RESULTS OF 2016 INSECTICIDE AND ACARICIDE STUDIES IN EASTERN NEW YORK

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Formulation	Materials Tested	Company
	Apple	
Insecticides		
Actara 25WDG		Syngenta
Agri-Flex SC		Syngenta
Altacor 35WG		E.I. DuPont De Nemours & Co.
Asana XL		E.I. DuPont De Nemours & Co.
Assail 30SG		United Phosphorus Inc.
Avaunt 30 WDG		E.I. DuPont De Nemours & Co.
Belt SC		Bayer CropScience
BioCover MLT (NIS)		Crop Protection Services
Bifenthrin DF		United Phosphorus Inc.
Carbaryl 4L		Derxel Chemical Co.
Centaur 0.7 WDG		Nichino America Inc.
Closer SC		Dow AgroSciences
Delegate WG		Dow AgroSciences
Entrust SC		Dow AgroSciences
Esteem 35WP		Dow AgroSciences
Exirel (Cyazypyr)		E.I. DuPont De Nemours & Co.
Imidan 70WP		Gowan Co.
LI700 (NIS)		Crop Protection Services
Movento 240SC		Bayer CropScience
Sivanto		Bayer CropScience
Surround WP		Tessenderlo Kerley
Voliam Flexi WDG		Syngenta
Voliam Express		Syngenta
	Pear	
Actara 25WDG		Syngenta
AgriMek 0.15EC		Syngenta
Asana XL		E.I. DuPont De Nemours & Co.
BioCover MLT (NIS)		Crop Protection Services
Centaur 0.7WG		Nichino America Inc.
Esteem 35WP		Dow AgroSciences
Surround WP		Tessenderlo Kerley
	Raspberry	
Boric Acid		Tranquility Products

Factors Contributing To The 2016 Hudson Valley Insect Pest Management Anomalies.

Rainfall accumulations: The start of the 2016 season began very dry in March increasing above the average through April with rainfall accumulations of 2.20" in March (3.6" Ave.), 4.40" in April (3.8" Ave.), and 2.55" in May (4.4" Ave.). The month of June saw a significant increase in rain events totaling 7.31" (4.4" Ave.), with enough rain to produce moderate levels of apple scab infection, especially in newly planted blocks. Each week in July had less than 0.5" of rain requiring weekly irrigation as only 1.23" of rain fell (4.7" Ave.). August experienced below average rainfall with accumulations of only 3.34" (4.2" Ave.). Total rainfall for the March 1st through September 1st growing season totaled 21.03" of rain, below the seasonal average of 25.1".

Tree phenology: Bud development was hampered in 2016 by a freeze event which occurred on the 4th and 5th of April (23.9 ^{o}F and 18.9^{o}F respectively). This event killed most stone fruit buds in the Hudson Valley, reducing pome fruit bloom depending on variety and site across the region. The season began as one of the earliest seasons on record. However, by petal-fall, the season was only one-day earlier than the 37-year mean.

McIntosh green tip (17 March) occurred 18 days earlier than the 37-year historical mean (see McIntosh phenology), one day shy of the earliest recorded day. King bloom on McIntosh began on the 25th of April. Predominately cool temperatures prevailed ranging between 50°F and 80.7^{o}F for an extended bloom period lasting 17 days, 7 days longer then the mean of 9.4 days. This was followed by 10 days of mean high temps of 59 ^{o}F to 83°F post petal fall. The 80% PF in McIntosh occurred on 12th May. There was ample sunlight yielding strong pollination and conditions for fruit set yet under conditions of severe cold injury from freeze temperatures on two nights of April 5th and 6th. Early water stress was a concern for tree fruit growers which lingered throughout most the season. Degree-day accumulations were the highest on record dating back to 1997 for base 43, the accumulating 597.8DD compared to the mean of 484.7DD_{43} by petal fall on 12th. By the 23rd of May, McIntosh king fruit had sized to 17mm with lateral fruitlets at 14.5mm.

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. Pre-bloom applications of a pyrethroid did not significantly reduce fruit injury compared to the UTC in Gingergold this season. Relatively dry conditions during the pre-bloom period favor TPB activity often requiring applications at both TC and P that in many years show numeric reduction in fruit injury yet this season were not significant during analysis. Lower 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 5.5% in Ginger Gold on 6 June in untreated plots with increasing damage noted in these plots at harvest.

Plum Curculio (PC) damage levels were low in early varieties and moderate in late varieties this season, yet required three applications in most orchards beginning at 80% PF, followed by 1st and 2nd cover for most mid to late varieties. Rains 9 days after the 1st cover application prompted a 2nd cover re-application. PC damage began shortly after fruit set given the very warm post bloom temperature we experienced. PC migration into orchards, oviposition and migration completion prediction model was calculated to end on 2nd of June at the HVRL using 308 DD_{50} from petal fall of McIntosh. Rains during the PF-1C period exceeded 0.61" and an additional 1.92" fell after the 1C application up to the morning of June 2nd. Moderate pressure was observed this season with PC injury observations prior to *June Drop* exceeding 10% in Red Delicious. In harvest assessments damage was 16.3% in Ginger Gold.

European apple sawfly (EAS) activity occurred in very low numbers this season with early varieties showing 1.8% injury in Ginger Gold and McIntosh cluster fruit evaluations. This was the third year in which EAS populations were at very low 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, the STLM has not been observed to cause injury to foliage to a degree requiring insecticide management.

San Jose scale (SJS) crawler emergence was predicted to occur during the first week of June using 1st adult capture on the 16th of May using 400 DD_{51} model. Nymphs were observed on fruit on the 10th of June, 8 days after the predicted emergence date. In general SJS scale levels were high in infested trees. The infestation means ranged from 27.3% to 86% injury observed in HVRL research plots on 26th August. In conventionally treated orchards, the SJS has become a major insect pest to manage in apple, requiring targeted applications for multiple generations. In 2015 we observed a 3rd generation in late September.

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

Codling moth (CM) 1st generation sustained adult flight occurred on 19th May with larval emergence predicted for 31st May using 220 DD_{50} from CM biofix. The internal lepidopteran complex, lesser apple worm (LAW), oriental fruit moth (OFM) and CM showed moderate levels of damage to apple, with frass produced by the internal lep. complex appearing during mid-late June through early July. Moderate levels of damage from the internal Lepidopteran complex was observed with 9.3% damage from 1st generation evaluated on 16th June on Red Delicious and with 7.0% & 23.1% for 1st and 2nd generation on Gingergold respectively. The 2nd generation adult sustained catch for the CM biofix occurred on 20th July with management for larval emergence prediction using 250 DD_{50} to occur on 28th July.

Obliquebanded leafroller (OBLR) monitoring and management by tree fruit growers continues to be a high priority. Targeting up to three seasonal application windows while employing a single mode of action for each period, growers can achieve successful management of the OBLR larva. These include the pre-bloom through Petal Fall period for the overwintering generation, often using IGR's such as Proclaim and Intrepid, the Summer generation using either Altacor / Belt or Delegate, and later in August applying either Altacor / Belt or Delegate. Recommendations for applications were made using insect phenology predictions for early emergence, using 340 DD_{50} from biofix to manage emergence of larvae, predicted to occur on mid June. In general, low-levels of leafroller feeding was observed on developing foliage and fruitlets this spring. Trap captures were moderate for 1st generation OBLR averaging 9.0 / day during the peak periods (5th June). The 2nd generation flight of OBLR biofix was low during August, averaging 2.0 / day during the peak periods (8th August). We are seeing a trend of increasingly high levels of RBLR with mixed populations of **tufted apple bud moth** (TABM) and **sparganothis fruitworm** (SFW) during the season, contributed to the overall leafroller damage each year.

Apple maggot (AM) emergence was late this season with first emergence on 11th July. Threshold of 5 flies per trap per block was observed on the 18th of August. AM density was low to moderate throughout the region with reduced emergence due to the lack of late season rainfall in July and early August. Low populations of adults were noted in the mid-Hudson Valley with seasonal accumulation totals near 40 flies per trap (mean n=4) by 31st August. Highest populations occurred late in the season as rainfall in August providing more ideal emergence conditions for the adult fly.

The **brown marmorated stink bug** (BMSB), *Halyomorpha halys,* has been observed throughout the southern Hudson Valley for the past 7 years with the first BMSB confirmation in December 2008. Since that time increasing populations have been documented in urban environments and present on many farms throughout the season in the lower to mid-Hudson Valley region. We have observed a second generation over the past two years, developing in mid-late August in HVRL voltinism studies. However, in 2016 we did not find adult egg laying after the development of 1st generation in the field.

Although there appears to be stink bug feeding in apple this season, both BMSB and the **green stink bug**, *Acrosternum hilare* BMSB was found from mid-season through harvest on pome fruit in lower to mid-Hudson Valley with increasing northern observations and fruit injury occurring in Columbia County in 2013. It has been found reproducing in deciduous trees such as Sugar Maple, *Acer saccharum*, White Ash, *Fraxinus americana*, Tree of Heaven, *Ailanthus altissima*, and eastern black walnut *Juglans nigra* in high numbers with lower numbers observed in Staghorn Sumac, *Rhus typhina,* and wild grape, *V. vinifera.* Late season nymphs and adult trap captures of BMSB using Tedders traps employing traditional black light traps, the USDA #10 lure and the *Plaudi stali* aggregation pheromone lure, *methyl (E,E,Z)-2,4,6-decatrienoate,* was observed along the orchard edges in Orange, Ulster, Dutchess and Columbia Counties throughout the season. In 2016 we monitored the population throughout NYS in 44 tree fruit orchard sites, employing a trap threshold of 10 total BMSB adults per trap to recommend management timing for tree fruit production. We are presently recommending that growers access https://www.eddmaps.org/bmsbny/ for weekly updates on BMSB monitoring of adults and fruit injury requiring management.

