz./100 12.5 lbs./100	19.9 b	30.0 abc	28.8 ab	23.8
3. Surround BioCover Oil	12.5 lbs./100 128.0 fl.oz./100	26.7 b	19.9 bc	16.3 b	9.8
4. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 1.0 qt./A	41.2 ab	26.7 abc	23.8 ab	25.0
5. BioCover Oil Venerate XC + oil	128.0 fl.oz./100 2.0 qt./A	48.3 ab	29.6 abc	32.5 ab	18.8
6. BioCover Oil Grandevo WDG	256.0 fl.oz./100 2.0 lb./A	57.1 ab	42.9 b	40.0 ab	33.8
7. BioCover Oil BotaniGard Certis CX-10282	256.0 fl.oz./100 2.0 qt./100 2.0 qt./100	59.6 ab	32.5 abc	33.8 ab	23.8
8. UTC		71.4 a	50.4 a	56.3 a	38.8
P value for transformed data		0.0051	0.0011	0.0066	0.644

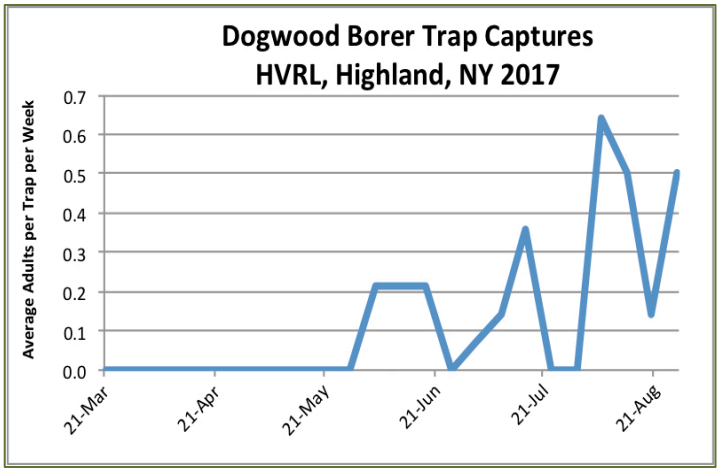
[a] Seasonal evaluations made on 'Bartlett'.

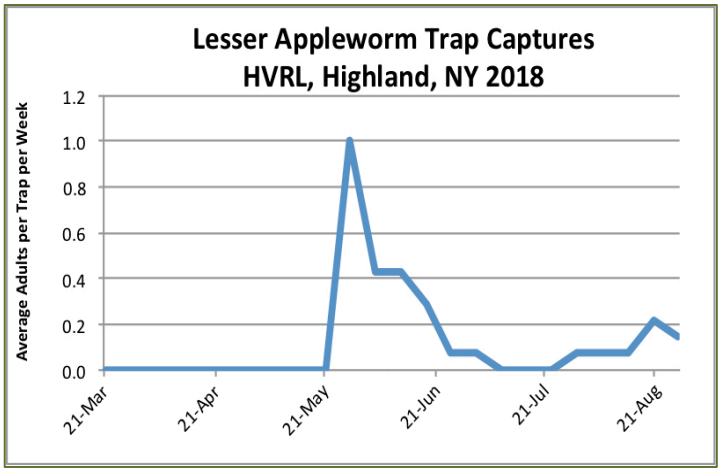
Mean separation by Tukey-Kramer HSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported. All applications made using a three-point hitch tractor mounted 'Pack Tank' sprayer and pecan handgun applied at 300 psi. dilute to runoff.

