RESULTS OF
2019
INSECTICIDE AND ACARICIDE
STUDIES IN EASTERN NEW YORK

Pub. # HV2019

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Formulation of Insecticides	Materials Tested	Company
	Apple	
Actara 25WDG	…….	Syngenta LLC
Altacor WG35	……	FMC Agricultural Solutions
Admire Pro	……	Bayer CropScience
Agri-Mek 0.15EC	…….	Syngenta LLC
Assail 30WG	……	United Phosphorus Inc.
Avaunt eVo	……	FMC Agricultural Solutions
Beleaf 50SG	……	FMC Agricultural Solutions
Bifenture EC	……	UPI
Brigade 2EC	……	FMC Agricultural Solutions
Captan 4L	……	Loveland Products, Inc.
Compound A	……	NA
Compound B	……	NA
Compound X	……	NA
Delegate 25 WG	……	Corteva Agriscience™
Exirel	……	FMC Agricultural Solutions
Imidan 70W	……	Gowan Co. USA
Leprotech	……	Vestaron
Lorsban 4EC	……	Corteva Agriscience™
Movento 240SC	……	Bayer CropScience
Mustang Maxx	……	FMC Agricultural Solutions
Sivanto Prime	……	Bayer CropScience
Sivanto HL	……	Bayer CropScience
Spear-Lep	……	Vestaron
Venerate XC	……	Marrone Bio Innovation
Voliam Flexi	……	Syngenta LLC

Factors Contributing to the 2019

Hudson Valley Insect Pest Management Anomalies

Rainfall accumulations & temperature events: The start of the 2019 season began relatively cool and dry in March remaining below the average rainfall through April with rainfall accumulations of 2.01" in March (3.6" Ave.), 2.01" in April (3.8" Ave.), and above average of 5.52" in May (4.4" Ave.). June saw a below average rain events totaling 3.00" (4.4" Ave.), with enough rain to produce moderate levels of apple scab and fire blight infection, especially in newly planted blocks. July had relatively consistent weekly levels of rain with 8 days above 90^{o}F requiring weekly irrigation and sunburn protection in UV sensitive fruiting varieties. August also experienced below average rainfall with accumulations of 3.30" (4.2" Ave.). Total rainfall for the March 1st through September 1st growing season totaled 19.21", significantly lower than 2019 of 26.74" of rain, and well below the seasonal average of 25.1". Rain events over the region were relatively lackluster in lower Ulster and Dutchess County, with no visible impact on fruit or tree architecture support systems.

Tree phenology: Bud development was again hampered in 2019 by lingering cold temperatures. The season began 10-days later than average. However, by petal-fall, the season was one week later than the latest day of the 38-year phenology mean, 10 days earlier then the latest recorded date.

McIntosh green tip (10 April) occurred 10 days later than the 38-year historical mid-range (see McIntosh phenology), the earliest recorded day at the HVRL. King bloom on McIntosh began on the 28th of April. Day length and predominately cool temperatures prevailed, ranging between 34.0^{o}F and 72.2^{o}F, and setting the stage for a very long bloom period lasting 17 days, 7 days longer than the mean of 9.4 days with $\geq$ 80% **PF in McIntosh occurring on 15th May**.

Degree-day accumulations of 533.1_{43BE} and 257.2_{50BE} were mid-range relative to the 38-year average up to PF. A moderate temperature range of 39 ^{o}F to 84.7^{o}F followed 15-days after PF.

There was ample sunlight and temperature for pollinators yielding strong pollination with many varieties showing strong fruit set, requiring significant thinning for a marketable crop. Yet, very cold temperatures hampered a few varieties in November 2019 as retained leaves and high water tables present from 2019 during record rain events exacerbated the damage. Trees suffered from significant bud injury on the morning of Nov. 23rd prior to complete leaf drop and hardening off. Temperatures fell from 43^{o}F to 6^{o}F over a two-day period, speculated to have caused bud injury and reduced flower development of varieties in compromised locations.

Early water stress was a concern for tree fruit growers during the early season, but ample rain fall and ground moisture was available during most the season. By 20th May, 100% of McIntosh fruit had set with king fruit sized $\geq$ 5 mm, with 3% 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 12.0% in Ginger Gold on 28 May—4 June in untreated plots with lower damage levels noted in these plots in early July.

Plum Curculio (PC) damage levels were moderately high with first observation of ovipositional injury on 20th June (3.0% at 5 days post PF in Ginger Gold; 25% PC injury in Red Delicious) in early varieties and moderate later into the season (25% by the 28th May in Red Del. and 32% by 3rd June). The predictive model using 308DD_{50BE} calculated the completion of PC migration and need for residual insecticide until 9th June using the HVRL NEWA station.

This season PC management required two applications in most orchards beginning at 80% PF to control PC based on reapplications using a 14d interval. Significant rain events occurred at the end of PF—1st cover for most mid- to late varieties. Rains after PF through 27th-29th May (1.50" @ 14 days post PF), meant that reapplication was required on the 30th of May. A June application after significant rainfall (0.67" post 9-days post 1C) may have been needed in cooler sites to maintain residue through the 9th of June or 308DD PC migration completion model. Very light PC migration likely began during bloom when temperatures exceeded 70°F on consecutive days. However, overall high PC pressure was observed this season just prior to McIntosh with low damage levels to Ginger Gold at >5mm fruit set and moderate PC injury observations prior to *June Drop* exceeding 30% in Ginger Gold and Red Delicious. In early harvest assessments after 'June Drop', damage was assessed at < 50% in untreated Ginger Gold.

European apple sawfly (EAS) activity occurred in very low numbers again this season with early varieties showing a range from 0.5% to 1.1% injury in Ginger Gold and McIntosh cluster fruit evaluations with early harvest assessments at < 1.0%. This was the fifth 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 second week of June (8th June) based on the 1st adult capture on the 20th of May using a 260-360 DD_{50BE} model. Nymphs were observed on fruit on the 17th of June, 9 days after the predicted emergence date. In general SJS scale levels were moderate in infested trees. The infestation means ranged from 0.5% to 3.0% injury observed in HVRL research plots on 8th July representing 1st generation infestation levels. 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 obliquebanded leafroller (OBLR) 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, effective, and have excellent residual activity. Relatively low levels of infestation were observed in the pre-bloom and early season leafroller complex.

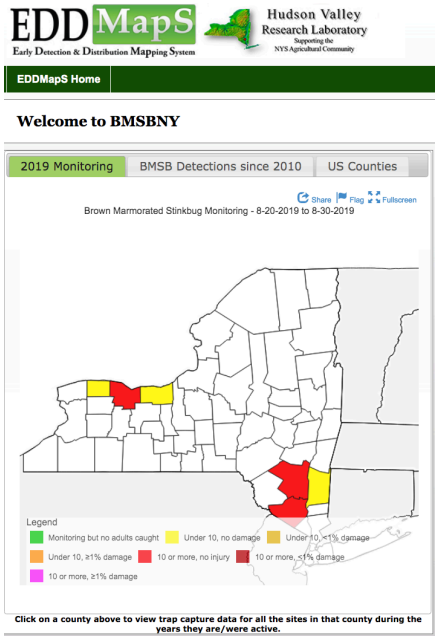
Codling Moth (CM) *1st* generation sustained adult flight occurred on 17th May with larval emergence predicted for 3rd June using 220 DD_{50BE} from CM biofix. The internal lepidopteran complex, lesser apple worm (LAW), oriental

fruit moth (OFM), and codling moth (CM), showed moderate levels of damage to apple, with frass produced by the internal lepidopteran complex appearing during mid-late June through early July. Damage from 1st generation evaluated in late June on untreated Ginger Gold and Red Delicious showed 15.9% and 22.7% injured fruit respectively. 1st generation internal worm composition of 60 untreated McIntosh fruit exhibiting either calyx end frass or larval site entry hole infested with 36 larvae. Upon dissection, 45 fruit (75%) had direct seed feeding and 30 live larvae without anal comb, with the remaining 17 fruit (15%) had feeding on the flesh and 6 live larvae with anal comb. The 2nd generation adult sustained catch for the CM biofix occurred on 12th of July with management for larval emergence prediction using 250 DD_{50BE} to occur on July 22nd.

Obliquebanded leafroller (OBLR) monitoring and management by tree fruit growers continues to be a high priority, albeit significantly lower levels of fruit injury is attributed to the leafroller complex in fruit pack-out assessments. By targeting up to three seasonal application windows while employing a single mode of action for each period, growers can achieve successful management of OBLR larvae. Recommended application windows 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 Delegate or Altacor in rotation for resistance management. Recommendations for applications were made using insect phenology predictions for early emergence, using 340 DD_{50BE} from biofix to manage emergence of larvae, predicted to occur on mid-June. In general, low levels of leafroller feeding were observed on developing foliage and fruitlets in spring 2019. Trap captures began on 3rd June and were moderate for 1st generation OBLR averaging 3.25 moths / day during the peak periods (27th June). The 340 DD_{43BE} emergence date of 1st summer OBLR generation was 22nd June. The 2nd generation flight began on the 22nd of July with larval emergence predicted for the 1st of August. OBLR trap numbers were very low during August at just above 0.5 adults per day.

We are seeing a trend of increasingly high levels of **red banded leafroller** (RBLR) with mixed populations of **tufted apple bud moth** (TABM) and ***sparganothis fruitworm*** (SFW) during the season, likely contributing to overall leafroller leaf and fruit damage .

Apple maggot (AM) emergence was earlier this season (24th June) compared with first emergence on 2nd July in 2018. The threshold of 5 flies per trap per block was observed on the 1st of July. Yet AM density was very low to moderate throughout the region with reduced emergence and subsequent trap captures through August. Highest populations occurred late in the season on 12th August under ideal emergence conditions for the adult fly. However, in our untreated orchard, we had a peak of only 20 flies per trap.

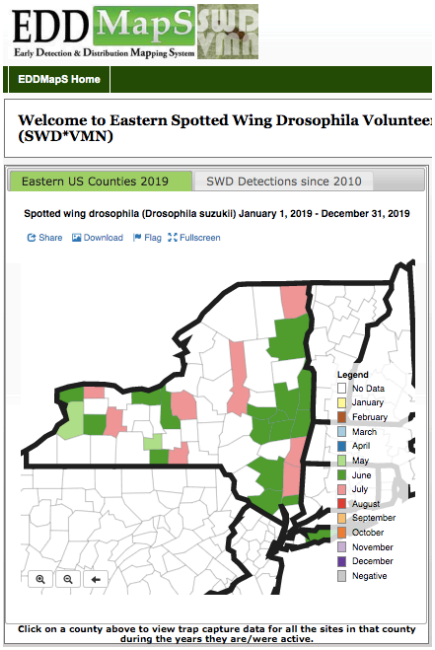


The **brown marmorated stink bug** (BMSB), *Halyomorpha halys,* has been observed throughout the southern Hudson Valley for the past 7 years with the first BMSB confirmation in December 2008. Since that time increasing populations have been documented in urban environments and present on many farms throughout 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. In 2019 we again found oviposition from mid-August through September.

Although there appears to be little stink bug feeding in apple this season, both BMSB and the **green stink bug**, *Acrosternum hilare* were 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.* Nymph and adult trap captures of BMSB using Tedders traps employing LED light traps, the USDA #10 lure, and the *Plaudi stali* aggregation pheromone lure, *methyl (E,E,Z)-2,4,6-decatrienoate,* were observed along orchard edges in Orange, Ulster, Dutchess, and Columbia Counties throughout the season. In 2019 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 late August of 2011. As in years past, EDDMaps was used to record trapping data. Erie County caught the first SWD on 22nd of May, which is the earliest recorded capture date in NYS. In 2019 SWD were monitored in four counties throughout the lower to mid-Hudson Valley using baited Trece Pherocon traps across small fruit, grape, and tree fruit. SWD trap captures were found in Columbia County on the 18th of June, 21st of June in Ulster County, on the 27th June in Suffolk County and at the HVRL on the week of the 5th of July. Populations were generally slow to build in commercial berry crops. 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.



Major Problems/Successes this Year: Codling moth fruit infestation continues to be a severe problem in orchards.
Contributing factors include rain events reducing insecticide efficacy, lax re-application spray schedules, delayed timing during the early emergence, reduced rates, or use of less effective insecticides.

Unusual entomological events: Fall Webworm, (Lepidoptera: Erebidae) *Hyphantria cunea* Drury, was observed for a second season in both research and commercial orchards beginning early August. Locust leaf miner, *Odontota dorsalis* (Thunberg), beetle was observed feeding on developing foliage in mid-spring. Apple leaf midge, *Dasineura mali*, a cecidomyiid fly larva feeding on early season foliage was present in low numbers in commercial blocks.

EVALUATION OF INSECTICIDES FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2019
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

Codling moth (CM): *Cydia pomonella* (Linnaeus)
European apple sawfly (EAS): *Hoplocampa testudinea* (Klug)
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 hilaris* (Say), *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, 24 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). Treatment applications were made dilute using a tractor mounted 3-point hitch Rears Pak-Tank and pecan handgun at 300 psi. averaging 0.56 – 0.7 gal. per tree. Insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A. Maintenance applications made using Slimline Tower Sprayer delivering 74 GPA at 100 psi. traveling at an average of 2.5 mph. Maintenance applications for disease management began with Cuprofix Ultra 40 Disperss at 3 lbs./A and LI700 at 0.25% on April 5th, Manzate Pro Stick at 3 lbs./A on April 13th, Inspire Super at 12.0 fl. oz./A, Manzate Pro Stick at 3 lbs./A on April 17th, 29th Manzate Pro Stick at 3 lbs./A, Luna Tranquility 16 fl.oz./A on 8th May, Manzate Pro Stick at 3 lbs./A, Inspire Super 12.0 fl. oz./A on 15th May, Flint at 3 oz./A on 17th May, Inspire Super at 12 fl./A on 27th June, Captan 80WG at 5 lbs./A, Rally 40WSP at 8 oz./A on 27th June.

Insecticide programs (Table 1) 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 60 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, feeding, and anal comb assessments to determine OFM / CM presence (83% 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 Tukey-Kramer HSD ($P \leq 0.05$) unless noted.