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

APPLE: *Malus domestica*, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

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

EVALUATION OF INSECTICIDES FOR CONTROLLING FRUIT FEEDING INSECT COMPLEX ON APPLE, 2016 –Hudson Valley Research Laboratory: Treatments were applied to four-tree plots of four varieties replicated four times in a randomized complete block design Treatments were applied concentrate using a Slim Line tower sprayer operated at 100 psi, delivering 0.69 to 0.75 gal/tree traveling at 2.5-2.86 mph. averaging 100 gal/acre. All insecticide calculations (presented as amt./A) are based on a standard dilution of 300 gal/acre trees. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Trees on the M.26 rootstock were 21 yr.-old, maintained at approximately 10 ft. height, planted to a research spacing of 10' x 30'. Calculations for applications were based on 16' tree row spacing as found in conventional production planting utilizing M.26. Alternate rows of unsprayed trees adjacent to treated plots are maintained for drift reduction, increased insect distribution and increased population pressure in yearly alternating plot placement.

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

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

Table 1 Treatment Schedule For Seasonal Apple Insecticide Screen.
Hudson Valley Research Lab., Highland, N.Y. - 2015.

Trmt.	Formulation	Rate	Timing	Application Dates
1	Imidan 70WP	5.75 lbs./A	PF-1C	15th May, 29th May
	Sivanto	10.5 fl.oz./A	TC	13th April
	Belt SC	5.0 fl.oz./A	2-3C	15th June, 31st June
	Assail 30SG	8.0 fl.oz./A	4-6C	6th, 15th July, 2nd Aug.
2	Imidan 70WP	5.75 lbs./A	PF-1C	15th May, 29th May
	Sivanto	14.0 fl.oz./A	TC	20th April
	Belt SC	5.0 fl.oz./A	2-3C	15th June, 31st June
	Assail 30SG	8.0 fl.oz./A	4-6C	6th, 15th July, 2nd Aug.
3	Imidan 70WP	5.75 lbs./A	PF-1C	15th May, 29th May
	Sivanto	10.5 fl.oz./A	TC, 2C (SJS Emg.)	20th April, 15th June
	Belt SC	5.0 fl.oz./A	2-3C	15th June, 31st June
	Assail 30SG	8.0 fl.oz./A	4-6C	6th, 15th July, 2nd Aug.
4	Imidan 70WP	5.75 lbs./A	PF-1C	15th May, 29th May
	Sivanto	14.0 fl.oz./A	PF	15th May
	Movento240SC	9.0 fl.oz./A	1C	31st May
	LI700	0.25%	PF-3C	15th May, 31st May, 15th June, 31st June
	Belt SC	5.0 fl.oz./A	2-3C	15th June, 31st June
	Assail 30SG	8.0 fl.oz./A	4-6C	6th, 15th July, 2nd Aug.
5	Imidan 70WP	5.75 lbs./A	PF-1C	15th May, 29th May
	Movento 240SC	6.0 fl.oz./A	PF, 1C	19th, 31st May
	LI700	0.25%	PF-3C	19th, 31st May, 15th June, 31st June
	Belt SC	5.0 fl.oz./A	2-3C	15th June, 31st June
	Assail 30SG	8.0 fl.oz./A	4-6C	6th, 15th July, 2nd Aug.
6	Asana XL 0.66EC	14.5 fl.oz./A	TC, P	13th , 21ST April
	Imidan 70WP	5.75 lbs./A	PF-6C	15th, 29th May, 15th June, 31st June , 6th, 15th July, 2nd Aug.
7	Asana XL 0.66EC	14.5 oz./A	TC	13th April
	Imidan 70WP	5.75 lbs./A	PF-1C, 4-6C	15th May, 29th May, 6th, 15th July, 2nd Aug.
	Centaur	34.5 oz./A	1C	29th May
	Delegate WG	6.0 oz./A	2-3C	31st May
8	Asana XL 0.66EC	14.5 oz./A	P	21ST April
	Imidan 70WP	5.75 lbs./A	PF-1, 4-6	15th May, 29th May, 6th, 15th July, 2nd Aug.
	Centaur 0.7WDG+	34.5 oz./A	1C	29th May
	BioCover MLT	0.25%	2C	29th May
	Delegate WG	6.0 oz./A	3C	31st May
9	UNTREATED			

Table 2a Evaluations Of Insecticides For Controlling Early Season Insect Complex On Apple [a].
Hudson Valley Research Lab. Highland N.Y. - 2016

		Incidence (%) of insect damaged cluster fruit					
Trmt. / Formulation	Rate	PC	TPB	MPB	LEP	EAS	Clean
1. Imidan 70WP	5.75 lbs./A	0.8 a	0.3 ab	0.0 a	0.8 ab	0.0 a	98.3 a
Sivanto	10.5 fl.oz./A						
Belt SC	5.0 fl.oz./A						
Assail 30SG	8.0 fl.oz./A						
2. Imidan 70 WP	5.75lbs./A	3.5 a	0.0 a	0.0 a	1.3 ab	0.3 ab	94.8 a
Sivanto	14.0 fl.oz./A						
Belt SC	5.0 fl.oz./A						
Assail 30SG	8.0 fl.oz./A						
3. Imidan 70 WP	5.75 lbs./A	0.5 a	0.5 ab	0.0 a	0.0 a	0.5 ab	98.5 a
Sivanto	10.5 fl.oz./A						
Sivanto	10.5 fl.oz./A						
Belt SC	5.0 fl.oz./A						
Assail 30SG	8.0 fl.oz./A						
4. Imidan 70 WP	5.75 lbs./A	1.3 a	0.0 a	0.0 a	0.5 a	0.5 ab	97.8 a
Sivanto	14.0 fl.oz./A						
Movento 240SC	9.0 fl.oz./ A						
LI700	0.25%						
Belt SC	5.0 fl.oz./A						
Assail 30SG	8.0 fl.oz./A						
5. Imidan 70 WP	5.75 lbs./A	2.3 a	0.3 ab	0.0 a	3.5 b	0.8 ab	90.8 a
Movento 240SC	6.0 fl.oz./A						
LI700	0.25%						
Belt SC	5.0 fl.oz./A						
Assail 30SG	8.0 fl.oz./A						
6. Asana XL 0.66 EC	14.5 fl.oz./A	1.7 a	0.6 ab	0.0 a	0.0 a	0.0 a	97.7 a
Imidan 70 WP	5.75 lbs./A						
7. Asana XL 0.66 EC	14.5 oz./A	0.3 a	1.8 b	0.0 a	0.6 a	0.0 a	97.3 a
Imidan 70 WP	5.75 lbs./A						
Centaur	34.5 oz./A						
Delegate	6.0 oz./A						
8. Asana XL 0.66 EC	14.5 fl.oz./A	6.9 a	1.4 ab	0.0 a	0.3 a	1.9 b	90.1 a
Imidan 70 WP	5.75 lbs./A						
Centaur 0.7WDG+	34.5 oz./A						
BioCover	0.25%						
Delegate	6.0 oz./A						
9. UNTREATED		16.0 b	3.5 a	0.0 a	0.5 ab	2.3 b	79.0 a
P value for transformed data		0.1947	0.2639	NS	0.1793	0.2991	0.4233

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

Table 2b Evaluations Of Insecticides For Controlling Early Season Insect Complex On Apple [a].
Hudson Valley Research Lab. Highland N.Y. - 2016

		Incidence (%) of insect damaged cluster fruit			
Trmt. Formulation	Rate	SJS	Int Lep	Rosy Apple Aphid	Clean
1. Imidan 70WP	5.75 lbs./A	13.5 ab	0.0 a	0.0 a	86.5 ab
Sivanto	10.5 fl.oz./A				
Belt SC	5.0 fl.oz./A				
Assail 30SG	8.0 fl.oz./A				
2. Imidan 70 WP	5.75lbs./A	21.0 ab	0.0 a	0.0 a	79.0 ab
Sivanto	14.0 fl.oz./A				
Belt SC	5.0 fl.oz./A				
Assail 30SG	8.0 fl.oz./A				
3. Imidan 70 WP	5.75 lbs./A	12.8 a	0.0 a	0.0 c	87.3 b
Sivanto	10.5 fl.oz./A				
Sivanto	10.5 fl.oz./A				
Belt SC	5.0 fl.oz./A				
Assail 30SG	8.0 fl.oz./A				
4. Imidan 70 WP	5.75 lbs./A	1.0 a	0.0 a	0.0 a	99.0 b
Sivanto	14.0 fl.oz./A				
Movento 240SC	9.0 fl.oz./ A				
LI700	0.25%				
Belt SC	5.0 fl.oz./A				
Assail 30SG	8.0 fl.oz./A				
5. Imidan 70 WP	5.75 lbs./A	1.5 a	0.0 a	0.0 a	98.5 b
Movento 240SC	6.0 fl.oz./A				
LI700	0.25%				
Belt SC	5.0 fl.oz./A				
Assail 30SG	8.0 fl.oz./A				
6. Asana XL 0.66 EC	14.5 fl.oz./A	9.3 a	0.0 a	0.0 a	90.8 b
Imidan 70 WP	5.75 lbs./A				
7. Asana XL 0.66 EC	14.5 oz./A	14.8 ab	0.0 a	0.0 a	85.3 b
Imidan 70 WP	5.75 lbs./A				
Centaur	34.5 oz./A				
Delegate	6.0 oz./A				
8. Asana XL 0.66 EC	14.5 fl.oz./A	20.8 ab	0.0 a	0.0 a	79.3 ab
Imidan 70 WP	5.75 lbs./A				
Centaur 0.7WDG+	34.5 oz./A				
BioCover	0.25%				
Delegate	6.0 oz./A				
9. UNTREATED		44.8 b	9.3 b	0.0 a	50.3 a
P value for transformed data		0.1157	0.0001	x	0.0478