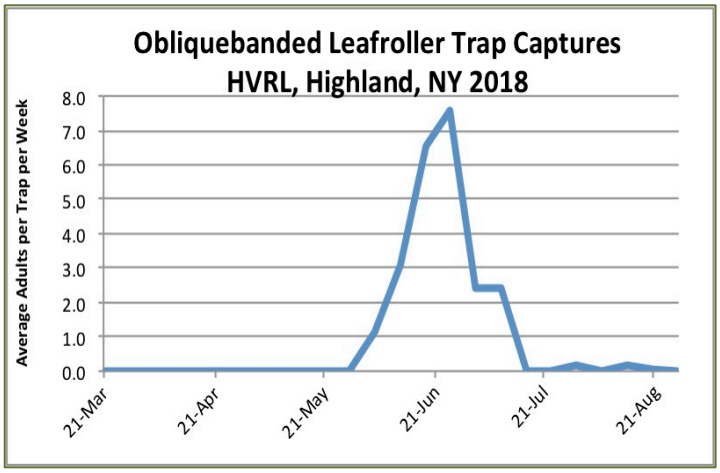
Regional Insect Trap Data – HVRL 2018

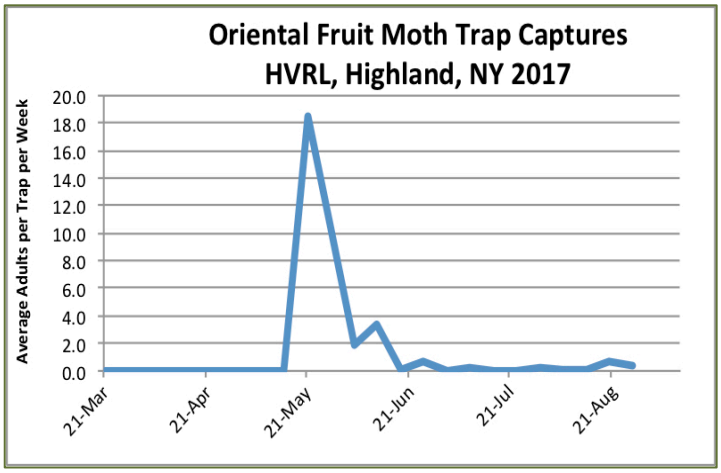


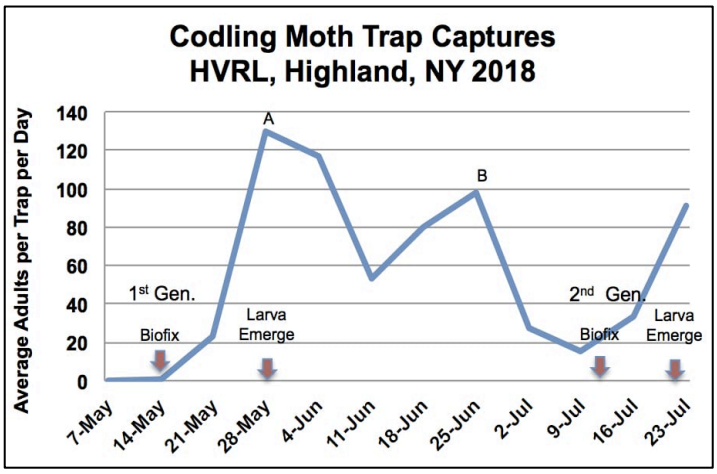


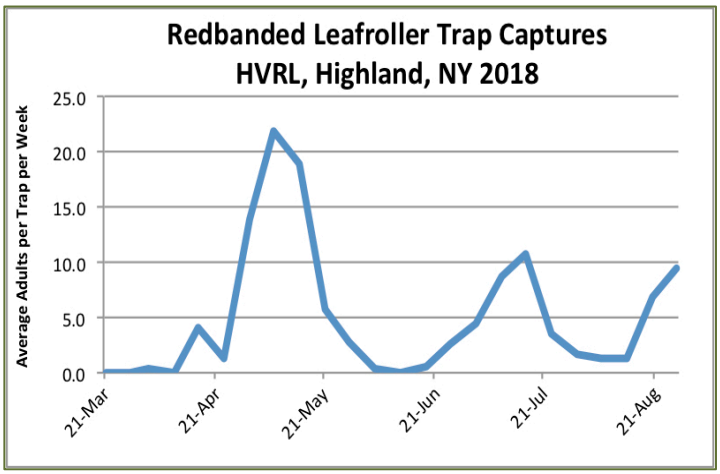


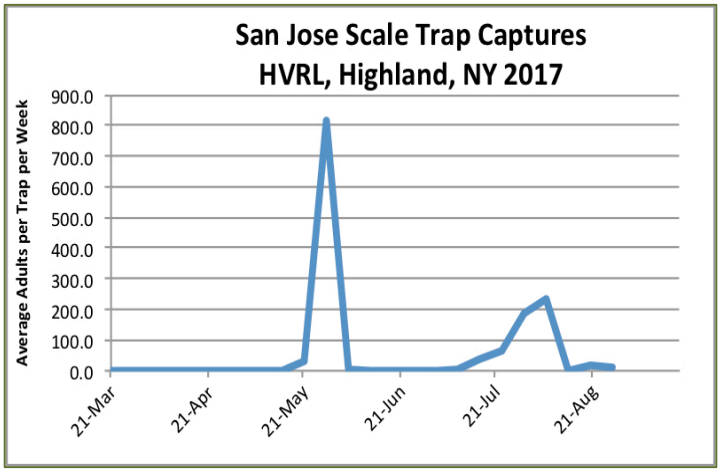


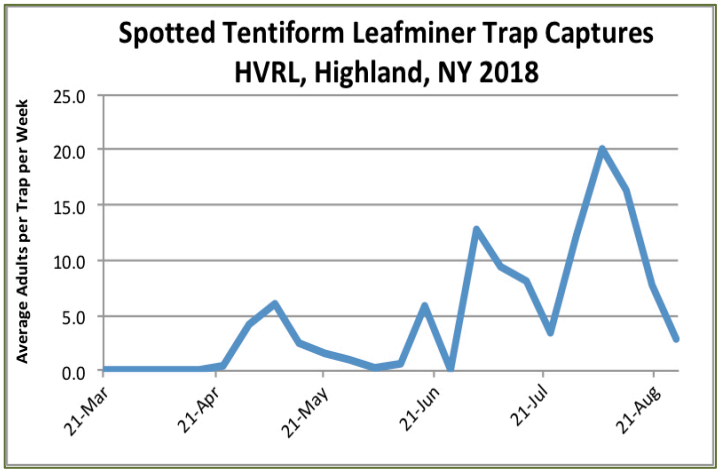