Table 1 Treatment Schedule for 2019 Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

Treatment/Formulation	RateTiming	Application Timing	Dates
1. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Sivanto Prime	14.0 oz./A	Pink	23 April
Movento*	9.0 oz./A	1C	3 June
2. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Sivanto HL*	7.0 oz./A	Pink	23 April
Movento*	9.0 oz./A	1C	3 June
3. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Movento*	9.0 oz./A	1C	3 June
4. Lorsban	4.0 pts./A	Pink	17 April
Actara	4.0 oz./A	PF	17 May
Imidan 70WP	3.0 lb./A	1C, 1st & 2nd SJS Emg.	
5. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Venerate XC**	4.0 qt./A	DD (1/4"G)	10 April,
6. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Venerate XC**	2.0 qt./A	1st gen SJS Emg. (1 app)	
Venerate XC**	2.0 qt./A	2nd gen SJS Emg. (1 app)	
7. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Venerate XC**	1.0 qt./A	1st gen SJS Emg. (1 app)	
Venerate XC**	1.0 qt./A	2nd gen SJS Emg. (1 app)	
8. UTC			
9. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Compound X	0.64 fl. oz./A	1st -2nd SJS Emg. (4 app)	
10. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Compound X	1.28 fl. oz./A	1st -2nd SJS Emg. (4 app)	
11. Actara	5.5 oz./A	PF, 1C	17 May, 3 June
Compound X	2.56 fl. oz./A	1st -2nd SJS Emg. (4 app)	
12. Actara	4.0 oz./A	PF, 1C	17 May, 3 June
Compound X	5.12 fl. oz./A	1st -2nd SJS Emg. (4 app)	

Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA.
* LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 2 Early Season Insect Damage from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence (%) of insect damaged cluster fruit							
Trmt. / Formulation		Rate	PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1.	Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	10.5	1.5	12.5	15.0	0.0	0.0	0.0 b	64.0
2.	Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	11.5	1.5	9.0	12.0	1.0	0.0	0.0 b	69.0
3.	Movento*	9.0 oz./A	6.5	1.5	10.0	13.5	0.5	0.0	0.0 b	66.0
4.	Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	11.5	0.0	12.0	11.0	0.0	0.0	0.0 b	68.5
5.	Venerate XC**	4.0 qt./A	12.0	1.5	10.0	10.5	0.5	0.0	0.0 b	67.0
6.	Venerate XC**	2.0 qt./A	10.0	2.0	9.5	5.5	0.5	0.0	0.0 b	73.0
7.	Venerate XC**	1.0 qt./A	9.5	0.0	17.5	9.0	1.0	0.0	0.0 b	67.5
8.	UTC		29.8	1.5	15.4	10.0	0.5	0.5	1.0 a	52.3
9.	Compound X **	0.64 fl. oz./A	11.0	2.0	9.0	12.0	0.5	0.0	0.0 b	70.0
10.	Compound X **	1.28 fl. oz./A	20.0	1.5	14.5	10.5	1.0	0.5	0.0 b	60.5
11.	Compound X **	2.56 fl. oz./A	10.5	3.0	19.0	10.5	0.5	0.5	0.0 b	60.0
12.	Compound X **	5.12 fl. oz./A	22.3	1.5	12.0	7.7	1.0	0.0	0.0 b	59.8
P value for transformed data			0.1445	0.8008	0.4479	0.8454	0.9764	0.6227	0.0062	0.6802

[a] Evaluation made on 'Ginger Gold' cultivar cluster fruit on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means (percentages) reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 3 Early Season Insect Damage from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence (%) of insect damaged cluster fruit							
Trmt. / Formulation		Rate	PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1.	Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	5.0 b	1.5 a	19.0	7.5	0.0	3.0	0.0	72.0 ab
2.	Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	2.0 b	0.0 a	22.0	9.3	0.0	0.0	0.0	68.0 ab
3.	Movento*	9.0 oz./A	7.5 ab	0.5 a	8.5	8.0	0.0	1.5	0.0	71.0 ab
4.	Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	3.5 b	1.5 a	16.0	4.5	0.0	0.0	0.0	75.0 a
5.	Venerate XC**	4.0 qt./A	4.0 ab	2.0 a	7.0	10.0	0.0	0.0	0.0	78.0 ab
6.	Venerate XC**	2.0 qt./A	11.3 ab	1.3 a	10.0	8.7	0.0	3.3	0.0	64.7 ab
7.	Venerate XC**	1.0 qt./A	7.0 b	2.5 a	17.5	7.0	0.0	0.5	0.0	70.0 ab
8.	UTC		32.0 a	3.3 a	22.7	6.7	0.5	0.0	0.0	45.3 b
9.	Compound X **	0.64 fl. oz./A	8.1 ab	0.5 a	12.4	5.2	0.0	1.1	0.0	74.3 a
10.	Compound X **	1.28 fl. oz./A	1.3 b	0.0 a	10.7	6.7	0.0	1.3	0.0	80.0 a
11.	Compound X **	2.56 fl. oz./A	11.3 ab	0.0 a	13.3	8.0	0.0	0.7	0.0	57.3 ab
12.	Compound X **	5.12 fl. oz./A	4.3 b	0.0 a	10.1	7.6	0.0	0.5	0.0	77.4 a
P value for transformed data			0.0089	0.0159	0.6292	0.9030	0.6453	0.9470	-.-	0.0171

[a] Evaluation made on 'Red Delicious' cultivar cluster fruit on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means (percentages) reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 4 Insect Injury to Foliage from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence of insect damage to foliage, per 10 terminals				
Trmt.	/ Formulation	Rate	PLH	WALH/RLH	Jap. Beetle	Early LR	Late LR
1.	Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	0.9 b	0.0	0.0	0.2	1.3
2.	Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	0.5 b	0.0	0.0	0.5	0.9
3.	Movento*	9.0 oz./A	0.9 b	0.0	0.3	0.2	0.8
4.	Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	0.4 b	0.0	0.0	0.2	0.8
5.	Venerate XC**	4.0 qt./A	1.2 b	0.0	0.1	0.4	0.9
6.	Venerate XC**	2.0 qt./A	1.2 b	0.0	0.1	0.4	1.0
7.	Venerate XC**	1.0 qt./A	0.9 b	0.0	0.1	0.3	1.0
8.	UTC		2.7 a	0.0	0.0	0.6	1.6
Y.	Compound X **	0.64 fl. oz./A	1.0 b	0.0	0.1	0.3	0.7
R.	Compound X **	1.28 fl. oz./A	0.4 b	0.0	0.2	0.4	0.9
B.	Compound X **	2.56 fl. oz./A	1.2 b	0.0	0.1	0.3	1.0
S.	Compound X **	5.12 fl. oz./A	1.7 ab	0.0	0.2	0.3	1.0
P value for transformed data			0.0001	-.-	0.6125	0.9716	0.2958

[a] Evaluation made on 'Red Delicious', 'McIntosh', and 'Ginger Gold' cultivar on 11-12th July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 5 Mite Incidence from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

		Incidence of mites per leaf								
Trmt. / Formulation	Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	3.7 cd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	1.3 d	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3. Movento*	9.0 oz./A	5.3 bcd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	12.5 abcd	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5. Venerate XC**	4.0 qt./A	56.5 a	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
6. Venerate XC**	2.0 qt./A	47.2 ab	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1
7. Venerate XC**	1.0 qt./A	20.8 abcd	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.6
8. UTC		13.4 abcd	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Y. Compound X **	0.64 fl. oz./A	68.6 a	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.1
R. Compound X **	1.28 fl. oz./A	24.5 abc	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0
B. Compound X **	2.56 fl. oz./A	22.4 abc	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0
S. Compound X **	5.12 fl. oz./A	46.4 abc	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1
P value for transformed data		0.0001	0.8381	0.6481	0.3509	0.1058	0.6778	0.5774	0.5567	0.3840

[a] Evaluation made on 'Red Delicious' cultivar on 10th June. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were transformed using log(mites/leaf) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 6 Mite Incidence from Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

		Incidence of mites per leaf								
Trmt. / Formulation	Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	4.5 a	0.2	0.6	0.0	0.0	0.1	0.1	0.5	2.3
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	2.4 a	0.3	0.4	0.0	0.1	0.2	0.1	1.2	2.9
3. Movento*	9.0 oz./A	5.0 a	1.0	0.9	0.0	0.0	0.2	0.1	1.8	6.5
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	11.7 a	1.0	1.5	0.0	0.1	0.3	0.2	2.0	7.6
5. Venerate XC**	4.0 qt./A	8.2 a	0.2	0.3	0.4	0.6	0.2	0.2	0.4	1.5
6. Venerate XC**	2.0 qt./A	11.8 a	0.4	0.3	0.1	0.2	0.1	0.1	0.7	2.5
7. Venerate XC**	1.0 qt./A	25.6 a	0.3	0.3	0.5	1.1	0.3	0.2	1.6	3.1
8. UTC		2.9 a	0.6	0.7	0.1	0.3	0.1	0.0	0.2	0.3
Y. Compound X **	0.64 fl. oz./A	10.4 a	0.1	0.2	0.5	0.7	0.2	0.0	0.4	2.2
R. Compound X **	1.28 fl. oz./A	13.9 a	0.1	0.1	0.4	0.6	0.1	0.0	0.2	1.4
B. Compound X **	2.56 fl. oz./A	8.0 a	0.1	0.1	0.5	0.7	0.3	0.1	0.2	0.6
S. Compound X **	5.12 fl. oz./A	13.1 a	0.2	0.3	0.1	0.4	0.2	0.1	0.3	1.1
P value for transformed data		0.0407	0.2918	0.2918	0.0625	0.1036	0.4910	0.5831	0.2468	0.2737

[a] Evaluation made on 'Red Delicious' cultivar on 17 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using log(mites/leaf) 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 7a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	21.8	0.8	35.8 ab	33.0	0.3	13.0 ab	0.0	13.5
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	16.4	1.8	36.6 ab	33.2	0.3	1.6 ab	0.0	26.6
3. Movento*	9.0 oz./A	12.3	0.0	31.7 ab	38.2	0.0	0.3 b	0.0	26.5
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	20.7	0.5	22.1 b	33.6	0.3	12.4 ab	0.0	25.6
5. Venerate XC**	4.0 qt./A	27.8	1.0	27.5 ab	33.4	0.3	24.4 a	0.0	15.0
6. Venerate XC**	2.0 qt./A	30.8	0.8	22.1 b	37.5	0.3	10.6 ab	0.0	20.0
7. Venerate XC**	1.0 qt./A	18.8	0.8	28.3 ab	34.5	0.3	15.3 ab	0.0	25.0
8. UTC		36.6	0.8	47.3 a	25.7	0.3	19.2 ab	0.0	6.1
9. Compound X **	0.64 fl. oz./A	35.0	0.5	31.4 ab	30.3	0.3	10.9 ab	0.0	14.1
10. Compound X **	1.28 fl. oz./A	22.1	0.5	27.8 ab	30.9	0.3	9.0 ab	0.0	20.9
11. Compound X **	2.56 fl. oz./A	28.4	0.5	25.8 ab	33.9	0.5	23.0 ab	0.0	15.5
12. Compound X **	5.12 fl. oz./A	20.7	0.8	19.0 b	30.9	0.5	8.1 ab	0.0	22.5
P value for transformed data		0.2030	0.5455	0.0040	0.8748	0.9878	0.0340	-.-	0.1165

[a] Evaluation made on 'Ginger Gold' cultivar on 31 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 7b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit CM	Lf. Roller	AMP	AMT	SB	Clean
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	18.8 a	10.5	18.5	10.5	0.5	13.5
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	20.4 a	9.5	6.0	3.4	0.0	26.6
3. Movento*	9.0 oz./A	20.1 a	6.1	4.0	2.3	0.3	26.5
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	13.6 a	7.9	11.4	5.0	0.3	25.6
5. Venerate XC**	4.0 qt./A	11.3 a	9.7	10.6	6.4	0.3	15.0
6. Venerate XC**	2.0 qt./A	13.0 a	12.5	6.3	2.8	0.5	20.0
7. Venerate XC**	1.0 qt./A	15.5 a	7.8	5.5	3.5	0.3	25.0
8. UTC		27.0 a	6.4	19.0	8.3	0.5	6.1
9. Compound X **	0.64 fl. oz./A	13.5 a	7.9	19.4	10.5	0.4	14.1
10. Compound X **	1.28 fl. oz./A	12.1 a	9.3	11.8	6.5	0.5	20.9
11. Compound X **	2.56 fl. oz./A	11.4 a	9.0	12.5	7.9	0.5	15.5
12. Compound X **	5.12 fl. oz./A	9.6 a	7.1	15.6	11.8	0.3	22.5
P value for transformed data		0.0640	0.9824	0.6287	0.8060	0.9877	0.1165

[a] Evaluation made on 'Ginger Gold' cultivar on 31 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 8a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	10.2 ab	1.4	47.8	40.5	0.6	17.5	11.5 a
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	10.7 ab	0.3	52.3	33.3	0.3	4.0	20.7 a
3. Movento*	9.0 oz./A	9.7 ab	2.3	55.5	34.9	0.0	6.4	17.1 a
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	5.3 ab	0.5	50.5	32.6	0.0	14.4	21.3 a
5. Venerate XC**	4.0 qt./A	8.2 ab	0.3	43.6	50.6	0.0	12.4	18.4 a
6. Venerate XC**	2.0 qt./A	14.0 ab	0.7	50.7	31.0	0.3	18.0	19.7 a
7. Venerate XC**	1.0 qt./A	7.0 ab	0.8	45.3	26.5	0.3	30.3	19.8 a
8. UTC		28.2 a	0.8	56.5	39.9	0.5	32.2	3.8 a
9. Compound X **	0.64 fl. oz./A	3.7 b	1.5	55.2	39.3	0.0	20.1	15.7 a
10. Compound X **	1.28 fl. oz./A	13.5 ab	0.0	57.7	37.1	0.0	8.3	12.5 a
11. Compound X **	2.56 fl. oz./A	8.5 ab	0.5	66.1	50.0	0.0	28.1	9.4 a
12. Compound X **	5.12 fl. oz./A	12.8 ab	1.0	51.2	38.4	0.7	12.5	15.2 a
P value for transformed data		0.0956	0.7007	0.5420	0.7456	0.4569	0.3534	0.0699