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

Table 3 Evaluations Of Insecticides For Controlling Early Season Insect Complex On Apple [a]. Hudson Valley Research Lab. Highland N.Y. - 2016

Treatment / Formulation	Rate	Number of Adult Mite / Leaf				
		ERM	TSM	ZM	AMB	ARM
1. Imidan 70WP	5.75 lbs./A	0.0 a	5.1 a	0.4 d	0.4 a	135.2 ab
Sivanto	10.5 fl.oz./A					
Belt SC	5.0 fl.oz./A					
Assail 30SG	8.0 fl.oz./A					
2. Imidan 70 WP	5.75 lbs./A	0.1 a	1.5 a	0.3 bcd	0.3 a	261.0 b
Sivanto	14.0 fl.oz./A					
Belt SC	5.0 fl.oz./A					
Assail 30SG	8.0 fl.oz./A					
3. Imidan 70 WP	5.75 lbs./A	0.2 a	0.9 a	0.5 d	0.3 a	195.4 ab
Sivanto	10.5 fl.oz./A					
Sivanto	10.5.fl.oz./A					
Belt SC	5.0 fl. oz./A					
Assail 30SG	8.0 fl.oz./A					
4. Imidan 70 WP	5.75 lbs./A	0.0 a	1.6 a	0.1 abc	0.2 a	25.4 a
Sivanto	14.0 fl.oz./A					
Movento	9.0 fl.oz./A					
LI700	0.25%					
Belt SC	5.0 oz./A					
Assail 30SG	8.0 fl.oz./A					
5. Imidan 70 WP	5.75 lbs./A	0.0 a	1.4 a	0.0 ab	0.1 a	27.2 a
Movento	6.0 fl.oz./A					
Movento	6.0 fl.oz./A					
LI700	0.25%					
Belt SC	5.0 fl.oz./A					
Assail 30SG	8.0 fl.oz./A					
6. Asana XL 0.66 EC	14.5 fl.oz./A	0.2 a	3.6 a	0.3 cd	0.2 a	128.8 ab
Imidan 70 WP	5.75 lbs./A					
7. Asana XL 0.66 EC	14.5 oz./A	0.2 a	0.6 a	0.0 a	0.5 a	123.8 ab
Imidan 70 WP	5.75 lbs./A					
Centaur	34.5 oz./A					
Delegate	6.0 oz./A					
8. Asana XL 0.66 EC	14.5 oz./A	0.2 a	0.3 a	0.1 abc	0.1 a	259.0 b
Imidan 70 WP	5.75 lbs./A					
Centaur +	34.5 oz./A					
BioCover	0.25%					
Delegate	6.0 oz./A					
P value for transformed data		0.7936	0.5861	0.0032	0.6757	0.155

[a] Evaluation made on Red Delicious cultivar on May 20. Data were transformed using $\log_{10}(x+1)$ using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported

Table 4a Treatment Schedule For Seasonal Apple Insecticide Screen.
N.Y.S.A.E.S., Hudson Valley Research Lab., Highland, N.Y. - 2016.

			Mean incidence (%) of insect damaged cluster fruit												
Trmt.	Formulation	Rate	PC	EAS	TPB	Ext LEP	LR	Int Lep.	CM1	CM2	AmP	AmT	SJS	SB	Clean
1	Imidan 70WP	5.75 lbs./A	1.5 a	0.5 a	4.0 a	0.5 ab	0.0 a	6.9 ab	0.8 a	17.9 ab	14.0 ab	9.7 ab	73.3 cd	3.1 b	15.8 abc
	Sivanto	10.5 fl.oz./A													
	Belt SC	5.0 fl.oz./A													
	Assail 30SG	8.0 fl.oz./A													
2	Imidan 70WP	5.75 lbs./A	3.5 ab	0.5 a	3.7 a	0.5 a	0.8 a	8.5 b	1.0 a	11.2 ab	25.8 ab	17.4 bc	83.6 d	0.6 a	8.3 ab
	Sivanto	14.0 fl.oz./A													
	Belt SC	5.0 fl.oz./A													
	Assail 30SG	8.0 fl.oz./A													
3	Imidan 70WP	5.75 lbs./A	5.3 ab	1.0 a	3.5 a	0.3 ab	0.0 a	4.3 ab	0.8 a	13.9 ab	10.1 a	5.0 ab	32.2 abc	0.3 a	42.0 cde
	Sivanto	10.5 fl.oz./A													
	Belt SC	5.0 fl.oz./A													
	Assail 30SG	8.0 fl.oz./A													
4	Imidan 70WP	5.75 lbs./A	2.5 ab	0.8 a	2.9 a	0.6 ab	0.0 a	7.9 ab	1.8 a	14.1 ab	11.8 ab	5.8 ab	5.1 a	3.3 b	57.0 e
	Sivanto	14.0 fl.oz./A													
	Movento 240SC	9.0 fl.oz./A													
	LI700	0.25%													
	Belt SC	5.0 fl.oz./A													
	Assail 30SG	8.0 fl.oz./A													
5	Imidan 70WP	5.75 lbs./A	8.7 bc	1.0 a	6.4 a	0.5 ab	0.3 a	8.9 b	1.3 a	8.4 a	15.3 ab	5.6 ab	7.0 ab	1.6 ab	49.0 de
	Movento 240SC	6.0 fl.oz./A													
	LI700	0.25%													
	Belt SC	5.0 fl.oz./A													
	Assail 30SG	8.0 fl.oz./A													
6	Asana XL 0.66EC	14.5 fl.oz./A	4.0 ab	2.0 a	2.8 a	0.0 a	0.0 a	2.5 a	0.3 a	8.3 a	9.3 a	5.3 ab	63.6 cd	2.3 ab	23.9 abcd
	Imidan 70WP	5.75 lbs./A													
7	Asana XL 0.66EC	14.5 oz./A	2.0 ab	1.0 a	3.0 a	0.3 ab	0.0 a	3.3 a	0.3 a	11.8 ab	9.6 a	3.0 a	48.9 bcd	1.0 ab	36.1 bcde
	Imidan 70WP	5.75 lbs./A													
	Centaur	34.5 oz./A													
	Delegate	6.0 oz./A													
8	Asana XL 0.66EC	14.5 oz./A	5.3 ab	1.1 a	4.1 a	0.8 ab	0.0 a	4.7 ab	0.3 a	9.2 ab	12.5 a	3.2 a	58.6 cd	2.2 ab	22.9 abc
	Imidan 70WP	5.75 lbs./A													
	Centaur 0.7WDG+	34.5 oz./A													
	BioCover	0.25%													
	Delegate	6.0 oz./A													
9	UNTREATED		16.3 c	2.3 a	5.5 a	1.2 b	0.5 ab	23.2 b	7.0 b	23.1 b	29.4 b	19.1 c	59.0 c	0.5 ab	11.3 ab
	P Value		0.0239	0.7054	0.9312	0.6392	0.2515	0.0003	0.0006	0.3556	0.3137	0.0344	0.0049	0.2269	0.0114

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

Table 4b Treatment Schedule For Seasonal Apple Insecticide Screen.

N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y. - 2016.

		Mean incidence (%) of insect damaged cluster fruit												
Trmt./Formulation		PC	EAS	TPB	E.LEP	LR	Int.Lep.	CM1	CM2	AmP	AmT	SJS	SB	Clean
1	Imidan 70WP Sivanto Belt SC Assail 30SG	0.5 a	0.8 ab	5.5 abc	0.0 a	0.0 a	5.3 a	0.0 a	3.5 a	9.5 ab	5.0 a	80.5 bc	17.5 ab	13.3 ab
2	Imidan 70WP Sivanto Belt SC Assail 30SG	3.8 ab	2.0 ab	8.0 abc	0.5 a	0.5 a	9.3 a	0.0 a	3.5 a	11.3 ab	5.0 a	67.9 bc	18.5 ab	18.3 abc
3	Imidan 70WP Sivanto Belt SC Assail 30SG	2.6 ab	1.3 ab	9.1 abc	0.0 a	0.0 a	5.3 a	0.0. a	3.1 a	6.6 ab	4.6 a	44.1 ab	14.8 ab	36.8 bc
4	Imidan 70WP Sivanto Movento 240SC LI700 Belt SC Assail 30SG	2.8 ab	0.0 a	11.0 bc	1.0 ab	0.0 a	3.8 a	0.0 a	2.5 a	7.8 ab	3.8 a	24.3 a	26.5 ab	38.5 bc
5	Imidan 70WP Movento 240SC LI700 Belt SC Assail 30SG	2.0 a	2.0 ab	0.15 c	0.3 a	0.0 a	6.8 a	0.5 b	2.3 a	7.5 ab	3.3 a	24.3 a	16.3 ab	41.9 c
6	Asana XL 0.66EC Imidan 70WP	4.0 ab	1.3 ab	3.0 a	0.3 a	0.0 a	5.3 a	0.0 a	4.3 a	5.5 a	2.5 a	91.5 c	14.8 ab	7.3 a
7	Asana XL 0.66EC Imidan 70WP Centaur Delegate	2.3 a	0.3 ab	4.6 ab	0.3 a	0.0 a	5.5 a	0.0 a	3.0 a	12.0 ab	4.1 a	65.5 abc	12.2 ab	24.3 abc
8	Asana XL 0.66EC Imidan 70WP Centaur 0.7WDG+ BioCover Delegate	8.9 b	3.5 b	12.1 bc	0.5 a	0.3 a	3.8 a	0.0 a	2.0 a	8.7 ab	5.1 a	67.4 ab	11.9 a	20.3 abc
9	Untreated	27.0 c	4.0 ab	6.8 abc	2.0 b	1.8 b	26.8 b	0.0 a	28.8 b	14.3 b	10.5 b	71.0 bc	28.0 b	4.3 a
P Value		0.0001	0.3966	0.1423	0.016	0.0089	0.0001	0.4586	0.0001	0.3414	0.0398	0.0317	0.3674	0.0163