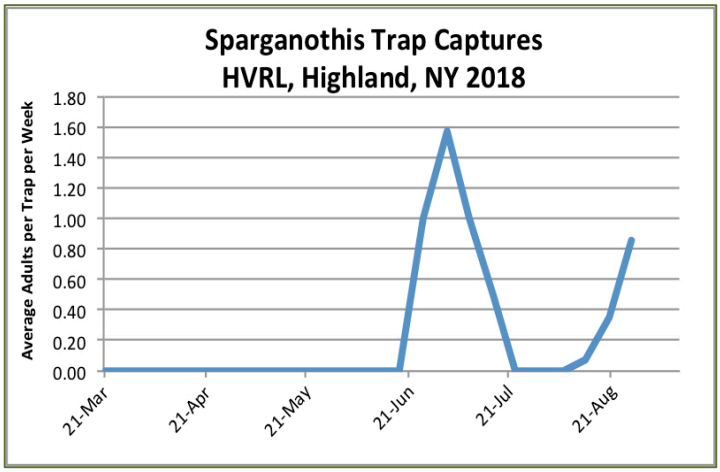


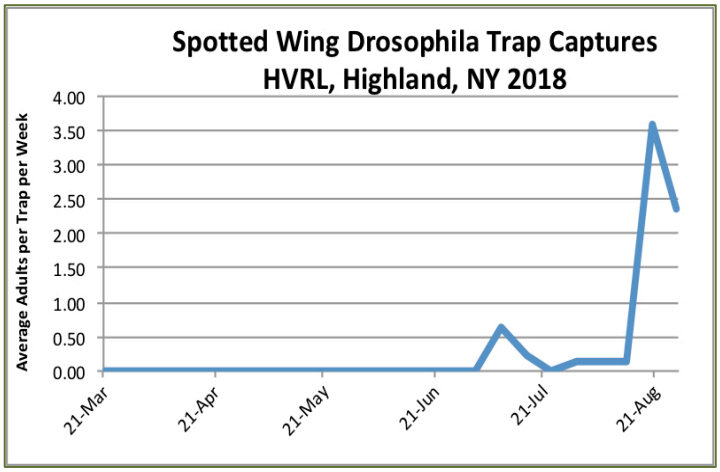

Codling Moth Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Day
140
120
100
80
60
40
20
0
A
B
1st Gen.
Biofix
Larva Emerge
2nd Gen.
Biofix
Larva Emerge
7-May
14-May
21-May
28-May
4-Jun
11-Jun
18-Jun
25-Jun
2-Jul
9-Jul
16-Jul
23-Jul