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means (percentages) reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 8b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit CM	Lf. Roller	AMP	AMT	SB	Clean
1. Sivanto Prime Movento* + LI700	14.0 oz./A 9.0 oz./A 32.0 oz./100	31.1	22.7	8.8	4.8	1.1	11.5 a
2. Sivanto HL* Movento*	7.0 oz./A 9.0 oz./A	37.3	24.3	3.7	2.0	1.3	20.7 a
3. Movento*	9.0 oz./A	32.3	24.1	5.7	2.3	0.3	17.1 a
4. Lorsban Imidan 70WP	4.0 pts./A 3.0 lb./A	29.5	19.1	3.1	1.0	1.0	21.3 a
5. Venerate XC**	4.0 qt./A	23.8	26.1	7.5	3.3	0.3	18.4 a
6. Venerate XC**	2.0 qt./A	28.3	21.0	4.7	1.7	0.3	19.7 a
7. Venerate XC**	1.0 qt./A	28.5	15.0	3.8	0.8	0.8	19.8 a
8. UTC		34.6	23.1	4.0	2.2	1.8	3.8 a
Y. Compound X **	0.64 fl. oz./A	37.8	22.2	4.8	1.3	1.4	15.7 a
R. Compound X **	1.28 fl. oz./A	37.2	27.6	6.5	4.4	1.5	12.5 a
B. Compound X **	2.56 fl. oz./A	48.9	31.8	1.5	0.5	1.0	9.4 a
S. Compound X **	5.12 fl. oz./A	30.0	26.8	4.9	2.8	0.3	15.2 a
P value for transformed data		0.2667	0.9317	0.3175	0.8496	0.5222	0.0699

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

EVALUATION OF INSECTICIDES FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2019
Apple: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

Codling moth (CM): *Cydia pomonella* (Linnaeus)
European apple sawfly (EAS): *Hoplocampa testudinea* (Klug)
Mullein plant bug (MPB): *Campylomma verbasci* (Meyer)
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 hilaris* (Say), *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, 24 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). Treatment applications were made dilute using a tractor mounted 3-point hitch Rears Pak-Tank and pecan handgun at 300 psi. averaging 0.56 – 0.7 gal. per tree. Insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A . Maintenance applications made using Slimline Tower Sprayer delivering 74 GPA at 100 psi. traveling at an average of 2.5 mph. Maintenance applications for disease management began with Cuprofix Ultra 40 Disperss at 3 lbs./A and LI700 at 0.25% on April 5th, Manzate Pro Stick at 3 lbs./A on April 13th, Inspire Super at 12.0 fl. oz./A, Manzate Pro Stick at 3 lbs./A on April 17th, 29th Manzate Pro Stick at 3 lbs./A, Luna Tranquility 16 fl.oz./A on 8th May, Manzate Pro Stick at 3 lbs./A, Inspire Super 12.0 fl. oz./A on 15th May, Flint at 3 oz./A on 17th May, Inspire Super at 12 fl./A on 27th June, Captan 80WG at 5 lbs./A, Rally 40WSP at 8 oz./A on 27th June.

Insecticide programs (Table 9) 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 60 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, feeding and anal comb assessments to determine OFM / CM presence (83% 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 9 Treatment Schedule for Seasonal Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

	Treatment/Formulation	Rate	Phenology / Timing	Application Dates
1.	Lorsban*	3 pt./A	DD	17 April
	Beleaf**	2.4 oz./A	P	23 April
	+ Mustang Maxx	3.0 fl.oz./A	P	23 April
	Avaunt***	6 oz./A	PF-1C	17 May
	+ Agri-Mek	3.25 oz./A	PF	17 May
	Mustang Maxx	3.0 fl.oz./A	1C	3 June
	Altacor 35 WG**	3.0 oz./A	2-3C	11, 24 June
	Admire Pro	2.8 fl.oz./A	2C	11 June
	Delegate	6.0 oz./A	4-5C	3, 23 July
	Exirel	16.0 fl.oz./A	6C	1 Aug.
	+ Captan 4L	72 fl.oz./A	6C	1 Aug.
	Brigade 2EC **	6.4 fl.oz./A	7-8C	11, 20 Aug.
2.	Lorsban*	3 pt./A	DD	17 April
	Mustang Maxx**	4.0 fl.oz./A	P	23 April
	Avaunt ***	6 oz./A	PF	17 May
	+ Agri-Mek	3.25 oz./A	PF	17 May
	Assail***	5.0 oz./A	1C	3 June
	Altacor 35 WG**	3.0 oz./A	2-3C	11, 24 June
	Admire Pro	2.8 fl.oz./A	2C	11 June
	Delegate	6.0 oz./A	4-6C	3, 23 July, 1 Aug.
	+ Captan 4L	72 fl.oz./A	6C	1 Aug.
	Brigade 2EC **	6.4 fl.oz./A	7-8C	11, 20 Aug.
3.	Beleaf**	2.4 oz./A	P	23 April
	+ Mustang Maxx	3.0 fl.oz./A	P	23 April
	Imidan***	3.5 lb./A	PF	17 May
	+ Agri-Mek	3.25 oz	PF	17 May
	Avaunt***	6 oz./A	1C	3 June
	Altacor 35 WG**	3.0 oz./A	2-3C	11, 24 June
	Admire Pro	2.8 fl.oz./A	2C	11 June
	Delegate	6.0 oz./A	4-5C	3, 23 July
	Exirel	16.0 fl.oz./A	6C	1 Aug.
	+ Captan 4L	72 fl.oz./A	6C	1 Aug.
	Brigade 2EC **	6.4 fl.oz./A	7-8C	11, 20 Aug.
4.	Mustang Maxx**	4.0 fl.oz./A	P	23 April
	Assail***	6.4 oz./A	PF	17 May
	+ Agri-Mek	3.25 oz./A	PF	17 May
	Assail***	5.0 oz./A	1C	3 June
	Voliam Flexi	4.0 fl.oz./A	2-3C	11, 24 June
	Delegate	6.0 oz./A	4-6C	3, 23 July, 1 Aug.
	+ Captan 4L	72 fl.oz./A	6C	1 Aug.
	Bifenture EC	6.5 fl.oz./A	7-8C	
5.	Imidan***	3.5 lb./A	PF	17 May
	+ Agri-Mek	3.25 oz./A	PF	17 May
	Altacor 35 WG**	4.0 oz./A	1-3C	3, 11, 24 June
	Delegate	6.0 oz./A	4-6C	3, 23 July, 1 Aug.
	Mustang Maxx**	4.0 fl.oz./A	7-8C	11, 20 Aug.
	UTC	-	-	-

* Tactic @ 12.5 fl.oz./A; ** LI-700 @ 0.125%; *** LI-700 @ 0.25%

Table 10 Evaluation of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit							
		PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1. Lorsban*	3 pt./A	4.0 b	1.0	0.0 b	5.0	0.0	0.0	0.0 b	91.0 a
Beleaf**	2.4 oz./A								
+ Mustang Maxx	3.0 fl.oz./A								
Avaunt***	6 oz./A								
+ Agri-Mek	3.25 oz./A								
2. Lorsban*	3 pt./A	6.0 b	1.0	0.0 b	2.5	0.0	0.5	0.0 b	90.5 a
Mustang Maxx**	4.0 fl.oz./A								
Avaunt ***	6 oz./A								
+ Agri-Mek	3.25 oz./A								
3. Beleaf**	2.4 oz./A	6.7 b	0.5	0.5 b	5.8	0.5	0.5	0.0 b	86.1 a
+ Mustang Maxx	3.0 fl.oz./A								
Imidan***	3.5 lb./A								
+ Agri-Mek	3.25 oz								
4. Mustang Maxx**	4.0 fl.oz./A	5.5 b	0.0	0.0 b	1.5	0.0	0.0	0.0 b	92.5 a
Assail***	6.4 oz./A								
+ Agri-Mek	3.25 oz./A								
5. Imidan***	3.5 lb./A	28.5 a	1.5	0.5 b	6.5	0.5	9.5	0.0 b	56.5 b
+ Agri-Mek	3.25 oz./A								
UTC		29.8 a	1.5	15.4 a	10.0	0.5	0.5	1.0 a	52.3 b
P value		0.0096	0.8569	0.0001	0.5794	0.7006	0.4063	0.0384	0.0014

[a] Evaluation made on 'Ginger Gold' cultivar cluster fruit on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using ANOVA (P ≤0.05). Means separation by Student's t-test (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 11 Evaluation of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit							
		PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1. Lorsban*	3 pt./A	2.0 b	1.0	0.0 b	1.0	0.0	0.5	0.0	94.5 a
Beleaf**	2.4 oz./A								
+ Mustang Maxx	3.0 fl.oz./A								
Avaunt***	6 oz./A								
+ Agri-Mek	3.25 oz./A								
2. Lorsban*	3 pt./A	12.0 ab	0.5	0.0 b	2.0	0.0	0.0	0.0	85.5 ab
Mustang Maxx**	4.0 fl.oz./A								
Avaunt ***	6 oz./A								
+ Agri-Mek	3.25 oz./A								
3. Beleaf**	2.4 oz./A	12.5 ab	0.5	0.5 b	1.5	0.0	5.0	0.0	81.0 abc
+ Mustang Maxx	3.0 fl.oz./A								
Imidan***	3.5 lb./A								
+ Agri-Mek	3.25 oz								
4. Mustang Maxx**	4.0 fl.oz./A	12.5 ab	0.5	0.0 b	4.0	0.0	2.5	0.0	81.5 abc
Assail***	6.4 oz./A								
+ Agri-Mek	3.25 oz./A								
5. Imidan***	3.5 lb./A	14.5 ab	1.5	0.5 b	2.0	0.0	32.5	0.0	52.5 bc
+ Agri-Mek	3.25 oz./A								
UTC		32.0 a	3.3	15.4 a	6.7	0.0	0.0	0.0	45.3 c
P value		0.0372	0.3703	0.0002	0.0786	-.-	0.0981	-.-	0.0034

[a] Evaluation made on 'Red Delicious' cultivar cluster fruit on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using ANOVA (P ≤0.05). Means separation by Student's t-test (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 12 Evaluations of Insecticides for Controlling Mite Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence of mite on foliage (mites/leaf)								
Trmt. / Formulation		Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1.	Lorsban*	3 pt./A	1.0 b	0.0 a	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Beleaf**	2.4 oz./A									
	+ Mustang Maxx	3.0 fl.oz./A									
	Avaunt***	6 oz./A									
	+ Agri-Mek	3.25 oz./A									
2.	Lorsban*	3 pt./A	0.5 b	0.0 a	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mustang Maxx**	4.0 fl.oz./A									
	Avaunt ***	6 oz./A									
	+ Agri-Mek	3.25 oz./A									
3.	Beleaf**	2.4 oz./A	0.6 b	0.0 a	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	+ Mustang Maxx	3.0 fl.oz./A									
	Imidan***	3.5 lb./A									
	+ Agri-Mek	3.25 oz									
4.	Mustang Maxx**	4.0 fl.oz./A	0.2 b	0.0 a	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Assail***	6.4 oz./A									
	+ Agri-Mek	3.25 oz./A									
5.	Imidan***	3.5 lb. ./A	1.4 b	0.0 a	0.0	0.0	0.0	0.1	0.0	0.0	0.0
	+ Agri-Mek	3.25 oz. ./A									
8.	UTC		13.4 ab	0.0 a	0.0	0.1	0.0	0.0	0.0	0.0	0.0
P value for transformed data			0.0037	0.0384	0.5793	0.2062	0.1637	0.4852	0.5740	0.1660	0.0935

[a] Evaluation made on 'Red Delicious' cultivar on 10th June. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using log(mites/leaf+1) 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

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

			Incidence of mite on foliage (mites/leaf)								
Trmt.	/ Formulation	Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1.	Lorsban*	3 pt./A	7.2	0.2	0.5	0.0 b	0.0 b	0.0	0.0	0.4	0.9
	Beleaf**	2.4 oz./A									
	+ Mustang Maxx	3.0 fl.oz./A									
	Avaunt***	6 oz./A									
	+ Agri-Mek	3.25 oz./A									
2.	Lorsban*	3 pt./A	1.3	0.0	0.0	0.0 b	0.0 b	0.0	0.0	0.1	0.4
	Mustang Maxx**	4.0 fl.oz./A									
	Avaunt ***	6 oz./A									
	+ Agri-Mek	3.25 oz./A									
3.	Beleaf**	2.4 oz./A	14.2	2.3	8.8	0.0 b	0.0 b	0.0	0.1	0.5	0.7
	+ Mustang Maxx	3.0 fl.oz./A									
	Imidan***	3.5 lb./A									
	+ Agri-Mek	3.25 oz									
4.	Mustang Maxx**	4.0 fl.oz./A	25.0	0.0	0.1	0.0 b	0.0 b	0.0	0.0	0.1	0.3
	Assail***	6.4 oz./A									
	+ Agri-Mek	3.25 oz./A									
5.	Imidan***	3.5 lb./A	2.4	0.0	0.2	0.0 b	0.0 b	0.1	0.1	0.0	0.3
	+ Agri-Mek	3.25 oz./A									
8.	UTC		2.9	0.6	0.7	0.1 a	0.3 a	0.1	0.0	0.2	0.3
P value for transformed data			0.1008	0.4226	0.4285	0.0004	0.0071	0.3511	0.4035	0.4062	0.6981