Harvest evaluation of Red Delicious on 13th September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions. (ArcSin Conversion used for ANOVA

Table 4c Treatment Schedule For Seasonal Apple Insecticide Screen.
N.Y.S.A.E.S., Hudson Valley Lab., Highland, N.Y. - 2016.

		Mean incidence (%) of insect damaged cluster fruit												
Trmt./Formulation		PC	EAS	TPB	E.LEP	LR	Int.Lep.	CM1	CM2	AmP	AmT	SJS	SB	Clean
1	Imidan 70WP Sivanto Belt SC Assail 30SG	4.8 abc	2.5 a	3.3 a	0.4 ab	0.0	3.5 a	0.0 a	0.6 a	7.0 a	5.2 a	88.6 c	5.9 a	11.0 ab
2	Imidan 70WP Sivanto Belt SC Assail 30SG	7.2 abc	0.3 a	3.3 a	2.1 ab	0.0	15.3 b	0.0 a	7.4 b	8.3 a	2.0 a	86.4 c	2.4 a	11.8 ab
3	Imidan 70WP Belt SC Assail 30SG	2.7 ab	0.8 a	4.7 a	0.3 a	0.0	6.4 ab	0.0 a	0.8 ab	5.7 a	4.9 a	68.2 bc	6.1 a	28.3 bcd
4	Imidan 70WP Sivanto Movento 240SC LI700 Belt SC Assail 30SG	7.4 abc	0.0 a	3.7 a	0.0 a	0.0	8.5 ab	0.0a	3.6 ab	4.3 a	2.6 a	39.0 ab	12.3 a	40.7 cd
5	Imidan 70WP Movento 240SC LI700 Belt SC Assail 30SG	4.0 abc	1.8 a	6.0 a	1.5 ab	0.0	8.5 ab	0.0 a	4.0 ab	7.8 a	4.8 a	35.2 a	10.4 a	43.6 d
6	Asana XL 0.66EC Imidan 70WP	5.9 abc	1.9 a	3.5 a	0.9 ab	0.0	6.0 ab	0.0 a	2.0 ab	5.8 a	3.4 a	94.9 c	5.8 a	4.3 ab
7	Asana XL 0.66EC Imidan 70WP Centaur Delegate	2.1 a	0.8 a	1.6 a	0.0 a	0.0	2.4 a	0.0 a	1.7 ab	4.4 a	4.4 a	84.0 c	4.3 a	14.8 abc
8	Asana XL 0.66EC Imidan 70WP Centaur 0.7WDG+ BioCover Delegate	13.0 bc	0.3 a	4.0 a	0.0 a	0.0	7.1 ab	0.0 a	3.1 ab	6.1 a	3.1 a	73.2 c	7.4 a	20.9 abc
9	Untreated	15.7 c	0.5 a	2.1 a	3.2 b	0.0	15.3 b	0.3 b	21.2 c	7.6 a	5.8 a	86.9 c	13.1 a	2.5 a
P Value		0.2699	0.5639	0.9226	0.2094	NA	0.0502	0.4586	0.0014	0.9883	0.801	0.0047	0.4786	0.0129

Harvest evaluation of McIntosh on 12th September. Treatments were applied dilute to runoff using a high-pressure handgun sprayer operated at 300 psi, delivering 1.3 to 1.9 gal/tree or 130 to 190 gal/acre with the range in gallonage representing the increasing amounts of foliage as the season progressed. All insecticide dilutions. (ArcSin Conversion used for ANOVA

APPLE: Malus domestica, cv. 'Ginger Gold', 'Red Delicious', 'McIntosh', 'Golden Delicious'

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

EVALUATION OF INSECTICIDES FOR CONTROLLING PLUM CURCULIO ON APPLE, 2016 – Hudson Valley Research Laboratory: Treatments were applied to four-tree plots of four varieties replicated four times in a randomized complete block design Treatments were applied concentrate using a Slim Line tower sprayer operated at 100 psi, delivering 0.69 to 0.75 gal/tree traveling at 2.5-2.86 mph. averaging 100 gal/acre. All insecticide calculations (presented as amt./A) are based on a standard dilution of 300 gal/acre trees. Maintenance applications for disease control and crop load reduction were also made using concentrate airblast, delivery using 100 GPA. Trees on the M.26 rootstock were 22 yr.-old, maintained at approximately 10 ft. height, planted to a research spacing of 10' x 30'. Calculations for applications were based on 16' tree row spacing as found in conventional production planting utilizing M.26. Alternate rows of unsprayed trees adjacent to treated plots are maintained for drift reduction, increased insect distribution and increased population pressure in yearly alternating plot placement.

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

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

Table 5 Treatment Schedule For Seasonal Apple Insecticide Screen.
Hudson Valley Research Lab., Highland, N.Y. - 2016.

Trmt.	Formulation	Rate	Timing	Application Dates
1	Imidan 70WP	10.5 oz./A	PF	15th May
	Actara 25 WDG	5.5 oz./A	1C	1st June
2	Imidan70 WP	14.0 oz./A	PF	15th May
	Avaunt 30 WDG	6.0 oz./A	1C	1st June
3	Imidan 70 WP	10.5 oz./A	PF	15th May
	Exirel	20.5 fl. oz./A	1C	1st June
4	Imidan 70 WP	14.0 oz./A	PF	15th May
	Voliam Flexi WDG	7.0 oz./A	1C	1st June
5	Imidan 70 WP	14.0 oz./A	PF	15th May
	Agri-Flex SC	8.5 fl.oz./A +	1C	1st June
	Biocover MLT	1%	1C	1st June
6	Imidan 70 WP	5.75 lbs./A	PF	15th May
	Voliam Express	12.0 fl.oz./A	1C	1st June
7	Imidan 70 WP	5.75 lbs./A	PF	15th May
	Carbaryl 4L	96.0 ts./A	1C	1st June
8	Imidan 70 WP	5.75 lbs./A	PF	15th May
	Closer SC	5.75 fl.oz./A	1C	1st June
9	Asana XL 0.66 EC	14.5 oz./A	PF	15th May
	Bifenthrin DF	32.0 oz./A	1C	1st June
10	UNTREATED			

Table 6a Evaluations Of Insecticides For Controlling Early Season Insect Complex On Apple[a]. Hudson Valley Research Lab. Highland N.Y. - 2016

		Incidence (%) of insect damaged cluster fruit					
Formulation	Rate	PC	TPB	MPB	LEP	EAS	Clean
1. Imidan 70WP Actara 25 WDG	10.5 oz./A 5.5 oz./A	22.7 a	5.4 a	0.0 a	0.5 a	2.6 a	67.4 b
2. Imidan70 WP Avaunt 30 WDG	14.0 oz./A 6.0 oz./A	21.1 a	1.6 a	0.0 a	3.1 ab	0.8 ab	73.4 a
3. Imidan 70 WP Exirel	10.5 oz./A 20.5 fl. oz./A	14.0 a	4.7 a	0.0 a	0.7 a	1.7 a	76.0 ab
4. Imidan 70 WP Voliam Flexi WDG	14.0 oz./A 7.0 oz./A	19.6 a	3.5 a	0.4 a	1.7 ab	0.0 ab	74.8 a
5. Imidan 70 WP Agri-Flex SC Biocover MLT	14.0 oz./A 8.5 fl.oz./A + 1%	11.8 a	4.1 a	0.0 a	0.0 a	0.6 a	83.8 ab
6. Imidan 70 WP Voliam Express	5.75 lbs./A 12.0 fl.oz./A	8.9 a	0.0 a	0.0 a	0.9 a	2.2 a	88.0 ab
7. Imidan 70 WP Carbaryl 4L	5.75 lbs./A 96.0 ts./A	19.5 a	1.2 a	0.0 a	1.2 a	0.6 a	77.4 ab
8. Imidan 70 WP Closer SC	5.75 lbs./A 5.75 fl.oz./A	25.2 a	4.9 a	0.0 a	0.9 a	0.9 a	68.6 ab
9. Asana XL 0.66 EC Bifenthrin DF	14.5 oz./A 32.0 oz./A	11.5 a	1.9 a	0.0 a	1.0 a	1.0 a	84.7 ab
10. UNTREATED		22.2 a	8.7 a	0.0 a	8.7 b	7.1 b	54.8 ab
P value for transformed data		0.8405	0.9589	0.6034	0.3193	0.4074	0.8809