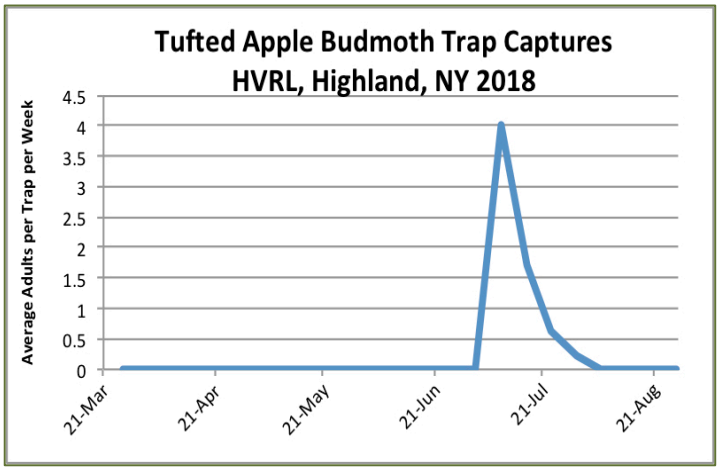

Redbanded Leafroller Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Week
25.0
20.0
15.0
10.0
5.0
0.0
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug

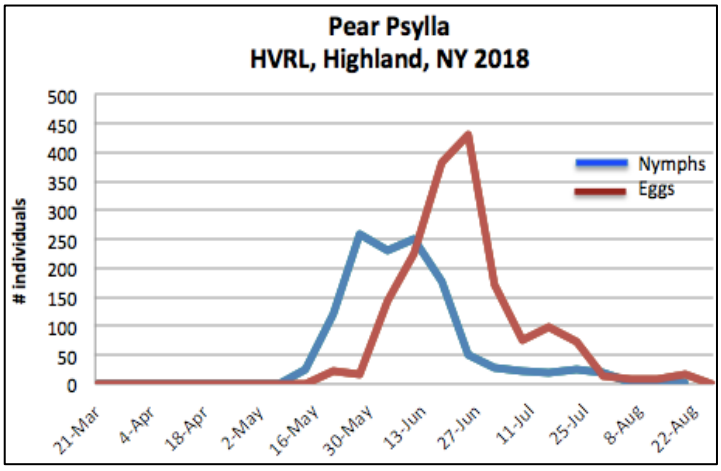

San Jose Scale Trap Captures
HVRL, Highland, NY 2017
Average Adults per Trap per Week
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug


Spotted Tentiform Leafminer Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Week
25.0
20.0
15.0
10.0
5.0
0.0
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug


Sparganothis Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Week
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug


Spotted Wing Drosophila Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Week
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug


Tufted Apple Budmoth Trap Captures
HVRL, Highland, NY 2018
Average Adults per Trap per Week
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
21-Mar
21-Apr
21-May
21-Jun
21-Jul
21-Aug


Pear Psylla
HVRL, Highland, NY 2018
individuals
500
450
400
350
300
250
200
150
100
50
0
Nymphs
Eggs
21-Mar
4-Apr
18-Apr
2-May
16-May
30-May
13-Jun
27-Jun
11-Jul
25-Jul
8-Aug
22-Aug

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}	
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)
4/7 (+/-20.5D)
4/14 (+/-20D)
4/22 (+/-14D)
5/1 (+/-15D)
5/7 (+/-16.5D)

Mean days in bloom 9.4 days

2018 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Laboratory, Highland, NY

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March

Date	Min. Air Temp (°F)	Max. Air Temp (°F)	Ave. Air Temp (°F)	Rain (inches)	Lf.Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	48.7	56.8	38.8	0.23	4	1	4.5	155
02	34.9	38.6	32.7	1.58	16	18	12.1	35
03	38.2	43.7	35.7	0.19	0	0	11.1	198
04	36.5	39.7	32.1	0.00	0	0	7.7	104
05	34.6	38.1	31.8	0.00	0	0	7.1	136
06	36.9	45.1	28.8	0.00	0	0	3.0	276
07	31.9	33.9	30.0	*0.01*	*9*	23	7.1	29
08	32.6	38.8	27.0	*0.29*	*0*	6	4.6	142
09	32.1	38.5	25.6	0.07	0	0	3.9	204
10	34.1	37.8	30.8	0.00	0	0	3.3	169
11	34.0	42.7	27.5	*0.00*	0	0	3.8	341
12	34.3	42.3	25.1	0.00	2	1	3.7	217
13	33.7	37.2	32.0	0.15	18	12	5.8	126
14	33.3	37.5	30.1	0.00	0	0	5.3	198
15	35.3	43.4	29.5	0.00	0	0	3.9	260
16	31.1	34.8	25.7	0.00	0	0	4.3	167
17	33.3	45.3	25.0	0.00	0	0	5.0	334
18	27.6	39.2	15.6	0.00	0	0	4.5	363
19	31.6	38.8	25.5	0.00	0	0	4.6	312
20	29.9	36.0	22.2	0.00	0	0	6.0	173
21	31.3	36.5	26.8	0.00	0	1	9.8	57
22	38.7	49.3	28.5	0.00	0	2	6.9	277
23	38.5	46.4	31.4	0.00	0	0	3.9	247
24	38.6	45.4	31.9	0.00	0	0	5.7	345
25	34.3	42.6	28.4	0.00	0	0	6.6	194
26	38.7	48.0	29.0	0.00	0	0	3.4	389
27	38.1	46.1	28.5	0.00	1	0	2.6	202
28	43.1	52.7	33.9	0.07	10	8	2.2	208
29	46.5	49.8	42.9	0.00	15	13	1.0	58
30	48.0	53.0	41.9	0.14	16	14	4.3	95
31	45.2	56.7	35.8	0.00	0	0	4.7	423
	36.3	56.8	15.6	2.73	91	99	5.2	6434