[a] Evaluation made on 'Red Delicious' cultivar on 16 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using log(mites/leaf+1) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 14a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
1. Lorsban*	3 pt./A	10.0 b	0.3	0.5 b	7.5 b	0.0 b	0.8	77.5 a
Beleaf**	2.4 oz./A							
+ Mustang Maxx	3.0 fl.oz./A							
Avaunt***	6 oz./A							
+ Agri-Mek	3.25 oz./A							
2. Lorsban*	3 pt./A	8.1 b	0.8	0.8 b	2.5 b	0.3 b	0.0	72.6 ab
Mustang Maxx**	4.0 fl.oz./A							
Avaunt ***	6 oz./A							
+ Agri-Mek	3.25 oz./A							
3. Beleaf**	2.4 oz./A	11.8 b	1.5	1.2 b	3.2 b	0.0 b	3.1	80.3 a
+ Mustang Maxx	3.0 fl.oz./A							
Imidan***	3.5 lb./A							
+ Agri-Mek	3.25 oz							
4. Mustang Maxx**	4.0 fl.oz./A	6.8 b	0.7	0.8 b	2.2 b	0.0 b	1.0	86.2 a
Assail***	6.4 oz./A							
+ Agri-Mek	3.25 oz./A							
5. Imidan***	3.5 lb./A	31.8 b	1.3	1.5 b	7.8 b	0.0 b	35.0	35.5 bc
+ Agri-Mek	3.25 oz./A							
UTC		61.7 a	0.8	15.0 a	21.3 a	2.0 a	21.1	13.1 c
P value		0.0001	0.7483	0.0020	0.0007	0.0095	0.0690	0.0001

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

Table 14b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit					
		Lf.Roller	CM	AMP	AMT	SB	Clean
1. Lorsban*	3 pt./A	0.0	0.3 b	3.0 ab	0.5 b	0.0	77.5 a
Beleaf**	2.4 oz./A						
+ Mustang Maxx	3.0 fl.oz./A						
Avaunt***	6 oz./A						
+ Agri-Mek	3.25 oz./A						
2. Lorsban*	3 pt./A	0.0	0.3 b	0.3 ab	0.0 b	0.5	72.6 ab
Mustang Maxx**	4.0 fl.oz./A						
Avaunt ***	6 oz./A						
+ Agri-Mek	3.25 oz./A						
3. Beleaf**	2.4 oz./A	0.0	0.9 b	0.0 b	0.0 b	0.3	80.3 a
+ Mustang Maxx	3.0 fl.oz./A						
Imidan***	3.5 lb./A						
+ Agri-Mek	3.25 oz						
4. Mustang Maxx**	4.0 fl.oz./A	0.0	0.8 b	0.0 b	0.0 b	3.1	86.2 a
Assail***	6.4 oz./A						
+ Agri-Mek	3.25 oz./A						
5. Imidan***	3.5 lb. ./A	0.5	0.5 b	1.3 ab	1.3 b	0.0	35.5 bc
+ Agri-Mek	3.25 oz. ./A						
UTC		1.0	18.1 a	5.3 a	4.5 a	0.5	13.1 c
P value		0.2712	0.0007	0.0207	0.0009	0.4432	0.0001

[a] Evaluation made on 'Ginger Gold' on 31 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using 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. * Tatic @ 12.8 oz** LI-700 @ 0.25%. *** Nu-Film P @ 0.25%. **** LI-700 @ 0.12%

Table 15a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit						
		PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
1. Lorsban*	3 pt./A	5.5 b	0.5	0.5 b	1.5 b	0.0	0.8 b	91.0 a
Beleaf**	2.4 oz./A							
+ Mustang Maxx	3.0 fl.oz./A							
Avaunt***	6 oz./A							
+ Agri-Mek	3.25 oz./A							
2. Lorsban*	3 pt./A	13.5 b	0.3	0.3 b	0.8 b	0.0	0.8 b	85.0 ab
Mustang Maxx**	4.0 fl.oz./A							
Avaunt ***	6 oz./A							
+ Agri-Mek	3.25 oz./A							
3. Beleaf**	2.4 oz./A	12.3 b	0.3	0.0 b	0.8 b	0.0	38.5 ab	52.8 b
+ Mustang Maxx	3.0 fl.oz./A							
Imidan***	3.5 lb./A							
+ Agri-Mek	3.25 oz							
4. Mustang Maxx**	4.0 fl.oz./A	12.0 b	0.5	0.0 b	1.5 b	0.0	32.8 b	57.8 b
Assail***	6.4 oz./A							
+ Agri-Mek	3.25 oz./A							
5. Imidan***	3.5 lb./A	19.5 b	1.0	0.5 b	3.5 b	0.5	78.5 a	14.0 c
+ Agri-Mek	3.25 oz./A							
UTC		51.3 a	0.5	20.3 a	27.5 a	0.0	46.0 a	5.8 c
P value		0.0001	0.6756	0.0001	0.0001	0.4457	0.0003	0.0001

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 15b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit					
		Lf.Roller	CM	AMP	AMT	SB	Clean
1. Lorsban*	3 pt./A	0.0 b	0.5 b	0.3 b	0.3	0.0	91.0 a
Beleaf**	2.4 oz./A						
+ Mustang Maxx	3.0 fl.oz./A						
Avaunt***	6 oz./A						
+ Agri-Mek	3.25 oz./A						
2. Lorsban*	3 pt./A	0.0 b	0.3 b	0.5 b	0.0	0.8	85.0 ab
Mustang Maxx**	4.0 fl.oz./A						
Avaunt ***	6 oz./A						
+ Agri-Mek	3.25 oz./A						
3. Beleaf**	2.4 oz./A	0.0 b	0.0 b	0.3 b	0.0	0.5	52.8 b
+ Mustang Maxx	3.0 fl.oz./A						
Imidan***	3.5 lb./A						
+ Agri-Mek	3.25 oz						
4. Mustang Maxx**	4.0 fl.oz./A	0.0 b	0.0 b	0.0 b	0.0	0.0	57.8 b
Assail***	6.4 oz./A						
+ Agri-Mek	3.25 oz./A						
5. Imidan***	3.5 lb./A	0.0 b	0.0 b	0.5 b	0.0	1.5	14.0 c
+ Agri-Mek	3.25 oz./A						
UTC		10.8 a	12.0 a	4.0 a	1.8	2.3	5.8 c
P value		0.0003	0.0002	0.0153	0.0597	0.2804	0.0001

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using 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. * Tactic @ 12.8 oz** LI-700 @ 0.25%. *** Nu-Film P @ 0.25%. **** LI-700 @ 0.12%

EVALUATION OF INSECTICIDES FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2019
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 hilaris* (Say), *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, 24 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). Treatment applications were made dilute using a tractor mounted 3-point hitch Rears Pak-Tank and pecan handgun at 300 psi. averaging 0.56 – 0.7 gal. per tree. Insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A. Maintenance applications made using Slimline Tower Sprayer delivering 74 GPA at 100 psi. traveling at an average of 2.5 mph. Maintenance applications for disease management began with Cuprofix Ultra 40 Disperss at 3 lbs./A and LI700 at 0.25% on April 5th, Manzate Pro Stick at 3 lbs./A on April 13th, Inspire Super at 12.0 fl. oz./A, Manzate Pro Stick at 3 lbs./A on April 17th, 29th Manzate Pro Stick at 3 lbs./A, Luna Tranquility 16 fl.oz./A on 8th May, Manzate Pro Stick at 3 lbs./A, Inspire Super 12.0 fl. oz./A on 15th May, Flint at 3 oz./A on 17th May, Inspire Super at 12 fl./A on 27th June, Captan 80WG at 5 lbs./A, Rally 40WSP at 8 oz./A on 27th June.

Insecticide programs (Table 16) 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 60 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, feeding and anal comb assessments to determine OFM / CM presence (83% 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. 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 16 Treatment Schedule for Seasonal Apple Insecticide Screen
Hudson Valley Research Laboratory, Highland, NY - 2019

Treatment/Formulation	Rate	Phenology / Timing	Application Dates
1. Compound A*	6.16 fl.oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
LI700	0.25%	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
2. Compound A *	8.21 fl.oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
LI700	0.25%	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
3. Compound B*	3.08 fl.oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
LI700	0.25%	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
4. Compound B*	4.11 fl.oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
LI700	0.25%	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
5. Altacor 35 WG*	4.0 oz./A	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
LI700	0.25%	PF, 1-8C	17 May, 3, 11, 24 June, 3, 23 July, 11, 20 Aug
Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
6. Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
Spear-Lep*	32 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
Leprotec*	16.0 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
Exirel	20.5 fl.oz./A	2nd gen. CM	23 July 11, 20 Aug
7. Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
Spear-Lep*	32.0 fl.oz./A	1st gen CM	3, 11, 24 June, 3 July
Leprotec*	16.0 fl.oz./A	2nd gen CM	23 July 11, 20 Aug
8. Actara*	4.0 oz./A	PF, 1C	17 May, 3 June
LI700	0.25%	PF	17 May
Exirel	20.5 fl.oz./A	1st & 2nd gen CM	11, 24 June, 3, 23 July, 11, 20 Aug
UTC			

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

Table 17 Evaluation of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit							
		PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1. Compound A*	6.16 fl.oz./A	7.0 c	1.5	0.5 d	4.0	0.5	0.5	0.0 b	86.5 a
Actara	4.0 oz./A								
2. Compound A *	8.21 fl.oz./A	10.0 c	2.5	1.0 d	5.0	0.0	1.5	0.0 b	81.0 ab
Actara	4.0 oz./A								
3. Compound B*	3.08 fl.oz./A	13.1 bc	2.5	0.0 d	0.5	0.0	0.0	0.0 b	83.9 a
Actara	4.0 oz./A								
4. Compound B*	4.11 fl.oz./A	7.5 c	1.5	1.0 d	2.0	0.0	0.0	0.0 b	88.0 a
Actara	4.0 oz./A								
5. Altacor 35 WG*	4.0 oz./A	8.5 c	1.0	0.5 d	2.5	0.0	3.0	0.0 b	85.0 a
Actara	4.0 oz./A								
6. Actara*	4.0 oz./A	24.5 ab	1.0	7.0 bc	10.5	0.0	0.5	0.0 b	61.5 cd
Spear-Lep	32 fl.oz./A								
Leprotec	16.0 fl.oz./A								
Exirel	20.5 fl.oz./A								
7. Actara*	4.0 oz./A	15.0 bc	1.0	12.5 ab	8.5	0.0	1.5	0.0 b	65.0 bcd
Spear-Lep	32.0 fl.oz./A								
Leprotec	16.0 fl.oz./A								
8. Actara*	4.0 oz./A	19.0 abc	1.0	3.0 cd	3.5	0.5	4.5	0.0 b	70.5 abc
Exirel	20.5 fl.oz./A								
UTC		29.8 a	1.5	15.4 a	10.0	0.5	0.5	1.0 a	52.3 d
P value for transformed data		0.0132	0.9300	0.0001	0.1781	0.6480	0.1531	0.0153	0.0013

[a] Evaluation made on 'Ginger Gold' cultivar cluster fruit on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were analyzed using ANOVA (P ≤0.05). Means separation by Student's t-test (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%.

Table 18 Evaluation of Insecticides for Controlling Early Season Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged cluster fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	MPB	Clean
1. Compound A*	6.16 fl.oz./A	6.0 bc	4.5	0.5 b	4.5	1.0	6.0	0.0	77.5
Actara	4.0 oz./A								
2. Compound A *	8.21 fl.oz./A	13.0 b	2.5	0.5 b	0.5	0.0	9.5	0.0	75.0
Actara	4.0 oz./A								
3. Compound B*	3.08 fl.oz./A	10.0 bc	3.5	0.0 b	2.0	0.0	16.0	0.0	72.5
Actara	4.0 oz./A								
4. Compound B*	4.11 fl.oz./A	1.0 c	3.5	1.0 b	2.0	0.0	23.5	0.0	70.5
Actara	4.0 oz./A								
5. Altacor 35 WG*	4.0 oz./A	5.5 bc	3.5	0.0 b	2.5	0.5	9.5	0.0	79.0
Actara	4.0 oz./A								
6. Actara*	4.0 oz./A	8.5 bc	1.0	4.5 b	4.5	0.0	8.0	0.0	76.0
Spear-Lep	32 fl.oz./A								
Leprotec	16.0 fl.oz./A								
Exirel	20.5 fl.oz./A								
7. Actara*	4.0 oz./A	6.5 bc	2.5	4.5 b	2.5	0.0	9.5	0.0	75.5
Spear-Lep	32.0 fl.oz./A								
Leprotec	16.0 fl.oz./A								
8. Actara*	4.0 oz./A	7.0 bc	4.0	1.5 b	2.5	0.5	20.5	0.0	67.5
Exirel	20.5 fl.oz./A								
UTC		32.0 a	3.3	22.7 a	6.7	0.0	0.0	0.0	45.3
P value for transformed data		0.0003	0.9455	0.0001	0.7072	0.6455	0.4129	-.-	0.2921

[a] Evaluation made on 'Red Delicious' cultivar on 12 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were analyzed using ANOVA (P ≤0.05). Means separation by Student's t-test (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%.