[a] Evaluation made on June 17 on Ginger Gold cultivar. Data were transformed using arcsine(Sqrt(x)) using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 6b Evaluations Of Insecticides For Controlling Early Season Insect Complex On Apple[a]. Hudson Valley Research Lab. Highland N.Y. - 2016

		Incidence (%) of insect damaged cluster fruit					
Formulation	Rate	PC	TPB	MPB	LEP	EAS	Clean
1. Imidan 70WP Actara 25 WDG	10.5 oz./A 5.5 oz./A	29.1 a	6.6 a	0.0 a	1.0 ab	0.5 a	62.8 a
2. Imidan70 WP Avaunt 30 WDG	14.0 oz./A 6.0 oz./A	19.2 a	5.3 a	0.0 a	0.4 a	4.1 ab	71.8 a
3. Imidan 70 WP Exirel	10.5 oz./A 20.5 fl. oz./A	17.6 a	1.2 a	0.0 a	1.6 a	5.5 b	73.7 a
4. Imidan 70 WP Voliam Flexi WDG	14.0 oz./A 7.0 oz./A	28.9 a	8.5 a	0.0 a	0.4 a	2.6 ab	59.6 a
5. Imidan 70 WP Agri-Flex SC Biocover MLT	14.0 oz./A 8.5 fl.oz./A + 1%	20.9 a	1.6 a	0.0 a	2.2 ab	0.8 a	74.8 a
6. Imidan 70 WP Voliam Express	5.75 lbs./A 12.0 fl.oz./A	8.3 a	4.7 a	0.0 a	0.4 a	1.2 a	85.4 a
7. Imidan 70 WP Carbaryl 4L	5.75 lbs./A 96.0 ts./A	51.9 a	4.8 a	0.0 a	0.0 a	1.0 a	42.3 a
8. Imidan 70 WP Closer SC	5.75 lbs./A 5.75 fl.oz./A	22.1 a	6.1 a	0.4 b	1.1 ab	0.4 a	69.8 a
9. Asana XL 0.66 EC Bifenthrin DF	14.5 oz./A 32.0 oz./A	12.7 a	2.6 a	0.0 a	2.2 ab	0.7 a	79.4 a
10. UNTREATED		41.9 a	6.0 a	0.0 a	6.7b	1.9 a	43.5 a
P value for transformed data		0.7794	0.9741	0.2218	0.2641	0.1451	0.7236

[a] Evaluation made on June 17 on Ginger Gold cultivar. Data were transformed using arcsine(Sqrt(x)) using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

APPLE: *Malus domestica*, cv. 'Red Delicious'

B**rown marmorated stink bug** (BMSB), *Halyomorpha halys* Stål

Comparison of Late Season Application of Closer and Bifenthrin for controlling Brown Marmorated Stinkbug in Apple –Hudson Valley Research Laboratory 2016.

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 BMSB populations have been documented in urban environments and are now present on many lower to mid-Hudson Valley regional fruit and vegetable farms throughout the season. In two of the past three years we've observed a second generation develop in mid-late August during voltinism studies. The rise of a second generation of BMSB from mid-August through mid-November has caused significant injury to late season fruit. The industry is in need of insecticide tools with a short pre-harvest interval to address injury from this insect pest.

In 2016 we conducted a field examination of Closer SC, recently registered for use on tree fruit in the US, to determine the impact of this insecticide on adult and nymphs feeding on late season apple. Treatments were applied to 8-tree plots replicated six times in a RCB design. Each plot employed six trees of 8 year old 'Red Delicious' cultivars bordered by guard trees to inhibit drift, spaced at 3' x 12' ft., 10 ft. in height, comprising 1210 trees per acre. All dilutions are based on 300 gallons/acre with plot requirements ranging from 12 to 15 gallons increasing seasonally with developing canopy. Treatments were applied dilute to runoff using a tractor mounted high-pressure handgun sprayer operated at 300 psi delivering approximately 378.1 GPA.

Red Delicious on dwarfing rootstock strains were sprayed with Closer SC (sulfoxaflor – Dow AgroSciences; EPA Reg. No. 62719-623), and Bifenture EC (25% bifenthrin, UPI, EPA Reg. No. 70506-227) at 12.8 fl. ozs. (0.20 lbs. ai.) per acre using highest labeled rates on the 2nd of August, 24 hours prior to BMSB placement. Three intervals of BMSB placement were made at 24 hr., 48 hr. and 72 hr. Both 3rd instar nymphs and adults were placed onto the north side of fruit in the shaded canopy of the apple for each exposure date. Over top of each insect life stage was placed a 1 oz. screened cup secured by a single #30 rubber band (ULINE 2" x 1/8"), (Image 1). After 7d and prior to insect removal a circled was scored with black 'Sharpie' defining the arena perimeter. The circled areas of the fruit were evaluated at harvest for stink bug injury assessing 'Feeding Sites' using 14x microscope of fruit surface, discoloration coined as 'Green Dimples', and upon skin removal, subsurface 'Corking' was appraised including undamaged 'Clean' fruit on September 14th (Tables 1-3).

Results: Overall there were no statistical differences between Bifenture EC and Closer SC residual efficacy to adult stink bug feeding on apple. Both Closer SC and Bifenthure EC providing statistical reductions in fruit feeding injury by adults compared to the UTC when placed on fruit at 24 and 48 hour timing placement dates. Statistical differences between treatments in feeding sites and corking were observed at 48-hour placement timing of nymphs. These results suggest that Closer SC applied at 7 days prior to harvest can reduce feeding injury to fruit, yet provide little in the way of mortality to nymph or adult BMSB in the field.

Comparison of Late Season Application of Closer and Bifenthrin for controlling Brown Marmorated Stinkbug *Halyomorpha halys* in Apple [a].HVRL. Highland N.Y. - 2016

			Incidence (%) of insect damaged cluster fruit			
Treatment	Hr. Post Appl	Life Stage	# Feeding Sites	Green Dimples	Corking	Clean
Closer	24h	Adult	0.0a	0.3 a	0.0 a	0.1 a
Bifenthrin	24h	Adult	0.3 a	0.6 a	0.4 a	0.5 ab
UTC	24h	Adult	1.6 b	0.9 a	1.6 b	0.9 b
P value			0.0079	0.6411	0.0109	0.024
Closer	48h	Adult	0.3 a	0.0 a	0.7 a	0.1 a
Bifenthrin	48h	Adult	0.7 a	0.3 a	0.7 a	0.7 ab
UTC	48h	Adult	0.9 a	1.4 b	1.1 a	0.7 b
P value			0.6113	0.0018	0.7383	0.0641
Closer	72h	Adult	0.0 a	0.4 a	0.3 a	0.3 a
Bifenthrin	72h	Adult	0.9 a	0.4 a	1.1 a	0.4 a
UTC	72h	Adult	1.1 a	0.8 a	1.8 a	0.6 a
P value			0.3548	0.499	0.3131	0.4854
Closer	24h	Nymph	0.1 a	0.3 a	0.1 a	0.4 a
Bifenthrin	24h	Nymph	0.4 a	0.3 a	0.6 a	0.6 a
UTC	24h	Nymph	1.1 a	1.4 a	1.1 a	0.7 a
P value			0.149	0.3699	0.1649	0.4526
Closer	48h	Nymph	0.0 a	0.3 a	0.1 a	0.3 a
Bifenthrin	48h	Nymph	0.3 a	1.4 a	0.3 a	0.6 a
UTC	48h	Nymph	1.8 b	2.0 a	2.8 b	0.7 a
P value			0.0267	0.3394	0.007	0.2
Closer	72h	Nymph	0.0 a	0.4 a	0.3 a	0.3 a
Bifenthrin	72h	Nymph	0.9 a	0.4 a	1.1 a	0.4 a
UTC	72h	Nymph	1.1 a	0.4 a	1.8 a	0.6 a
	P value		0.3548	0.499	0.3131	0.4854

[a] Evaluation made on August 14 on Red Delicious cultivar.

Data were transformed using arcsine(Sqrt(x)) using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 7b Comparison of Late Season Application of Closer and Bifenthrin for Controlling Brown Marmorated Stinkbug Nymphs, *Halyomorpha halys* in Apple [a].HVRL Highland N.Y. - 2016

Nymphs in Cups

Day after Exposure	Treatment	Alive (%)	Mortality(%)
2	Closer	86.3 b	13.7
	Bifenthrin	44.3 a	55.7
	UTC	90.5 b	9.5
	P-Value	0.0086	
10	Closer	28.0 a	72.0
	Bifenthrin	8.9 a	91.1
	UTC	39.9 a	60.1
	P-Value	0.3023	
15	Closer	18.5 a	81.5
	Bifenthrin	4.7 a	95.2
	UTC	35.7 a	64.3
	P-Value	0.2239	
21	Closer	18.5 a	81.5
	Bifenthrin	4.8 a	95.2
	UTC	26.8 a	73.2
	P-Value	0.2756	
26	Closer	13.7 a	86.3
	Bifenthrin	4.8 a	95.2
	UTC	22.6 a	77.4
	P-Value	0.3289	
33	Closer	9.5 a	90.5
	Bifenthrin	4.8 a	95.2
	UTC	13.7 a	86.3
	P-Value	0.6159	

[a] Evaluation made on August 14 on Red Delicious cultivar. Data were transformed using arcsine(Sqrt(x)) using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 7c Comparison of Late Season Application of Closer and Bifenthrin for Controlling Brown Marmorated Stinkbug Adults, *Halyomorpha halys* in Apple [a].HVRL. Highland N.Y. - 2016

Adults in Cups

Days after Exposure	Treatment	Alive (%)		Mortality (%)
2	Closer	91.7	b	8.3
	Bifenthrin	29.2	a	70.8
	UTC	76.2	b	23.8
	P-Value	0.031		
7	Closer	16.7	a	83.3
	Bifenthrin	9.7	a	90.3
	UTC	14.3	a	85.7
	P-Value	0.901		
15	Closer	0.0		100.0
	Bifenthrin	0.0		100.0
	UTC	0.0		100.0
	P-Value	-		

[a] Evaluation made on September 14 on Red Delicious cultivar. Data were transformed using arcsine(Sqrt(x)) using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Image 1. BMSB in arena on apple.