April

Date	Min. Air Temp (°F)	Max. Air Temp (°F)	Ave. Air Temp (°F)	Rain (inches)	Lf. Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	45.9	52.9	34.6	0.00	1	0	4.4	244
02	34.9	42.0	28.8	0.23	6	5	2.7	255
03	36.0	38.1	31.5	0.53	13	16	1.3	69
04	43.2	56.1	36.9	0.11	16	14	3.7	74
05	34.6	40.5	29.7	0.00	0	0	4.1	256
06	34.3	42.1	26.4	0.19	13	10	1.4	92
07	37.6	43.6	30.6	0.02	6	2	4.8	268
08	32.8	38.7	25.3	0.00	0	0	5.5	246
09	36.5	47.1	26.1	0.00	0	0	2.6	198
10	38.9	43.2	34.5	0.00	0	0	3.3	194
11	40.3	49.0	26.6	0.00	0	0	2.7	285
12	47.2	56.9	36.4	0.04	6	0	2.5	126
13	57.3	66.5	50.9	0.00	2	0	3.6	183
14	48.1	60.4	33.8	0.00	0	0	7.8	308
15	35.0	39.3	32.5	0.07	7	4	7.6	86
16	41.6	52.5	32.8	2.00	22	21	5.4	60
17	40.4	45.0	34.6	0.02	7	0	3.1	119
18	40.6	48.9	34.0	0.00	0	0	3.0	165
19	38.2	43.2	34.2	0.20	11	6	3.4	119
20	39.2	46.6	33.6	0.00	0	0	5.3	399
21	46.4	58.3	30.5	0.00	0	0	3.7	454
22	51.6	63.6	36.0	0.00	0	0	3.7	517
23	54.0	68.1	38.0	0.00	0	0	3.4	508
24	54.9	65.9	41.9	0.01	1	0	3.1	359
25	51.8	56.8	47.1	0.58	22	23	2.9	80
26	57.3	64.4	49.8	0.03	8	8	2.8	78
27	47.5	49.0	44.4	0.28	15	15	2.4	47
28	56.1	69.9	46.8	0.42	8	14	3.0	149
29	47.6	51.8	43.4	0.21	11	11	2.9	57
30	44.0	47.4	39.2	0.14	10	1	2.9	119
	43.8	69.9	25.3	5.08	185	150	3.6	6114

2018 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Laboratory, Highland, NY