Table 19 Evaluation of Insecticides for Controlling Mite Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence of Mites or Mite Eggs per Leaf								
Trmt. / Formulation		Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1.	Compound A*	6.16 fl.oz./A	1.0 bc	0.0	0.0	0.0 b	0.0	0.0	0.0	0.0	0.0
	Actara	4.0 oz./A									
2.	Compound A *	8.21 fl.oz./A	0.2 c	0.0	0.0	0.0 ab	0.0	0.0	0.0	0.0	0.0
	Actara	4.0 oz./A									
3.	Compound B*	3.08 fl.oz./A	0.5 bc	0.0	0.0	0.0 b	0.0	0.0	0.0	0.0	0.0
	Actara	4.0 oz./A									
4.	Compound B*	4.11 fl.oz./A	0.2 c	0.0	0.0	0.0 b	0.0	0.0	0.0	0.0	0.0
	Actara	4.0 oz./A									
5.	Altacor 35 WG*	4.0 oz./A	5.4 abc	0.0	0.0	0.0 b	0.0	0.0	0.0	0.0	0.0
	Actara	4.0 oz./A									
6.	Actara*	4.0 oz./A									
	Spear-Lep	32 fl.oz./A	5.1 ab	0.1	0.1	0.0 b	0.0	0.1	0.0	0.0	0.0
	Leprotec	16.0 fl.oz./A									
	Exirel	20.5 fl.oz./A									
7.	Actara*	4.0 oz./A	4.3 abc	0.0	0.0	0.0 ab	0.0	0.1	0.1	0.0	0.1
	Spear-Lep	32.0 fl.oz./A									
	Leprotec	16.0 fl.oz./A									
8.	Actara*	4.0 oz./A	2.2 abc	0.0	0.0	0.0 b	0.0	0.0	0.0	0.0	0.0
	Exirel	20.5 fl.oz./A									
8.	UTC		13.4 a	0.0	0.0	0.1 a	0.0	0.0	0.0	0.0	0.0
P value			0.0001	0.4602	0.5850	0.0162	0.1000	0.3671	0.5858	0.4627	0.4669

[a] Evaluation made on 'Red Delicious' cultivar on 10th June. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. All insecticide dilutions based on 300 GPA. Data were transformed using log(mites/leaf+1) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 20 Evaluation of Insecticides for Controlling Mite Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

			Incidence of Mites or Mite Eggs per Leaf								
Trmt. / Formulation		Rate	ARM	TSSM	TSSME	Z.mali	ZME	AMB	AMBE	ERM	ERME
1.	Compound A*	6.16 fl.oz./A	0.3 c	0.1	0.1 b	0.0 ab	0.0 b	0.0	0.0	0.1	0.4 ab
	Actara	4.0 oz./A									
2.	Compound A *	8.21 fl.oz./A	1.4 c	0.0	0.1 b	0.0 ab	0.0 b	0.0	0.0	0.0	0.3 ab
	Actara	4.0 oz./A									
3.	Compound B*	3.08 fl.oz./A	0.5 c	0.0	0.1 b	0.0 b	0.0 b	0.0	0.0	0.1	0.1 b
	Actara	4.0 oz./A									
4.	Compound B*	4.11 fl.oz./A	0.8 c	0.1	0.1 b	0.0 b	0.0 b	0.0	0.0	0.0	0.1 b
	Actara	4.0 oz./A									
5.	Altacor 35 WG*	4.0 oz./A	15.8 ab	1.1	5.6 a	0.0 b	0.0 b	0.0	0.0	0.3	1.5 a
	Actara	4.0 oz./A									
6.	Actara*	4.0 oz./A									
	Spear-Lep	32 fl.oz./A	16.5 a	1.6	1.5 ab	0.0 ab	0.0 ab	0.1	0.0	0.0	0.1 b
	Leprotec	16.0 fl.oz./A									
	Exirel	20.5 fl.oz./A									
7.	Actara*	4.0 oz./A	29.0 a	0.1	0.3 ab	0.1 ab	0.1 ab	0.1	0.0	0.1	0.4 ab
	Spear-Lep	32.0 fl.oz./A									
	Leprotec	16.0 fl.oz./A									
8.	Actara*	4.0 oz./A	16.3 ab	0.6	1.1 ab	0.0 b	0.0 b	0.0	0.0	0.1	0.4 ab
	Exirel	20.5 fl.oz./A									
8.	UTC		2.9 bc	0.6	0.7 ab	0.1 a	0.3 a	0.1	0.0	0.2	0.3 ab
P value			0.0001	0.2325	0.0155	0.0192	0.0157	0.2601	0.5739	0.1098	0.0431

[a] Evaluation made on 'Red Delicious' cultivar on 16 July. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. 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. * LI-700 @ 0.25%. ** Nu-Film P @ 0.25%.

Table 21a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
1. Compound A*	6.16 fl.oz./A	16.3	3.0	1.5 cd	5.3 bc	0.3	22.3	52.0 ab
Actara	4.0 oz./A							
2. Compound A *	8.21 fl.oz./A	15.5	3.8	1.3 cd	2.3 bc	0.3	16.0	63.5 a
Actara	4.0 oz./A							
3. Compound B*	3.08 fl.oz./A	20.6	1.6	0.3 d	1.5 bc	0.5	15.7	65.6 a
Actara	4.0 oz./A							
4. Compound B*	4.11 fl.oz./A	11.8	1.3	0.8 d	1.3 c	0.0	21.3	63.8 a
Actara	4.0 oz./A							
5. Altacor 35 WG*	4.0 oz./A	24.3	0.8	1.3 cd	4.5 bc	0.0	47.5	39.3 ab
Actara	4.0 oz./A							
6. Actara*	4.0 oz./A	24.6	1.0	10.5 bc	14.0 ab	0.0	6.0	45.2 ab
Spear-Lep	32 fl.oz./A							
Leprotec	16.0 fl.oz./A							
Exirel	20.5 fl.oz./A							
7. Actara*	4.0 oz./A	22.0	2.8	12.8 b	11.0 abc	0.3	6.3	51.5 ab
Spear-Lep	32.0 fl.oz./A							
Leprotec	16.0 fl.oz./A							
8. Actara*	4.0 oz./A	18.9	2.3	2.8 bcd	2.3 bc	0.3	35.3	46.0 ab
Exirel	20.5 fl.oz./A							
UTC		36.6	0.8	47.3 a	25.7 a	0.3	19.2	6.1 b
P value for transformed data		0.2827	0.1960	0.0001	0.0001	0.9164	0.3697	0.0235

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

Table 21b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit					
		Lf. Roller	CM	AMP	AMT	SB	Clean
1. Compound A*	6.16 fl.oz./A	0.3 bc	0.3 d	4.5 ab	1.3 ab	0.3	52.0 ab
Actara	4.0 oz./A						
2. Compound A *	8.21 fl.oz./A	0.3 bc	1.3 cd	0.3 b	0.0 b	1.0	63.5 a
Actara	4.0 oz./A						
3. Compound B*	3.08 fl.oz./A	0.0 c	0.3 d	0.0 b	0.0 b	0.3	65.6 a
Actara	4.0 oz./A						
4. Compound B*	4.11 fl.oz./A	0.3 bc	0.3 d	1.0 b	0.5 b	0.5	63.8 a
Actara	4.0 oz./A						
5. Altacor 35 WG*	4.0 oz./A	0.0 c	0.5 d	0.8 b	0.3 b	0.0	39.3 ab
Actara	4.0 oz./A						
6. Actara*	4.0 oz./A	2.0 abc	7.8 bc	4.5 ab	4.0 ab	0.5	45.2 ab
Spear-Lep	32 fl.oz./A						
Leprotec	16.0 fl.oz./A						
Exirel	20.5 fl.oz./A						
7. Actara*	4.0 oz./A	3.0 ab	9.5 bc	3.3 ab	2.0 ab	0.0	51.5 ab
Spear-Lep	32.0 fl.oz./A						
Leprotec	16.0 fl.oz./A						
8. Actara*	4.0 oz./A	0.0 c	1.0 cd	0.3 b	0.3 b	0.8	46.0 ab
Exirel	20.5 fl.oz./A						
UTC		6.4 a	27.0 a	18.9 a	8.3 a	0.5	6.1 b
P value for transformed data		0.1746	0.0001	0.0038	0.0027	0.6205	0.0235

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

Table 22a Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit						
		PC	TPB	Int. LEP	Ext. LEP	EAS	SJS	Clean
1. Compound A*	6.16 fl.oz./A	10.5	1.3	0.0 c	1.3 cd	0.0	31.3 a	62.0 a
Actara	4.0 oz./A							
2. Compound A *	8.21 fl.oz./A	14.0	1.0	0.5 bc	0.5 d	0.0	28.8 a	61.0 a
Actara	4.0 oz./A							
3. Compound B*	3.08 fl.oz./A	11.3	0.8	0.3 bc	2.8 cd	0.3	33.5 a	54.8 ab
Actara	4.0 oz./A							
4. Compound B*	4.11 fl.oz./A	6.2	1.7	0.3 bc	1.3 cd	0.0	35.8 a	56.0 a
Actara	4.0 oz./A							
5. Altacor 35 WG*	4.0 oz./A	8.4	1.5	0.3 bc	1.3 cd	0.3	75.9 a	20.7 cd
Actara	4.0 oz./A							
6. Actara*	4.0 oz./A	10.0	0.5	3.0 bc	8.0 bc	0.0	37.5 a	49.5 ab
Spear-Lep	32 fl.oz./A							
Leprotec	16.0 fl.oz./A							
Exirel	20.5 fl.oz./A							
7. Actara*	4.0 oz./A	15.3	1.0	8.8 b	16.3 b	0.0	49.8 a	24.5 bc
Spear-Lep	32.0 fl.oz./A							
Leprotec	16.0 fl.oz./A							
8. Actara*	4.0 oz./A	10.3	0.5	0.0 c	1.0 cd	0.0	80.8 a	13.3 cd
Exirel	20.5 fl.oz./A							
UTC		28.2	0.8	56.5 a	39.9 a	0.5	32.2 a	3.8 d
P value for transformed data		0.0807	0.8383	0.0001	0.0001	0.6392	0.0222	0.0001

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%

Table 22b Evaluation of Insecticides for Controlling Insect Complex on Apple [a]
Hudson Valley Research Laboratory, Highland, NY - 2019

Trmt. / Formulation	Rate	Incidence (%) of insect damaged fruit					
		Lf. Roller	CM	AMP	AMT	SB	Clean
1. Compound A*	6.16 fl.oz./A	0.0 c	0.0 c	0.0 a	0.0 a	0.3	62.0 a
Actara	4.0 oz./A						
2. Compound A *	8.21 fl.oz./A	0.0 c	0.3 bc	0.0 a	0.0 a	1.0	61.0 a
Actara	4.0 oz./A						
3. Compound B*	3.08 fl.oz./A	0.0 c	0.0 c	0.3 a	0.0 a	1.0	54.8 ab
Actara	4.0 oz./A						
4. Compound B*	4.11 fl.oz./A	0.3 bc	0.0 c	0.3 a	0.0 a	0.5	56.0 a
Actara	4.0 oz./A						
5. Altacor 35 WG*	4.0 oz./A	0.2 bc	0.0 c	0.3 a	0.0 a	1.0	20.7 cd
Actara	4.0 oz./A						
6. Actara*	4.0 oz./A	1.3 bc	0.8 bc	3.0 a	1.5 a	0.5	49.5 ab
Spear-Lep	32 fl.oz./A						
Leprotec	16.0 fl.oz./A						
Exirel	20.5 fl.oz./A						
7. Actara*	4.0 oz./A	4.8 b	12.8 b	1.0 a	0.5 a	0.8	24.5 bc
Spear-Lep	32.0 fl.oz./A						
Leprotec	16.0 fl.oz./A						
8. Actara*	4.0 oz./A	0.0 c	0.0 c	0.0 a	0.0 a	0.0	13.3 cd
Exirel	20.5 fl.oz./A						
UTC		23.1 a	34.6 a	4.0 a	2.2 a	1.8	3.8 d
P value for transformed data		0.0001	0.0001	0.0240	0.0357	0.4605	0.0001

[a] Evaluation made on 'Red Delicious' cultivar on 5 Sept. Applications specifically timed for emergence of SJS nymph and apple maggot. All insecticide calculations (presented as amt/A) are based on a standard dilution of 300 gal/A trees. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Tukey-Kramer HSD (P ≤0.05); treatment means followed by the same letter are not significantly different. Arithmetic means reported. * LI-700 @ 0.25%

EVALUATION OF DRAPE NETTING WITH AND WITHOUT IPM FOR CONTROLLING INSECT COMPLEX ON APPLE
Hudson Valley Research Laboratory 2018
Apple: *Malus domestica*, cv. 'Crimson Crisp', 'Gold Rush', 'Liberty'

Codling moth (CM): *Cydia pomonella* (Linnaeus)
European apple sawfly (EAS): *Hoplocampa testudinea* (Klug)
Green fruitworm (GFW*): Lithophane antennata* (Walker)
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)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
Stink Bug: Green and Brown Marmorated Stink Bug (SB): *Chinavia hilaris* (Say), *Halyomorpha halys* Stål
Tarnished plant bug (TPB): *Lygus lineolaris* (P. de B.)

Trees on the G.11 rootstock, 13 yr.-old, maintained 10' ft., planted on research spacing of 3' x 11' or 1200 trees per acre. Calculations for applications based on 11' tree row spacing as found in conventional production utilizing highly dwarfing rootstock. Treatments applied in a split-block to northern or southern half of the orchard to eleven-tree varietal plots, replicated in six rows with 11-tree plots in a randomized complete block design (RCBD). Spray treatments were applied concentrate using a Slim Line tower sprayer using 100 psi, delivering 0.05 to 0.07 gal/tree traveling at 2.5-2.86 mph averaging 74 gal/A. Insecticide calculations (presented as amt/A) are based on a standard dilution of 100 gal/A. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Rows were treated with drape net on three dates: 26 April, 3 May, and 24 May.

Maintenance applications for insecticide and disease management were split between north and south. Disease management across the orchard began on April 4th using Cuprofix Ultra 40 Disperss 6.0 lbs/A, April 15th Vanguard 5 oz./A, April 17th Inspire Super 12.0 fl.oz./A, Manzate ProStick 6 lbs/A, April 29th Inspire Super 12.0 fl.oz./A, Manzate ProStick 6 lbs/A, 6th May Manzate ProStick 3 lbs/A and Luna Tranqulity 16 fl. oz./A, 15th May Flint 3.0 oz./A, 9th & 15th of May Manzate ProStick 3 lbs/A and Inspire Super 12 fl/A, 24th of May Agri-mycin 8.0 oz./A and Regulaid 1.5 pts./100 gal or LI700 24 fl/100 gal, 31st May Indar 2F 8 fl.oz./A, Aprovia 7 fl.oz./A, Captan Gold 80WG 5 lbs/A, 12th June Flint 3.0 oz./A, Biocover oil 1qt./100, 24th June and 7th July Aprovia 7 fl.oz./A and Biocover oil 1qt./100, 24th July Merivon 5.5 fl.oz./A and Biocover oil 1qt./100, August 7th Captan Gold 80WG 5 lbs/A

Insecticide programs (Table 23) applied to manage the insect complex were assessed at harvest with evaluations made on 'Crimson Crisp', 'Honey Crisp', and 'Gold Rush' cultivars on 6 October by randomly selecting 50 fruit from each tree and scoring for external and internal damage (Table 24). 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 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 relative to LAW or OFM. San Jose scale (SJS) injury to fruit was assessed by scoring fruit as injured with 'red haloed' markings. To stabilize variance, percent data were transformed using arcsine(Sqrt(x)) conducted prior to analysis. Mean separation by Student's t ($P \leq 0.05$) unless noted.