PEAR: *Pyrus communis* L. 'Bartlett', 'Bosc'

Pear psylla: *Cacopsylla pyricola* (Foerster)
Codling moth (CM): *Cydia pomonella* (Linnaeus)
Pear rust mite (PRM): *Epitrimerus pyri*
Fabraea Leaf Spot (FLS) *Fabraea maculata*

EFFICACY OF INSECTICIDES AGAINST PEAR PSYLLA ADULTS, EGGS AND NYMPHS, 2013: – Cornell University's Hudson Valley Lab: Treatments were applied to four-tree plots replicated four times in a RCB design. Each plot contained two trees each of 'Bartlett' and 'Bosc' cultivars, spaced 12 x 18 ft., 12 ft. in height, and 34 years old. All dilutions are based on 400 gallons/acre with plot requirements ranging from 20 to 50 gallons increasing seasonally with developing canopy. Treatments were applied dilute to runoff using a tractor mounted high-pressure handgun sprayer operated at 300 psi delivering approximately 350 GPA.

Treatments were applied on various schedules as shown in Table . Application dates corresponding to tree phenology of 'Bartlett' beginning at delayed dormant (DD) and 1st psylla egg observed on 15 March, bud burst (BB) on 4 Aprilh, green cluster and 1st observed nymph on 11 April, white bud (WB) on 18 April; bloom on 25 April, PF on 2 May, >5mm fruit set on 9 May, crop load reduction using NAA and 0.25% Biocover MLT on 10 May, PF appl. for PC management on 5 May, 10p PF AgriMek on 19 May, 14 day post petal fall (PF) on 20 June.

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

The greatest season long control of the psylla nymph was achieved by early pre-bloom and petal fall applications of Surround WP at 50 lbs./A, followed by post PF applications of 1% horticultural Biocover MLT. No rust mites were observed in the orchard this season.

Table 8 Treatment Schedule For Seasonal Pear Insecticide Screen.
Hudson Valley Research Lab., Highland, N.Y. - 2015.

Treatment / Formulation	Rate	Timing	Application Dates
1 Biocover MLT	128.0 fl.oz./100	DD-EOS @ 14d	15, 30 March, 21 April, 5, 19 May, 20 June, 6, 20 July, 3 August
2. Biocover MLT	128.0 fl.oz./100	DD, GC, WB, PF	15, 30 March, 21 April, 5 May 20 June, 6, 20 July, 3 August
Surround	12.5 lbs./100	DD, WB, PF	15, 21 April, 5 May
3. Surround	12.5 lbs./100	DD, GC, WB, PF	15, 30 March, 21 April, 5 May
Biocover MLT	128.0 fl.oz./100	1 – 3C	19 May, 20 June, 6, 20 July, 3 August
4. Biocover MLT	128.0 fl.oz./100	DD, 5C	15 March, 3 August
Asana XL	19.2 fl.oz./A	WB	21 April
Actara	5.5 oz./A	PF	5 May
AgriMek	20.0 fl.oz./A	10pPF + 21d	19 May, 20 June
Delegate WG	7.0 oz./A	3-4C	6, 20 July
Biocover MLT	32.0 fl.oz./100	10pPF + 21d, 3-4C	19 May, 20 June, 6, 20 July
5. Biocover MLT	128 fl.oz./100	DD, 5C	15 March, 3 August
Actara	5.5 oz./A	PF	5 May
AgriMek	20.0 fl.oz./A	10pPF + 21d	19 May, 20 June
Delegate WG	7.0 oz./A	3-4C	6, 20 July
Biocover MLT	32.0 fl.oz./100	10pPF + 21d, 3-4C	19 May, 20 June, 6, 20 July
6. Biocover MLT	256.0 fl.oz./100	DD, 5C	15 March, 3 August
Biocover MLT	32.0 fl.oz./100	10pPF + 21d WB, 3-5C	30 March, 19 May, 20 June, 6, 20 July
Centaur	46.0 oz./A	WB, 3C	30 March,
AgriMek	20.0 fl.oz./A	10pPF + 21d	19 May, 20 June
Delegate WG	7.0 oz./A	3-4C	6, 20 July
7. Biocover MLT	256.0 fl.oz./100	DD, 5C	15 March, 3 August
Biocover MLT	32.0 fl.oz./100	10pPF + 21d WB, 3-4C	30 March, 30 March, 19 May, 20 June, 6, 20 July
Esteem 35WP	5.0 oz./A	WB, 3C	30 March,
AgriMek	20.0 fl.oz./A	10pPF + 21d	19 May, 20 June
Delegate WG	7.0 oz./A	3-4C	6, 20 July
8. UTC			

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

Table 9 Evaluations Of Insecticide Schedules For Controlling Insect Complex On Pear [A]. Hudson Valley Research Lab. Highland N.Y. -2016.

Treatment / Formulation	Rate	Pear psylla Nymphs per 25 leaf or bud sample					
		10 May	18 May	1 June	13 June	30 June	12 July
1 BioCover Oil	128.0 fl.oz./100	0.1 a	0.0 a	2.3 c	1.7 a	5.1 a	1.0 cd
2. BioCover Oil	128.0 fl.oz./100	0.1 a	0.0 a	0.5 a	2.2 a	3.8 a	0.7 abc
+ Surround	12.5 lbs./100						
3. Surround	12.5 lbs./100	0.0 a	0.3 a	0.9 ab	2.6 a	3.1 a	1.0 bcd
BioCover Oil	128.0 fl.oz./100						
4. BioCover Oil	128.0 fl.oz./100	0.1 a	0.3 cd	1.9 bc	4.3 a	2.3 a	0.6 abc
BioCover Oil	32.0 fl.oz./100						
Asana XL	19.2 fl.oz./A						
Actara	5.5 oz./A						
AgriMek	20.0 fl.oz./A						
Delegate	7.0 oz./A						
5. BioCover Oil	128.0 fl.oz./100	0.2 ab	0.2 a	1.2 abc	3.8 a	5.4 a	0.4 ab
BioCover Oil	32.0 fl.oz./100						
Centaur 0.7WDG	46.0 oz./A						
AgriMek	20.0 fl.oz./A						
Delegate	7.0 oz./A						
6. BioCover Oil	256.0 fl.oz./100	0.2 a	0.3 a	1.2 bc	2.9 a	2.0 a	0.2 a
BioCover Oil	32.0 fl.oz./100						
Esteem 35WP	5.0 oz./A						
AgriMek	20.0 fl.oz./A						
Delegate	7.0 oz./A						
7. BioCover Oil	256.0fl.oz./100	0.1 a	0.3 a	1.4 abc	3.9 a	3.2 a	0.3 ab
BioCover Oil	32.0 fl.oz./100						
AgriMek	20.0 fl.oz./A						
Delegate	7.0 oz./A						
8. UTC		0.4 b	1.1 b	5.5 d	12.5 a	4.5 a	1.4 d
P value for transformed data		0.0312	0.0473	0.0001	0.0001	0.4308	0.0122

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

Table 10 Evaluations Of Insecticide Schedules For Controlling Insect Complex On Pear [A]. Hudson Valley Research Lab. Highland N.Y. -2016.