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May

Date	Min. Air Temp (°F)	Max. Air Temp (°F)	Ave. Air Temp (°F)	Rain (inches)	Lf.Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	60.8	76.9	41.8	0.00	0	5	1.8	311
02	75.1	88.9	61.5	0.00	0	0	6.3	334
03	74.7	86.4	64.0	0.12	7	5	7.9	388
04	73.8	81.3	66.0	0.01	1	1	6.6	255
05	66.6	75.9	56.3	0.00	0	0	3.2	516
06	57.5	66.1	53.1	0.28	16	14	2.9	94
07	58.3	67.5	49.2	0.00	9	9	3.1	339
08	62.3	75.1	47.0	0.00	0	1	2.6	506
09	65.8	79.2	49.9	0.00	0	0	2.4	574
10	60.8	70.2	49.0	0.63	6	6	2.3	336
11	59.8	67.2	53.8	0.01	5	6	3.2	517
12	49.3	54.0	47.5	0.15	16	13	1.8	62
13	51.3	55.2	47.8	0.05	11	14	2.4	185
14	**62.0**	**75.0**	**51.6**	0.00	10	9	1.6	446
15	67.3	87.9	57.3	**1.14**	5	16	2.5	361
16	59.5	66.2	54.0	0.02	8	17	1.4	227
17	63.7	72.9	56.7	0.11	10	11	0.7	309
18	62.0	71.7	53.2	0.00	0	1	4.3	482
19	51.6	55.0	45.6	**0.88**	18	15	1.1	82
20	66.1	77.1	54.9	0.03	9	10	2.3	336
21	65.8	77.4	54.1	0.00	0	2	1.8	638
22	59.4	63.4	55.9	0.06	8	5	1.2	138
23	67.6	81.4	57.0	0.04	9	9	2.6	549
24	69.9	82.9	58.1	0.00	0	0	2.3	612
25	73.7	87.5	57.4	0.00	0	0	2.4	577
26	78.3	87.2	66.1	0.00	0	0	2.0	502
27	62.6	72.5	53.3	0.07	10	3	4.6	74
28	61.1	69.8	52.5	0.00	0	5	1.7	268
29	76.4	87.3	64.8	0.00	0	3	2.6	581
30	72.3	82.0	62.4	0.00	0	0	2.4	533
31	66.9	71.5	60.5	0.00	1	6	1.2	156
	64.6	88.9	41.8	3.48	152	181	2.7	11288

June

Date	Min. Air Temp (°F)	Max. Air Temp (°F)	Ave. Air Temp (°F)	Rain (inches)	Lf. Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	73.4	84.2	67.0	0.29	9	14	0.7	290
02	72.8	77.6	67.7	0.00	7	8	4.5	484
03	62.1	67.9	53.4	0.01	8	3	2.6	257
04	57.6	68.4	49.8	0.46	9	12	0.9	335
05	59.6	66.1	51.7	0.01	3	0	1.9	223
06	59.4	66.4	51.0	0.03	0	4	1.5	298
07	63.8	71.0	57.2	0.00	0	2	2.0	385
08	69.3	82.4	57.2	0.00	0	0	1.5	507
09	67.8	75.5	59.2	0.00	0	0	1.9	426
10	63.6	69.5	58.4	0.00	0	0	0.8	241
11	64.8	76.3	57.5	0.00	0	1	2.9	550
12	65.6	77.1	52.7	0.00	0	0	3.6	588
13	66.5	73.3	57.9	0.02	4	3	2.2	148
14	71.4	80.9	64.5	0.00	0	0	3.0	508
15	64.1	69.7	58.8	0.00	0	0	2.2	273
16	69.4	82.1	52.3	0.00	0	5	1.7	589
17	74.8	88.7	55.8	0.00	0	0	1.8	582
18	79.6	91.4	68.8	0.03	4	1	2.5	457
19	76.0	83.0	67.7	0.01	3	6	3.9	519
20	69.8	77.8	61.7	0.00	0	0	0.9	331
21	73.2	83.2	64.3	0.00	0	1	3.3	532
22	68.2	78.3	58.4	0.00	0	0	3.4	483
23	62.4	63.8	60.4	0.00	2	2	1.7	123
24	69.4	81.1	60.3	0.66	11	17	1.3	280
25	68.2	76.2	61.1	0.11	7	8	3.8	511
26	66.8	79.7	52.3	0.00	0	0	2.0	571
27	64.9	70.0	60.3	0.59	10	8	1.2	141
28	71.9	79.2	63.8	0.96	13	17	1.0	242
29	77.0	89.4	64.9	0.00	0	7	0.1	611
30	78.7	90.6	63.4	0.00	0	1	1.5	532
	68.4	91.4	49.8	3.18	90	120	2.1	12017

2018 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Laboratory, Highland, NY