The use of 'Drape Net' appears to exclude late season insect complex, shown more clearly in the IPM/Organic schedule. Significant differences across the lepidopteran, apple maggot, and stink bug categories were most apparent. Late season reduction of insecticide use may be reduced given the potential for insect exclusion using this management strategy.

Table 23 Insecticide Treatment Schedule to Manage the Apple Insect Complex Using Season Long IPM and IPM / Organic Split Management [1]. Hudson Valley Research Laboratory, Highland, NY - 2019

Treatment/Formulation	RateTiming	Application Dates
No Insecticide Management (No Ins.)		
Season Long IPM		
Altacor	4.5 oz./A	31st May
Actara	5.5 oz./A	31st May
Altacor	4.5 oz./A	12th June
BioCover MLT	1 qt./100	12th June
Mustang Maxx	6.0 oz./A	24th June
Movento	9.0 fl. oz./A	7th July
BioCover MLT	1 qt./100	7th July
Avaunt	6.0 oz./A	7th July
Avaunt	6.0 oz./A	19th July
Warrior II	2.56 oz./A	24th July
Danitol 2.4EC	20.0 fl. oz./A	5th August
Movento	9.0 fl. oz./A	7th August
Biocover oil	1 qt. /100	7th August
Avaunt	6.0 oz./A	20th August

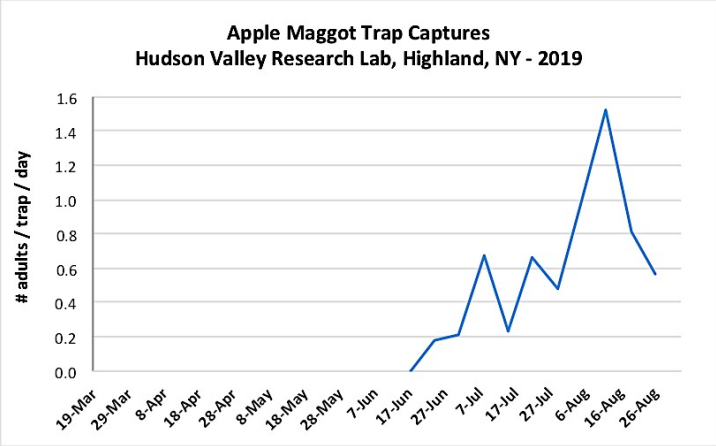
Treatments were applied concentrate using a Slim Line tower sprayer using 100 psi, delivering 0.05 to 0.07 gal/tree traveling at 2.5-2.86 mph averaging 74 gal/A. Insecticide calculations (presented as amt/A) are based on a standard dilution of 100 gal/A. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Drape net applied on 3 dates: at or near pink of Crimson Crisp variety on 26th April and after fruit set on 3rd & 24th May.

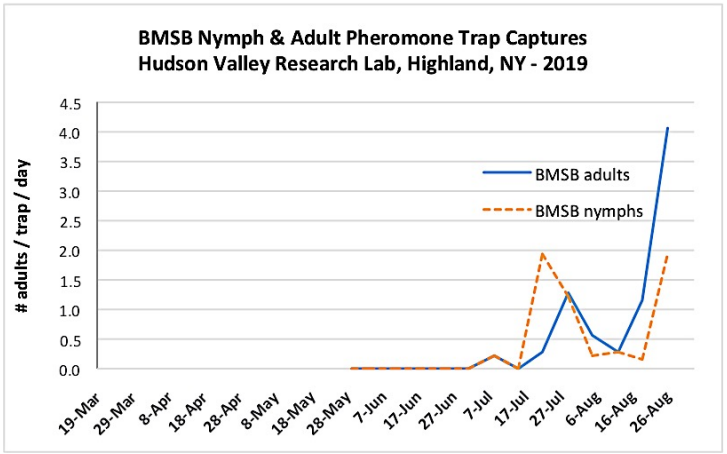
Table 24 Insecticide Treatment Schedule to Manage the Apple Insect Complex Using Season Long IPM and IPM / Organic Split Management. Hudson Valley Research Laboratory, Highland, NY - 2019

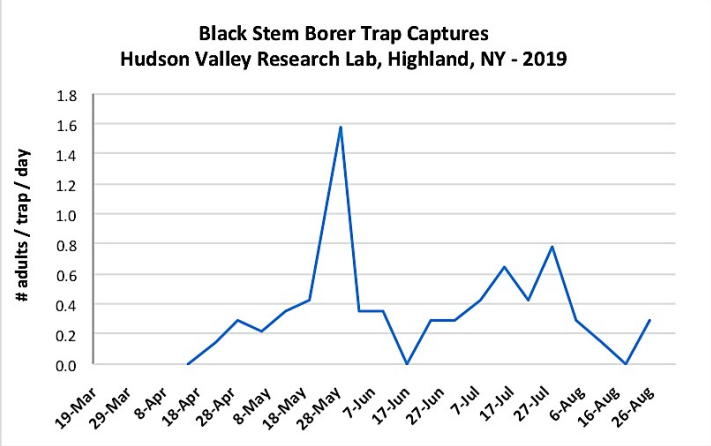
Net Type Treatment / Rate	Incidence (%) of insect damaged cluster fruit											
	PC	EAS	TPB	Lf.Rlr	Int. Lep	Ext.Lep	CM	AM.P	AM.T	SJS	SB	Clean
1. No Ins. + No Drape (UTC)	23.2ab	0.2	0.0	4.2a	24.5a	15.7a	15.1a	0.3	0.2	48.0b	0.2	19.9c
2. No Ins. + Drape 26 April	27.3a	0.0	0.0	4.5a	9.7b	8.5b	8.2b	0.5	0.2	73.5a	0.3	10.4cd
3. No Ins. + Drape 3 May	15.8abc	0.2	0.0	4.0ab	5.2bc	7.5 b	4.2c	1.2	0.2	77.8a	0.2	13.3cd
4. No Ins. + Drape 24 May	23.4ab	0.0	0.0	1.3bc	5.9bc	2.8c	4.7bc	0.5	0.2	82.8a	0.0	8.8d
5. IPM + No Drape	4.0c	0.5	0.3	0.2c	1.5cd	1.0c	1.2cd	0.2	0.0	1.5c	0.0	91.7a
6. IPM + Drape 26 April	3.2c	0.0	0.0	0.2c	0.2d	0.2c	0.0d	0.0	0.0	12.1c	0.0	81.1b
7. IPM + Drape 3 May	5.0c	0.7	0.7	0.3c	0.2d	0.3c	0.0d	0.0	0.0	2.3c	0.0	82.0ab
8. IPM + Drape 24 May	11.1bc	0.0	0.2	0.0c	0.0d	0.6c	0.0d	0.0	0.0	4.4c	0.0	84.0ab
P value	0.0009	0.2183	0.5183	0.0012	0.0001	0.0001	0.0001	0.0770	0.7945	0.0001	0.3030	0.0001

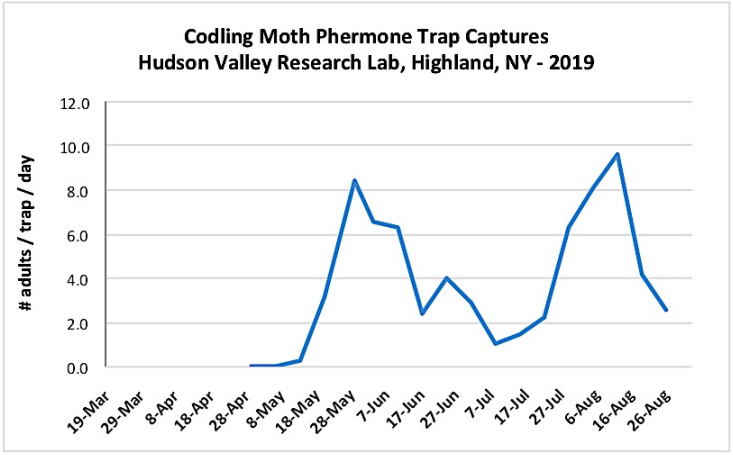
[a] Evaluation made on 'Crimson Crisp', 'Honey Crisp' & 'Gold Rush' cultivars harvested on 6th Oct. Data were transformed using arcsine(sqrt(x)) prior to ANOVA (P ≤0.05). Means separation by Student's t-test; treatment means followed by the same letter are not significantly different. Arithmetic means reported, each rounded to the nearest tenth for table presentation.

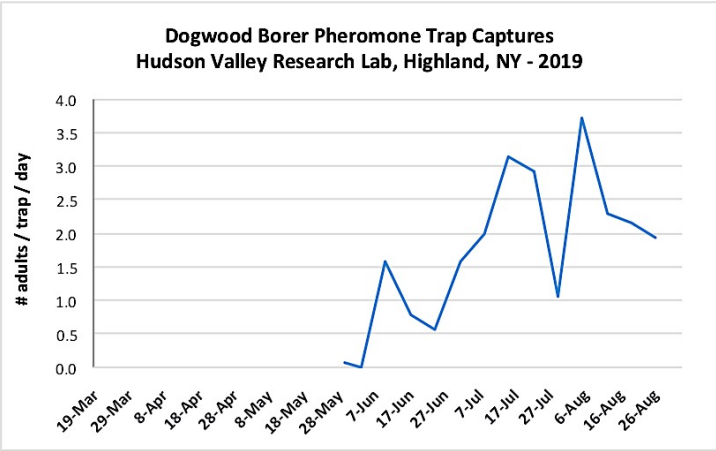
Codling moth (CM), *Cydia pomonella* (Linnaeus); European apple sawfly (EAS), *Hoplocampa testudinea* (Klug); Green fruitworm (GFW), *Lithophane antennata* (Walker); Mullein plant bug & apple red bug; (MPB), *Campylomma verbasci* (Meyer) & (ARB) *Lygidea mendax* (Reuter); Obliquebanded leafroller (OBLR), *Choristoneura rosaceana* (Harris); Oriental fruit moth (OFM), *Grapholitha molesta* (Busck); Plum curculio (PC), *Conotrachelus nenuphar* (Herbst); Redbanded leafroller (RBLR), *Argyrotaenia velutinana* (Walker); San Jose scale (SJS), *Quadraspidiotus perniciosus* (Comstock); Stink Bug: Green and Brown Marmorated Stink Bug (SB): *Chinavia hilaris* (Say), *Halyomorpha halys* (Stål); Tarnished plant bug (TPB), *Lygus lineolaris* (P. de B.); Apple Maggot (AM), *Rhagoletis pomonella* (Walsh) (AMP=puncture, AMT=tunnel)

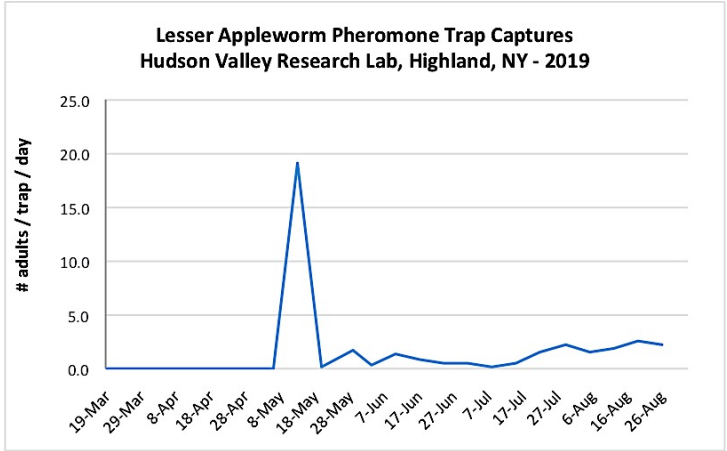

Apple Maggot Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

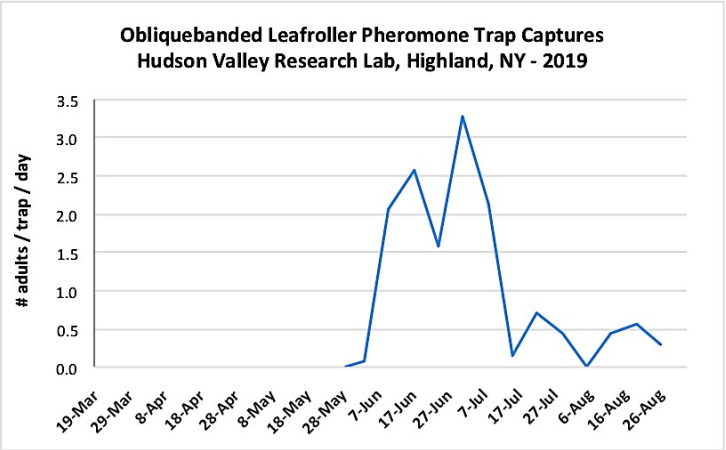

BMSB Nymph & Adult Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
BMSB adults
BMSB nymphs
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