Treatment / Formulation	Rate	Pear psylla Eggs per 25 leaf sample					
		10 May	18 May	1 June	13 June	30 June	12 July
1 BioCover Oil	128.0 fl.oz./100	0.9 abc	0.3 a	17.0 a	7.2 abc	3.7 a	1.9 b
2. BioCover Oil + Surround	128.0 fl.oz./100 12.5 lbs./100	0.1 a	0.1 a	8.4 a	6.0 ab	3.2	1.1 ab
3. Surround BioCover Oil	12.5 lbs./100 128.0 fl.oz./100	0.2 ab	0.0 a	10.5 a	3.7 a	1.7 a	1.3 ab
4. BioCover Oil BioCover Oil Asana XL Actara AgriMek Delegate	128.0 fl.oz./100 32.0 fl.oz./100 19.2 fl.oz./A 5.5 oz./A 20.0 fl.oz./A 7.0 oz./A	1.1 abc	0.9 ab	23.6 a	10.0 bc	1.6 a	1.3 ab
5. BioCover Oil BioCover Oil Centaur 0.7WDG AgriMek Delegate	128.0 fl.oz./100 32.0 fl.oz./100 46.0 oz./A 20.0 fl.oz./A 7.0 oz./A	1.8abc	1.1 ab	12.7 a	11.4 bc	3.3 a	0.5 a
6. BioCover Oil BioCover Oil Esteem 35WP AgriMek Delegate	256.0 fl.oz./100 32.0 fl.oz./100 5.0 oz./A 20.0 fl.oz./A 7.0 oz./A	2.8 c	1.5 b	12.8 a	7.5 abc	1.5 a	0.8 a
7. BioCover Oil BioCover Oil AgriMek Delegate	256.0 fl.oz./100 32.0 fl.oz./100 20.0 fl.oz./A 7.0 oz./A	1.7 abc	0.7 ab	4.7 a	12.2 c	3.0 a	0.6 a
8. UTC		2.3 bc	1.5 b	52.9 b	19.7 d	3.3 a	1.2 ab
P value for transformed data		0.1319	0.029	0.003	0.0005	0.4603	0.1401

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

Evaluation of herbicide programs for control of orchard weed pests.
PEAR (*Pyrus communis)*

Common Name	**Scientific Name**	Foxtail	*Alopecurus sp.*
Orchard Grass	*Dactylis glomerata*	Oriental Bittersweet	*Celastrus orbiculatus*
Quack Grass	*Elymus repens*	Common Mullein	*Verbascum thapsus*
Dandelion	*Taraxacum officinale*	Wild heath Aster	*Symphyotrichum ericoides*
Thistle	*Cirsium sp.*	Ground Ivy	*Glechoma hederacea*
White Clover	*Trifolium repens*	Lamb's Quarter	*Chenopodium album*
Virginia Creeper	*Parthenocissus quinquefolia*	Common Mallow	*Malva neglecta*
		Cypress Spurge	*Euphorbia cyparissias*
Barnyard Grass	*Echinochloa sp*	Wild Mulberry	*Morus sp.*
Crabgrass	*Digitalia sp*	Heal-all	*Prunella vulgaris*
Pigweed	*Amaranthus sp.*	Buckhorn Plantain	*Plantago lanceolata*
Burdock	*Arctium sp.*	Common Pokeweed	*Phytolacca americana*
Broadleaf Plantain	*Plantago major*	Timothy Grass	*Phleum pratense*
Tree of Heaven	*Ailanthus altissima*		

A trial to evaluate the effectiveness of herbicide programs for the management of the spring and summer weed complex in pome fruit was conducted using a single application made on the 23rd of March using a 25 gallon Spray King trailered sprayer with electric pump at 25 psi. at 39.5 GPA. All treatments received LI-700 at 0.125%. Temperature during application ranged between 61.4 – 66.5 F (average temperature 64.2 F), Wind speed and direction was South at 1.7-4.4 mph (average mph of 3.3) with rainfall beginning 48 hours after the last treatment, totaling 0.15" within 48 hours and 0.8" within 6 days post application. Six randomized replicates were applied with 3 replicates evaluated.

Trmt #	Treatment *	Material #1	Rate	Material #2	Rate	Material #3	Rate
1	Alion + Rely	Rely	5.0 pts/A	Alion 1.67	5.6 oz/A		
2	Alion + Glyphosate	Glyphosate	2.0 qts./A	Alion 1.67	5.6 oz/A		
3	Alion + Gramoxone	Gramoxone	2.0 qts./A	Alion 1.67	5.6 oz/A		
4	Glyphosate alone	Glyphosate	2.0 qts./A				
5	Gramoxone alone	Gramoxone	3.5 pts/A				
6	Gramoxone + Simazine + Diuron (1/2 rate)	Gramoxone	3.5 pts/A	Simazine 90 DF	1.1 lbs/A	Diuron 80 DF	1.25 lbs/A
7	Gramoxone + GoalTender	Gramoxone	3.5 pts/A	Goal Tender	3 pts/A		
8	Control	Control	na				
* LI-700 at 0.125% added to all spray treatments							

Table 11a

Assessment of % Area Infested 18th May

Trt.	Materials	I	II	III	Mean	Weeds Plants:
1	Alion (Indaziflam) Rely 280 (Glufosinate) LI-700	5	10	15	10	Orchard Grass, Quack Grass, White Clover, Virginia Creeper, Broadleaf Plantain, Common Mullein, Wild Heath Aster, Ground Ivy, Wild Mulberry
2	Alion (Indaziflam) Honcho Plus (Glyphosate) LI-700	2	2	5	2	Orchard Grass, Quack Grass, Thistle, White Clover, Virginia Creeper, Oriental Bittersweet, Broadleaf Plantain, Common Mallow, Heal-all
3	Alion (Indaziflam) Gramoxone SL 2.0 (Paraquat) LI-700	5	10	15	10	Ochard Grass, Quack Grass, Dandelion, White Clover, Barnyard Grass, Virginia Creeper, Pigweed, Burdock, Tree of Heaven, Broadleaf Plantain, Ground Ivy, Lamb's Quarter, Buckhorn Plantain
4	Honcho Plus (Glyphosate) LI-700	8	5	5	6	Orchard Grass, Dandelion, White Clover, Virginia Creeper, Barnyard Grass , Oriental Bittersweer, Tree of Heaven, Broadleaf Plantain, Lamb's Quarter
5	Gramoxone SL 2.0 (Paraquat) LI-700	15	25	50	30	Orchard Grass, Dandelion, Thistle, White Clover, Virginia Creeper, Barnyard Grass, Plantain, Crabgrass, Burdock, Broadleaf Plantain, Wild Heath Aster, Ground Ivy, Lamb's Quarter, Wild Mulberry, Buckhorn Plantain, Common Pokeweed
6	Gramoxone SL 2.0 (Paraquat) Simazine 90 DF (Simazine) Parrot DF (Diuron) LI-700	25	25	10	20	Dandelion, Thistle, White Clover, Virginia Creeper, Barnyard Grass, Tree of Heaven, Common Mullein, Wild Heath Aster , Ground Ivy, Lamb's Quarter, Cypress Spurge,
7	Gramoxone SL 2.0 (Paraquat) GoalTender (Oxyfluorfen) LI-700	10	10	10	10	Orchard Grass, Dandelion, Thistle, White Clover, Virginia Creeper, Baryard Grass, Oriental Bittersweet, Broadleaf Plantain, Wild Heath Aster, Ground Ivy, Lamb's Quarter, Cypress Spurge
8	Control	80	90	95	88.33	Orchard Grass, Quack Grass, Dandelion, White Clover, Virginia Creeper, Barnyard Grass, Foxtail, Broadleaf Plantain, Common Mullein, Wild Heath Aster, Ground Ivy, Lamb's Quarter

Table 11 b

Assessment of % Area Infested 1st July

Trt.	Materials	I	II	III	Mean	Weeds Plants:
1	Alion (Indaziflam) Rely 280 (Glufosinate) LI-700	15	20	55	30.0	Orchard Grass, White Clover, Broadleaf Plantain, Thistle, Virginia Creeper, Quack Grass
2	Alion (Indaziflam) Honcho Plus (Glyphosate) LI-700	10	10	50	23.3	Oriental Bittersweet, Virginia Creeper, White Clover, Plantain, Orchard Grass
3	Alion (Indaziflam) Gramoxone SL 2.0 (Paraquat) LI-700	15	65	35	38.3	Orchard Grass, White Clover, Dandelion, Tree of Heaven, Virginia Creeper, Broadleaf Plantain
4	Honcho Plus (Glyphosate) LI-700	100	95	100	98.3	Orchard Grass, Wild Heath Aster, Ground Ivy, Quack Grass, White Clover, Timothy
5	Gramoxone SL 2.0 (Paraquat) LI-700	95	100	100	98.3	Thistle, Pigweed, Broadleaf Plantain, Lamb's Quarter, Timothy, Virginia Creeper, Quack Grass, Wild Heath Aster, White Clover, Orchard Grass, Common Mallow, Buckhorn Plantain
6	Gramoxone SL 2.0 (Paraquat) Simazine 90 DF (Simazine) Parrot DF (Diuron) LI-700	80	90	80	83.3	Common Mullein, Broadleaf Plantain, Heal-All, Orchard Grass, Quack Grass, Thistle, Dandelion, Oriental Bittersweet, Virginia Creeper, Lamb's Quarter, Buckhorn Plantain, Tree of Heaven
7	Gramoxone SL 2.0 (Paraquat) GoalTender (Oxyfluorfen) LI-700	75	70	70	71.7	Broadleaf Plantain, Common Mallow, Orchard Grass, Buckhorn Plantain, Common Mullein, Heal-All, Wild Heath Aster, Oriental Bittersweet
8	Control	100	100	100	100.0	Cypress Spurge, Common Mallow, Wild Heath Aster, Quack Grass, Broadleaf Plantain, Virginia Creeper, Lamb's Quarter, White Clover

Photos: 1st July

Treatment 1

Treatment 2

Treatment 3

Treatment 4

Treatment 5

Treatment 6

Treatment 7

Treatment 8

EVALUATION OF ATTRACT AND KILL DISKS FOR CONTROLLING SPOTTED WING DROSOPHILA (*Drosophila suzukii* Matsumura) IN HUDSON VALLEY RASPBERRY - 2016

RASPBERRY: *Rubus idaeus* L
SPOTTED WING DROSOPHILA: (SWD) *Drosophila suzukii* Matsumura

Attract and Kill bait stations were applied to 1 acre raspberry plantings on 2 organic and 1 conventional farm sites in the mid-Hudson Valley region of New York using randomized complete block designs within each site. Attract and Kill bait stations were comprised of 3" diameter netted disks, brewers yeast, gelatin, super-absorbent polymer, apple cidar vinegar and red raspberry concentrate as bait solution. Treatments applied to disks were made with a mechanical spray bottle calibrated to deliver 2 mL of AtK solution to each disk. Randomized block treatment configuration included disk spacing (1.5' or 3' apart in raspberry row), spray intervals (3-4 day or 7 day spray timing), treated and untreated disk plots employing 1% Boric Acid as the toxicant. Three rowstimings for placement were made on 1st adult emergence in NYS on 14th June, 1st trap capture on 19th June and 1st oviposition of fruit. Three replicates of each treatment were made using individual rows as replicates. Treatments were applied to individual rows on each farm based on 1st SWD in NY or, 1st SWD on farm site or and 1st SWD oviposition of fruit or to determine if tere were differences in placement timings. Weekly fruit samples were taken from each site, selecting 25 berries from each treatment. Berries were weighed and egg or larvae assessed. Infested fruit was analyzed using Fishers Protected LSD ($P \leq 0.05$). Treatment means followed by the same letter are not significantly different. Arithmetic means reported.