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	July									August								
	Min.	Max.	Ave.	Rain	Lf.Wet	rH	Wind Spd	Solar		Min.	Max.	Ave.	Rain	Lf. Wet	rH	Wind Spd	Solar
Date	Air Temp (°F)			(inches)	Hrs.	≥ 90%	(mph)	Rad (L)	Date	Air Temp (°F)			(inches)	Hrs.	≥ 90%	(mph)	Rad (L)
01	83.0	93.6	71.6	0.00	0	0	0.9	490	01	74.1	80.0	67.0	0.65	5	10	6.5	223
02	84.1	93.9	73.0	0.00	0	6	2.3	278	02	77.8	85.0	73.0	0.21	12	10	6.9	152
03	82.0	94.1	71.0	0.00	0	2	2.4	308	03	76.2	84.0	71.0	0.91	19	11	5.9	257
04	80.6	92.4	71.0	0.00	0	6	2.9	97	04	75.5	85.0	70.0	0.38	10	7	5.0	470
05	80.3	90.5	71.5	0.00	0	7	2.3	125	05	78.1	92.0	65.0	0.00	0	4	3.5	425
06	76.2	82.7	65.6	0.16	8	9	3.3	75	06	79.7	90.0	68.0	0.16	0	5	3.9	391
07	67.4	77.1	55.9	0.00	0	0	3.2	270	07	79.8	89.0	72.0	0.00	0	4	6.7	199
08	70.7	83.9	54.3	0.00	0	1	2.3	333	08	77.6	86.0	69.0	0.00	8	9	3.3	139
09	75.9	88.8	59.0	0.00	0	0	2.4	151	09	75.7	87.6	67.8	2.56	8	8	2.9	208
10	77.2	91.8	62.8	0.00	0	0	3.0	216	10	72.5	82.2	62.9	0.00	0	0	1.9	93
11	72.6	83.0	64.0	0.00	0	0	8.4	637	11	68.1	69.3	66.8	0.17	15	0	3.3	103
12	70.5	83.3	56.0	0.00	0	0	4.1	589	12	71.6	78.5	67.3	0.02	11	0	4.9	163
13	76.4	88.6	61.5	0.00	0	0	1.6	256	13	70.5	73.0	69.1	0.45	18	0	4.7	152
14	75.7	88.5	67.6	1.06	6	4	1.5	238	14	72.4	80.5	68.3	0.01	10	0	1.9	260
15	75.8	85.3	69.7	0.08	9	13	1.0	314	15	76.3	90.1	64.2	0.00	0	0	1.5	281
16	80.1	90.1	69.5	0.00	0	8	1.2	372	16	77.5	87.0	67.9	0.00	0	0	2.0	193
17	74.9	85.7	68.3	0.79	8	17	1.5	182	17	75.7	84.7	70.0	0.40	6	0	2.4	161
18	70.4	80.2	60.8	0.01	7	7	2.9	490	18	72.5	81.6	66.8	0.33	13	0	4.6	184
19	70.3	81.3	57.9	0.00	0	0	1.7	417	19	70.0	75.7	64.8	0.00	0	0	5.6	370
20	73.2	84.3	59.7	0.00	0	0	1.8	167	20	69.3	76.0	62.9	0.00	0	0	3.2	224
21	70.1	77.9	59.7	0.00	0	2	2.3	324	21	70.2	76.6	64.2	0.07	0	0	2.9	111
22	72.6	81.9	64.3	0.29	14	13	3.2	200	22	72.2	82.8	66.7	1.46	9	0	2.0	319
23	75.8	79.0	72.9	0.82	14	19	3.8	87	23	67.5	75.5	60.3	0.00	1	0	2.9	147
24	78.8	85.3	74.1	0.00	4	7	1.1	260	24	69.4	83.4	55.7	0.00	0	0	2.2	178
25	74.7	78.0	70.2	0.91	10	15	1.7	94	25	69.4	77.5	60.6	0.00	0	0	2.8	64
26	75.8	84.0	69.6	0.01	3	13	3.4	395	26	71.4	81.1	61.9	0.00	0	0	3.3	157
27	76.3	86.0	67.0	0.17	6	3	6.0	504	27	75.4	84.0	67.7	0.00	0	0	2.0	274
28	73.6	83.0	68.0	0.19	11	10	3.5	448	28	81.2	92.8	71.1	0.00	0	8	1.6	160
29	71.3	82.0	61.0	0.00	0	7	4.5	556	29	81.4	92.6	72.0	0.00	0	8	1.6	314
30	70.9	81.0	58.0	0.00	0	3	3.0	447	30	77.0	85.1	67.9	0.00	0	6	3.0	149
31	72.0	81.0	61.0	0.00	0	4	4.3	441	31	65.5	70.1	61.6	0.01	2	6	2.9	150
	75.1	94.1	65.1	4.49	100	176	2.8	9761		81.4	69.3	66.6	7.79	147	96	107.8	6671