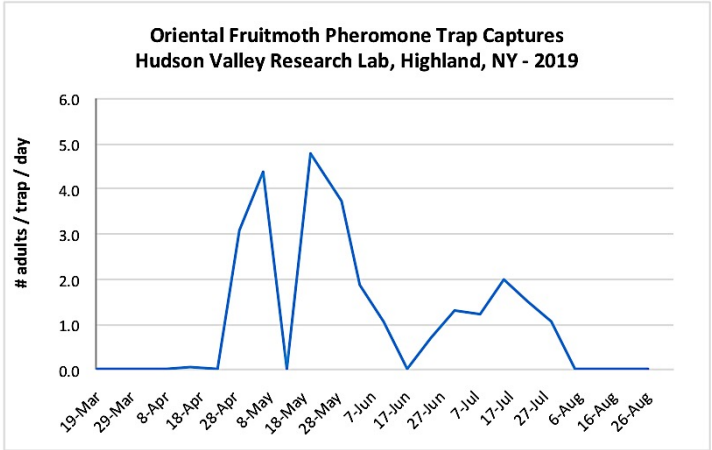

Black Stem Borer Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

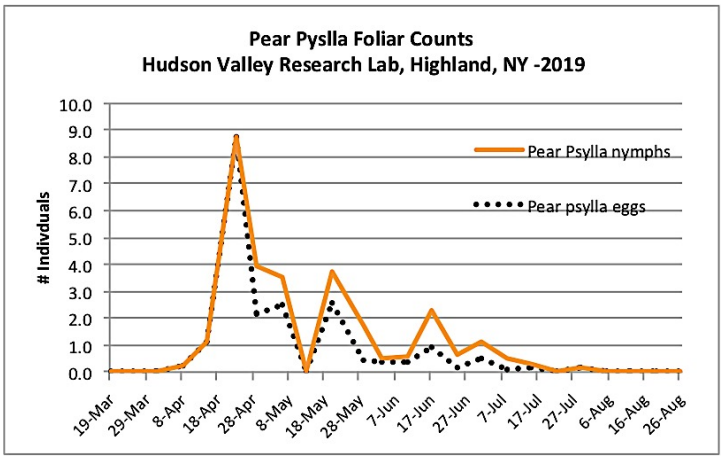

Codling Moth Phermone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
2.0
4.0
6.0
8.0
10.0
12.0
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

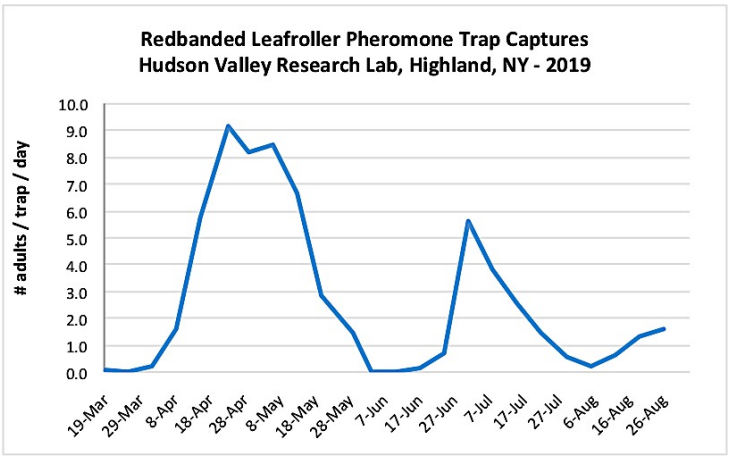

Dogwood Borer Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

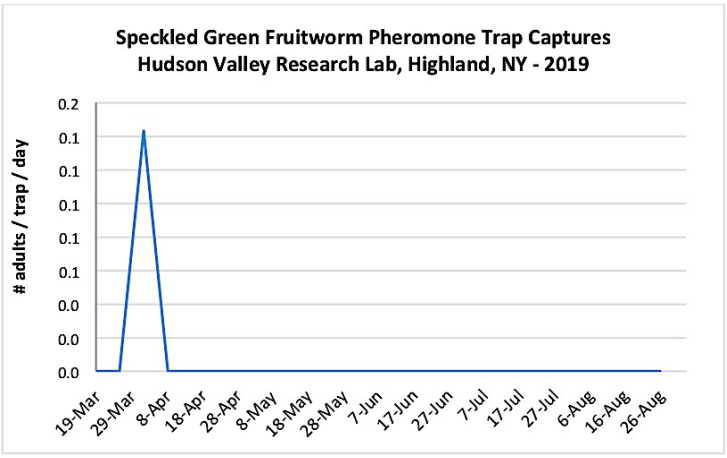

Lesser Appleworm Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
5.0
10.0
15.0
20.0
25.0
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

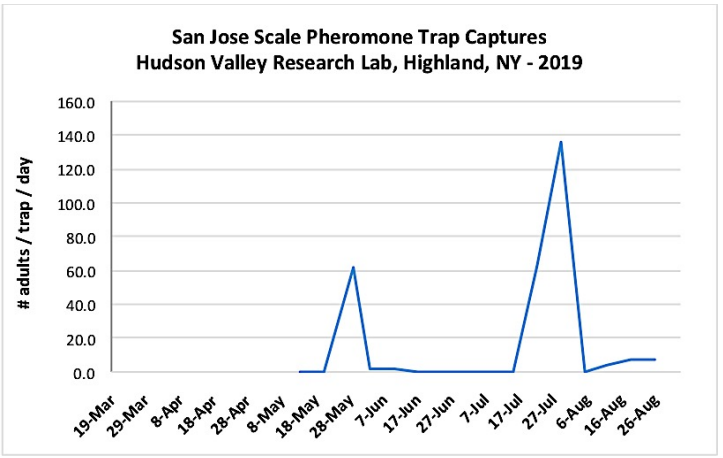

Obliquebanded Leafroller Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

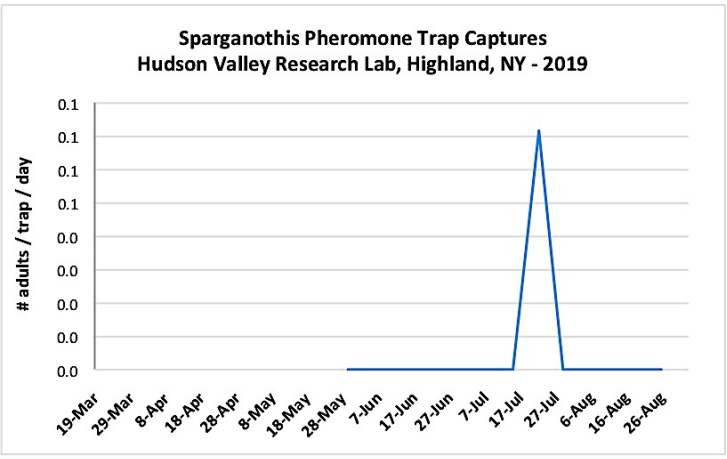

Oriental Fruitmoth Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
0.0
1.0
2.0
3.0
4.0
5.0
6.0
19-Mar
29-Mar
8-Apr
18-Apr
28-Apr
8-May
18-May
28-May
7-Jun
17-Jun
27-Jun
7-Jul
17-Jul
27-Jul
6-Aug
16-Aug
26-Aug

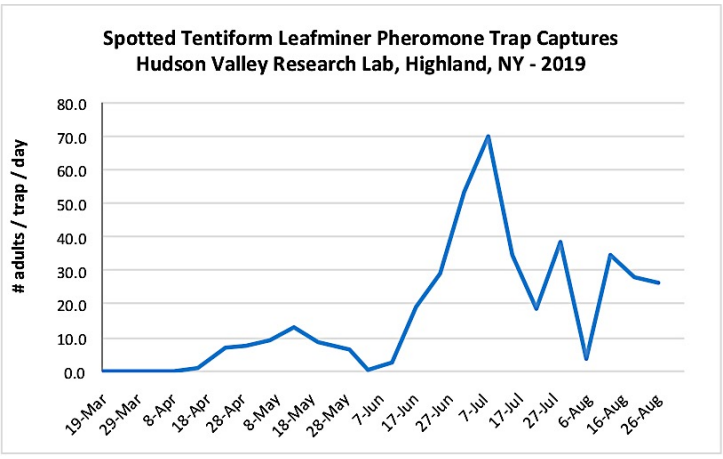

Pear Pysllа Foliar Counts
Hudson Valley Research Lab, Highland, NY -2019
Individuals
Pear Psylla nymphs
Pear psylla eggs
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug

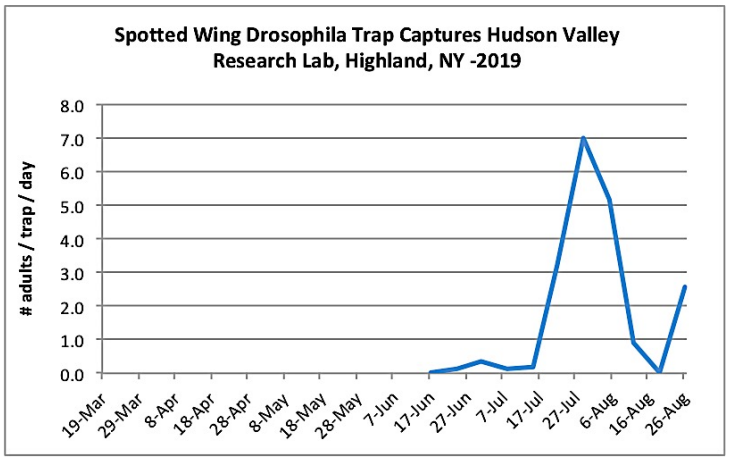

Redbanded Leafroller Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug

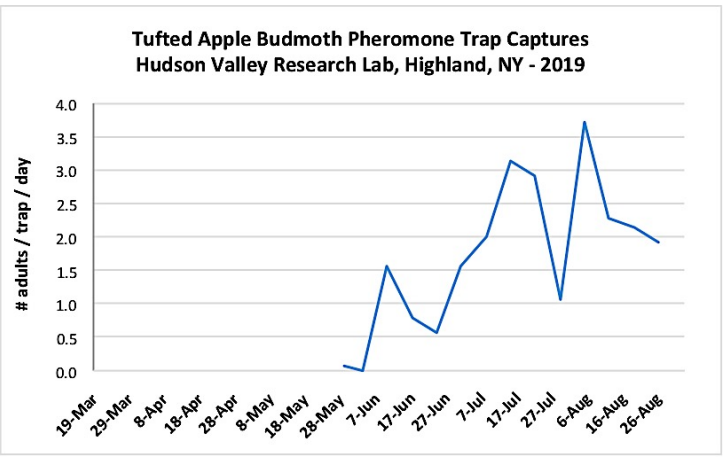

Speckled Green Fruitworm Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug


San Jose Scale Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug


Sparganothis Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug


Spotted Tentiform Leafminer Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug


Spotted Wing Drosophila Trap Captures Hudson Valley
Research Lab, Highland, NY -2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-Aug


Tufted Apple Budmoth Pheromone Trap Captures
Hudson Valley Research Lab, Highland, NY - 2019
adults / trap / day
19-Mar 29-Mar 8-Apr 18-Apr 28-Apr 8-May 18-May 28-May 7-Jun 17-Jun 27-Jun 7-Jul 17-Jul 27-Jul 6-Aug 16-Aug 26-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}	
2019	4/10	4/15	4/19	4/22	5/8	5/15	533.1	257.2	
2018	4/18	4/28	4/30	5/4	5/9	5/14	514.5	274.6	
2017	4/2	4/11	4/17	4/24	4/27	5/8	603.0	312.0	
2016	3/17	4/04	4/11	4/18	4/25	5/12	597.8	186.0	
2015	4/13	4/20	4/27	5/4	5/6	5/12	527.8	304.5	
2014	4/14	4/18	4/28	5/6	5/12	5/19	594.9	321.5	
2013	4/13	4/18	4/24	4/30	5/7	5/13	510.6	262.2	
2012	3/16	3/18	3/25	4/8	4/16	4/21	506.5	267.5	
2011	4/4	4/11	4/25	5/1	5/9	5/16	526.0	268.3	
2010	3/20	4/2	4/6	4/10	4/20	4/28	305.0	168.5	
2009	4/6	4/13	4/20	4/24	4/29	5/7	452.0	219.6	
2008	4/10	4/14	4/21	4/24	4/29	5/7	404.5	207.4	
2007	4/2	4/21	4/24	5/2	5/7	5/14	397.0	228.3	
2006	4/3	4/10	4/17	4/22	4/26	5/8	419.2	220.0	
2005	4/7	4/11	4/18	4/26	5/8	5/16	493.7	258.6	
2004	4/12	4/19	4/22	4/27	5/3	5/13	558.5	304.7	
2003	4/7	4/16	4/24	4/28	5/1	5/19	595.0	324.7	
2002	3/25	4/10	4/14	4/15	4/16	5/7	498.0	283.2	
2001	4/11	4/17	4/25	4/28	5/2	5/10	481.3	288.0	
2000	3/27	4/2	4/14	4/24	5/1	5/8	488.3	346.0	
1999	4/2	4/7	4/12	4/26	5/2	5/13	530.1	174.4	
1998	3/27	3/29	4/1	4/10	4/23	5/4	498.1	382.0	
1997	4/4	4/11	4/21	4/28	5/1	5/14	422.7	250.0	
1996	4/15	4/19	4/22	4/29	5/6	5/20			
1995	4/11	4/19	4/24	4/29	5/8	5/19			
1994	4/11	4/14	4/20	4/29	5/5	5/12			
1993	4/12	4/19	4/24	5/1	5/3	5/10			
1992	4/13	4/21	5/4	5/7	5/12	5/18			
1991	4/5	4/8	4/11	4/17	4/27	5/7			
1990	3/21	4/16	4/23	4/26	4/29	5/11			
1989	3/29	4/17	4/28	5/3	5/9	5/19			
1988	4/4	4/9	4/28	5/5	5/8	5/19			
1987	3/29	4/10	4/18	4/22	4/29	5/16			
1986	3/31	4/7	4/19	4/27	5/3	5/8			
1985	3/30	4/12	4/15	4/22	5/4	5/12			
1984	4/10	4/26	4/30	5/6	5/16	5/24			
1983	4/12	4/27	4/30	5/2	5/5	5/18			
1982	4/15	4/22	4/30	5/4	5/13	5/17			
1981		4/8	4/16	4/22	5/5	5/14			
1980	4/15		4/24	5/2	5/5	5/10			
Earliest day	**3/16**	**3/18**	**3/25**	**4/8**	**4/16**	**4/21**	305.0	168.5	**Low**
Latest day	**4/18**	**4/28**	**5/4**	**5/7**	**5/16**	**5/24**	603.0	382.0	**High**

Midrange: **3/31** (+/-14D)
4/7 (+/-20.5D)
4/14 (+/-20D)
4/22 (+/-14D)
5/1 (+/-15D)
5/7 (+/-16.5D)

Mean days in bloom 9.4 days

2019 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. Numbers in *italics* are interpreted

March

Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf.Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	28.1	36.6	19.1	0.06	6	0	2.0	322
02	33.0	37.7	27.9	0.09	9	5	2.3	201
03	33.8	40.5	30.7	0.00	7	5	0.9	276
04	29.9	37.8	19.3	0.21	6	8	3.1	330
05	21.4	30.2	13.3	0.00	0	0	3.0	397
06	17.6	24.0	12.6	0.00	0	0	4.0	326
07	18.9	29.2	8.4	0.00i	0i	0	4.1	397
08	26.1	36.5	12.9	0.03i	0	0	4.7	374
09	33.5	44.4	22.8	0.02	0	0	1.4	419
10	33.1	35.1	29.6	0.21i	17	18	0.0	64
11	42.2	50.4	34.6	0.11	5	4	4.2	427
12	34.5	40.7	29.7	0.00	0	0	5.8	403
13	35.0	45.6	22.8	0.00	0	0	4.3	340
14	45.7	59.1	36.8	0.00	3	0	3.6	363
15	56.2	71.7	45.2	0.00	0	0	3.3	292
16	41.0	46.6	32.5	0.00	1	0	3.5	323
17	32.5	39.9	27.2	0.00	0	0	2.8	439
18	32.3	42.1	23.9	0.00	0	0	2.5	362
19	35.1	43.7	25.4	0.00	0	0	2.5	330
20	40.2	52.8	27.9	0.00i	0	0	3.7	454
21	39.2	41.9	37.1	0.20i	18	15	3.3	85
22	38.8	43.5	35.9	0.81	15	13	6.7	114
23	35.7	44.5	31.0	0.00	0	0	6.0	396
24	43.6	56.6	28.1	0.00	0	0	2.3	437
25	42.5	48.9	31.4	0.00	0	0	3.3	384
26	34.3	42.9	26.3	0.00	0	0	10.1	54211
27	36.1	47.2	26.5	0.00	0	0	3.4	488
28	41.7	53.5	28.5	0.00	0	0	3.0	418
29	46.3	53.2	40.7	0.12	11	9	0.6	110
30	55.6	69.0	44.8	0.00	0	10	1.1	309
31	47.7	56.4	35.4	0.15	9	2	4.8	85
	36.5	71.7	8.4	2.01	107	89	3.4	10207

April

Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf. Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	34.7	41.8	29.0	0.01	0	0	4.8	488
02	38.4	50.1	25.8	0.00	0	0	3.4	428
03	48.2	62.0	34.8	0.00	0	0	5.5	541
04	42.9	52.3	35.1	0.00	0	0	4.5	532
05	33.5	39.9	30.9	0.28	10	6	1.3	131
06	45.9	60.9	32.5	0.16	11	11	2.8	471
07	54.7	69.4	39.4	0.00	0	0	1.2	436
08	55.6	69.2	48.6	0.34	12	12	0.0	196
09	48.5	57.6	43.4	0.20	13	18	0.0	329
10	44.6	51.3	37.0	0.01	5	3	0.0	575
11	40.8	46.5	33.7	0.00	0	0	0.0	251
12	48.7	60.1	40.6	0.13	11	5	0.0	167
13	64.1	75.7	56.4	0.35	10	11	0.0	343
14	60.6	68.0	52.8	0.04	2	4	0.0	280
15	53.7	63.6	41.8	0.67	11	9	0.0	255
16	49.4	61.2	37.9	0.00	0	0	0.0	586
17	52.3	62.9	42.7	0.00	0	0	0.0	617
18	49.3	52.7	45.2	0.00	2	4	0.0	74
19	64.4	77.2	51.0	0.02	9	11	0.0	241
20	62.7	66.1	54.1	0.61	12	15	1.1	109
21	57.6	64.8	49.5	0.00	0	5	0.6	274
22	58.3	66.8	51.3	0.00i	2i	3	5.7	266
23	63.3	77.1	51.0	0.02i	6i	0	1.7	514
24	56.1	62.2	44.3	0.04	5	3	0.0	620
25	53.8	66.5	39.6	0.00i	0i	0	0.3	558i
26	53.0	56.0	50.2	0.50i	22	19	0.0	108
27	45.4	49.9	42.6	0.40i	8i	6	0.3	323
28	42.0	44.0	38.7	0.22i	9i	6	1.6	115
29	46.5	57.1	34.0	0.02i	1	0	0.0	584
30	48.3	55.6	41.1	0.31	11	11	0.0	312
	36.5	71.7	8.4	2.01	107	89	3.4	10207

2019 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. Numbers in *italics* are interpreted

May 1 **June**

Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf.Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)	Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf. Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	49.3	54.9	45.0	0.00	8	6	0.0	165	01	67.0	79.6	53.8	0.00	0	4	0.0	569
02	56.7	70.1	47.3	0.01	12	10	0.0	282	02	66.5	74.6	55.8	0.11	4	8	0.0	423
03	51.4	54.0	48.2	0.07	7	17	0.0	117	03	57.0	66.3	48.4	0.00	0	5	0.0	689
04	57.3	64.6	52.2	0.18	14	15	0.0	235	04	58.9	68.6	43.8	0.00	0	0	0.0	641
05	53.8	58.5	51.3	0.60	22	24	0.0	100	05	69.7	80.0	59.7	0.00	0	0	0.0	445
06	58.4	70.2	48.5	*0.01i*	*2i*	10	0.6	413	06	70.5	74.5	63.6	0.07	6	6	0.0	526
07	57.0	72.1	48.9	*0.34i*	*5i*	14	2.0	328	07	68.6	78.7	58.7	0.00	0	6	0.0	572
08	56.8	65.8	48.5	0.00	0	3	0.0	636	08	69.1	79.9	57.6	0.00	0	2	0.0	703
09	52.9	60.2	46.2	0.00	0	0	0.0	303	09	66.8	79.2	54.7	0.00	0	0	0.0	661
10	58.8	73.5	50.6	0.92	12	12	0.0	171	10	62.8	71.3	49.3	0.39	9	7	0.0	269
11	55.9	63.3	49.5	0.00	3	2	0.0	612	11	66.5	72.9	56.1	0.12	9	9	0.0	548
12	42.6	53.4	39.0	1.33	23	17	0.0	65	12	63.5	75.0	48.9	0.00	0	0	0.0	690
13	42.4	44.9	39.7	0.50	15	21	0.1	82	13	58.7	65.3	54.6	*0.47i*	*6i*	3	0.2	289
14	43.8	49.0	40.3	*0.05i*	*16i*	16	0.6	139	14	62.2	73.2	55.0	0.04	7	7	0.0	424
15	53.2	65.7	39.0	*0.00i*	*6i*	5	0.9	515	15	67.7	78.8	52.4	*0.00i*	*0i*	0	1.0	620
16	59.3	69.3	48.2	*0.00i*	*0i*	0	0.3	564	16	65.4	68.6	61.6	0.20	21	20	0.0	116
17	61.0	69.8	50.0	*0.05i*	*5i*	0	0.8	208	17	67.7	75.4	60.7	*0.01i*	*6*	7	0.0	424
18	60.4	71.8	47.1	*0.00i*	*0i*	0	0.8	669	18	66.8	70.9	63.8	*0.27i*	*8i*	23	0.3	157
19	68.0	81.2	53.6	*0.10i*	*3i*	2	0.2	596	19	67.3	74.9	61.0	0.00	0	16	0.0	259
20	71.4	81.0	63.5	0.05	10	10	0.0	348	20	69.7	75.7	64.7	0.00	16	17	0.0	197
21	59.0	67.6	51.1	0.00	0	0	0.0	693	21	66.5	73.6	61.8	0.23	11	11	0.0	347
22	58.6	68.7	47.4	0.00	0	0	0.0	625	22	68.0	77.7	57.3	0.00	0	0	0.0	653
23	62.3	69.8	52.8	0.18	9	5	0.0	348	23	70.9	83.7	54.8	0.00	0	0	0.0	675
24	64.0	69.4	57.8	0.01	2	4	0.0	587	24	70.9	82.0	58.5	0.00	2	0	0.0	534
25	61.7	70.7	51.3	0.00	0	1	0.0	482	25	72.6	84.2	65.2	0.60	11	11	0.3	310
26	69.5	84.7	55.9	0.02	8	5	0.0	587	26	73.7	86.2	64.1	0.48	6	8	1.3	669
27	67.9	77.9	57.3	*0.00i*	*0i*	0	0.2	701	27	73.7	85.2	60.4	0.00	8	9	1.3	659
28	58.4	61.2	55.3	*0.53i*	*12i*	12	0.6	85	28	75.5	90.0	60.0	0.00	0	1	0.8	617
29	57.5	65.1	50.8	0.45	17	18	0.0	280	29	76.0	85.9	70.4	0.01	4	0	0.9	381
30	60.8	69.2	55.9	0.10	16	20	0.0	245	30	70.2	77.7	64.4	0.00	4	1	2.5	541
31	67.9	79.3	59.2	0.02	8	9	0.0	577									
	58.0	84.7	39.0	5.52	235	258	0.2	11758		67.7	90.0	43.8	3.00	138	181	0.3	14608

2019 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Laboratory, Highland, NY

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July

Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf.Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	70.7	82.7	57.4	0.00	0	1	1.7	640
02	72.1	81.4	61.3	0.00	0	1	1.1	398
03	76.2	89.6	65.5	0.00	0	6	1.4	594
04	78.3	91.3	66.5	0.00	0	2	1.9	667
05	76.7	87.3	64.6	0.00	0	0	1.7	612
06	77.3	88.9	70.5	0.65	8	3	1.5	463
07	72.8	81.4	66.7	0.01	2	0	3.5	624
08	70.4	81.2	63.0	0.00i	0i	0	1.9	540
09	73.4	84.3	62.2	0.00i	5	3	1.7	673
10	74.4	88.2	60.6	0.00	0	3	1.4	569
11	76.1	85.8	71.2	0.00	0	0	1.6	398
12	74.5	81.9	66.7	0.00	0	0	2.1	505
13	74.5	87.1	61.6	0.00	0	0	1.5	642
14	77.8	87.0	68.1	0.00	0	0	2.1	628
15	74.2	86.9	60.8	0.00	0	0	2.1	674
16	76.2	91.5	59.6	0.06	4	0	1.8	600
17	76.7	90.9	69.9	0.08	10	0	1.2	365
18	71.6	73.6	68.8	0.09i	18i	0	2.2	147
19	80.5	95.7	68.2	0.00	0	0	1.4	541
20	84.5	94.7	75.4	0.00	0	0	1.3	494
21	83.5	98.1	72.6	0.00	0	0	1.3	483
22	70.4	78.8	64.2	1.37	11	0	3.6	193
23	67.4	75.9	63.5	0.50	10	0	3.5	352
24	69.7	79.7	60.8	0.00	0	0	2.8	633
25	70.8	84.1	57.6	0.00	0	0	1.5	619
26	73.0	86.4	59.4	0.00	0	0	1.2	626
27	75.7	87.9	62.3	0.00i	0i	0	1.4	603
28	78.2	88.8	65.0	0.00i	0i	2	1.7	572
29	76.9	91.0	67.7	0.52	9	0	1.5	595
30	79.7	91.9	68.4	0.01i	9	0	1.2	595
31	72.0	81.1	65.2	0.08	4	0	1.0	367
	75.0	98.1	57.4	3.37	90	21	1.8	16412

August

Date	Ave. Air Temp (°F)	Min. Air Temp (°F)	Max. Air Temp (°F)	Rain (inches)	Lf. Wet Hrs.	rH ≥ 90%	Wind Spd (mph)	Solar Rad (L)
01	73.3	83.3	63.3	0.00	3	0	1.8	605
02	73.9	85.8	61.5	0.00i	0i	0	2.0	584
03	73.1	85.1	65.3	0.41i	5i	3	2.9	427
04	71.3	81.8	61.8	0.01	9	0	1.0	500
05	71.0	81.8	59.9	0.00	0	0	1.5	622
06	70.5	80.5	61.1	0.09	6	0	1.0	323
07	72.3	81.7	65.9	0.01i	10i	3	2.5	289i
08	71.0	85.6	58.0	0.02i	6i	8	2.7	442i
09	71.1	83.8	60.2	0.00	8	0	1.1	599
10	67.7	78.6	57.2	0.04i	3	0	2.2	534
11	67.5	81.6	54.3	0.00	0	0	1.2	554
12	72.6	85.7	55.8	0.00	0	0	1.6	569
13	72.4	80.3	67.8	0.12	6	0	0.9	275
14	70.8	81.3	64.6	0.04i	1i	0	3.0	328
15	72.4	85.7	61.8	0.00i	0	0	1.6	553
16	71.4	84.2	60.9	0.02	9	0	0.8	382
17	75.3	86.3	66.5	1.16	12	0	1.5	391
18	73.1	89.9	65.0	0.24	14	0	1.0	411
19	75.7	88.8	64.3	0.01	8	0	0.9	494
20	75.8	87.1	65.1	0.00i	0i	0	1.4	551
21	73.6	82.8	68.0	0.80	12	0	1.2	332
22	74.1	87.2	66.6	0.03i	13	0	1.0	433
23	67.4	77.0	58.2	0.00i	0i	0	4.0	257
24	64.1	71.7	53.0	0.00	0	0	3.7	590
25	65.8	72.4	59.1	0.00i	0	0	3.0	407
26	63.1	75.9	51.3	0.00i	0	0	2.1	575
27	63.7	74.7	49.0	0.00i	0i	2	3.0	301
28	69.1	79.8	56.0	0.30i	7i	4	1.8	405
29	67.5	79.7	57.9	0.00i	0i	0	1.8	499
30	69.3	82.9	54.7	0.00	0	0	1.9	455
31	66.3	74.1	57.1	0.00i	0i	0	2.9	456
	70.5	89.9	49.0	3.30	132	20	1.9	14143