Table 12 Evaluations Of Attract and Kill disks for Controlling Spotted Wing Drosophila in Raspberry. N.Y.S.A.E.S. Hudson Valley Lab. Highland N.Y. - 2016

			Eggs/Larvae Per Gram In Sampled Fruit					
Formulation	Rate	Timing	PFP	% Redu.	WestWind	% Redu	Trapani	% Redu
Red- Boric Acid	1%	2x Weekly	0.20 a	78.0%	0.16 a	42.9%	0.03 a	80.0%
Red- Boric Acid	1%	1x Weekly	0.22 a	76.2%	0.11 a	60.7%	0.05 a	66.7%
Yellow- Boric Acid	1%	2x Weekly	0.28 a	69.2%	0.22 a	21.4%	0.07 a	53.3%
Yellow- Boric Acid	1%	1x Weekly	0.14 a	84.6%	0.22 a	21.4%	0.02 ab	86.7%
White- No Spray	0%	2x Weekly	0.24 a	72.6%	0.24 a	14.3%	0.12 ab	20.0%
White- No Spray	0%	1x Weekly	0.35 a	61.5%	0.26 a	7.1%	0.10 ab	33.3%
UTC - No Disks			0.91 b	-	0.28 a	-	0.15 ab	-
P value for transformed data			0.0001		0.7993		0.4415	

Red: Disks spaced 1.5" apart (20 disks per section)
Yellow: Disks spaced 3" apart (10 disks per section)
White: Disks spaced 3" apart (10 disks per section, Unsprayed)

A. 1st SWD in NY (14th June)
B. 1st SWD on site (19th June)
C. 1st SWD oviposition of fruit (25th June)

Raspberry: *Rubus idaeus* L
Spotted Wing Drosophila: (SWD) *Drosophila suzukii* Matsumura

Evaluation Of Attract And Kill Disks for Controlling Spotted Wing Drosophila (*Drosophila suzukii* Matsumura) in Laboratory Efficacy Screening Studies – 2016

Introduction: *Drosophila suzukii* is a newly invasive insect to the Northeast United States, with a native range in Southeast Asia, where it is predominantly a pest of cherry. Due to specialized ovipositor capable of oviposition into unripened fruit, high fecundity, and short generational time, lack of native parasitoids and rapid rate of infestation, *D. suzukii* has become a serious pest of small fruit such as raspberries, blackberries, and blueberries, occasionally opportunistic in cherry, plum, and peach. First establishing in the region in 2011, *D. suzukii* infestations have attained 90-100% fruit loss in organic raspberry by 2012.

Conventional orchards obtain control of the pest employing tight interval spray programs, yet organic growers have relatively few options for management with a high degree of risk for development of insecticide resistance. IPM management strategies are needed to develop resistance management strategies for SWD that include cultural controls using infested fruit removal, harvest management timing, trap-out and cold storage of fruit in organic production systems to obtain marketable fruit. To assist conventional and organic growers in SWD management, development of attract-and-kill (AtK) system has been designed, manufactured and tested in the laboratory to reduce SWD populations to minimize fruit infestation. Field placed disks exhibit environmental moisture absorption and volatile release with attractant shape, color and size.

Materials and Methods: Attract and Kill (AtK) disks formed in petri dishes employ a polypropylene net disk base, layered with brewers yeast, gelatin, super-absorbent polymer to which apple cider vinegar and red raspberry concentrate is applied as a AtK bait solution. To assess the efficacy of AtK disks, bait solution containing 1% boric acid was applied to treated disks using a mechanical spray bottle calibrated to deliver 1 mL of AtK solution to each side of the disk. A rearing room held at 70°F and 75% rH was used with 13 gravid female and 12 male SWD adults released to insect cages containing disks, organic raspberries, 1 oz. container of water suspended in superabsorbent polymer, and held for 48 hours, during which time oviposition and adult SWD mortality was assessed. Three different disks of 9, 6.5, and 5 cm in diameter (small, medium large), placed singularly or as duel disks (2x) were used in comparative studies with untreated (UT) AtK disks. Additionally, efficacy studies layered with pretreated insecticide net (ZeroFly Vestergaard: Deltamethrin) with and without treated disk were included in the study.

Results: The 1% boric acid treated disks had significantly different (SD) and higher levels of mortality of SWD compared to the untreated disks . While both treated and untreated disks increased mortality over the UTC in all but one trial. Small disks attached to ZeroFly® netting did not show a significant increase in adult mortality compared to small disks alone. Two disk comparisons (2x) to single disks was not SD in mortality, yet two disks yielded numerical improvements in ovipositional deterrence in most trials. Smallest disks (5cm) exhibited a slightly higher adult mortality than medium and large disks.

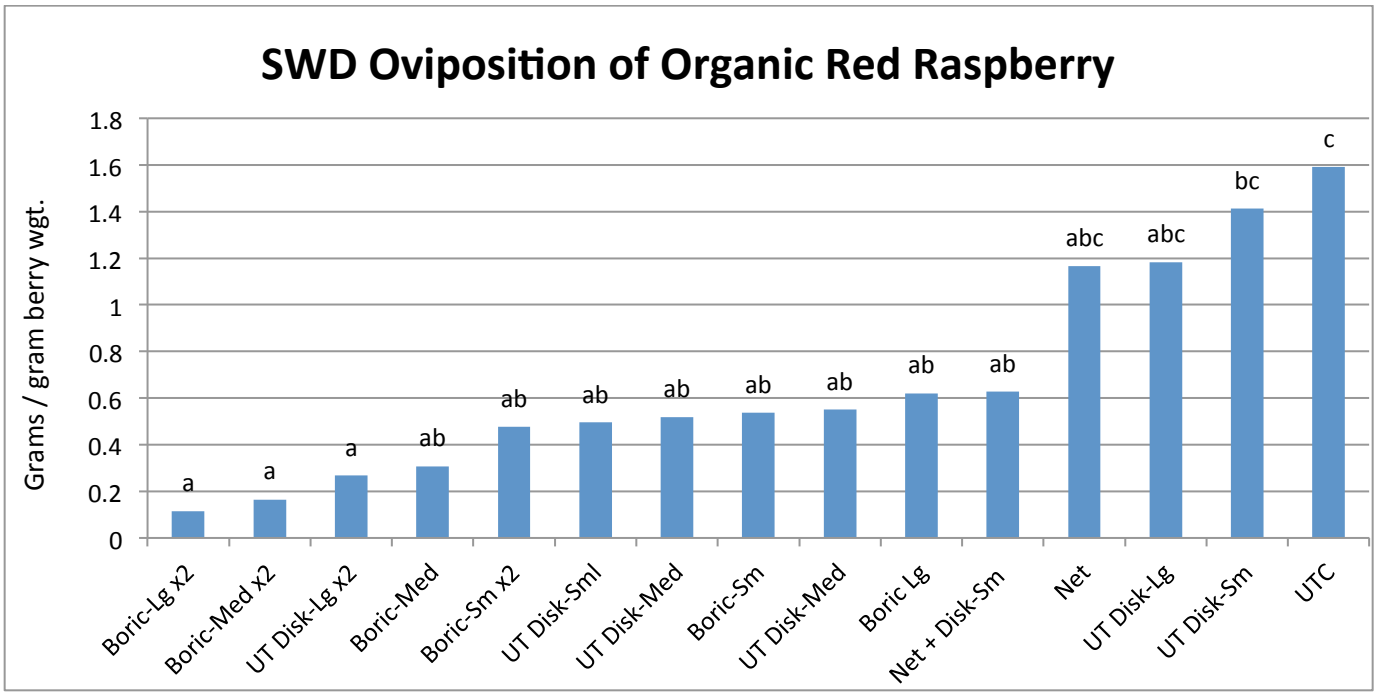
Analysis of variance was performed on fly mortality and oviposition as eggs and or larvae per gram of fruit at 48 hours. Generally, 1% boric acid disks performed statistically better then SWD, indeed, the addition of a second disk only led to modest increases in efficacy at 48 hours, indicating that at such close ranges it may not be necessary to have a large number of these disks. However, in field tests, doubling the number of disks in a row of raspberries does reduce oviposition. Use of smaller disks to cut down on material usage is an option that won't adversely affect the efficacy of these materials.

Table 13 Attract and Kill Station Screening to Manage Spotted Wing Drosophila in Raspberry

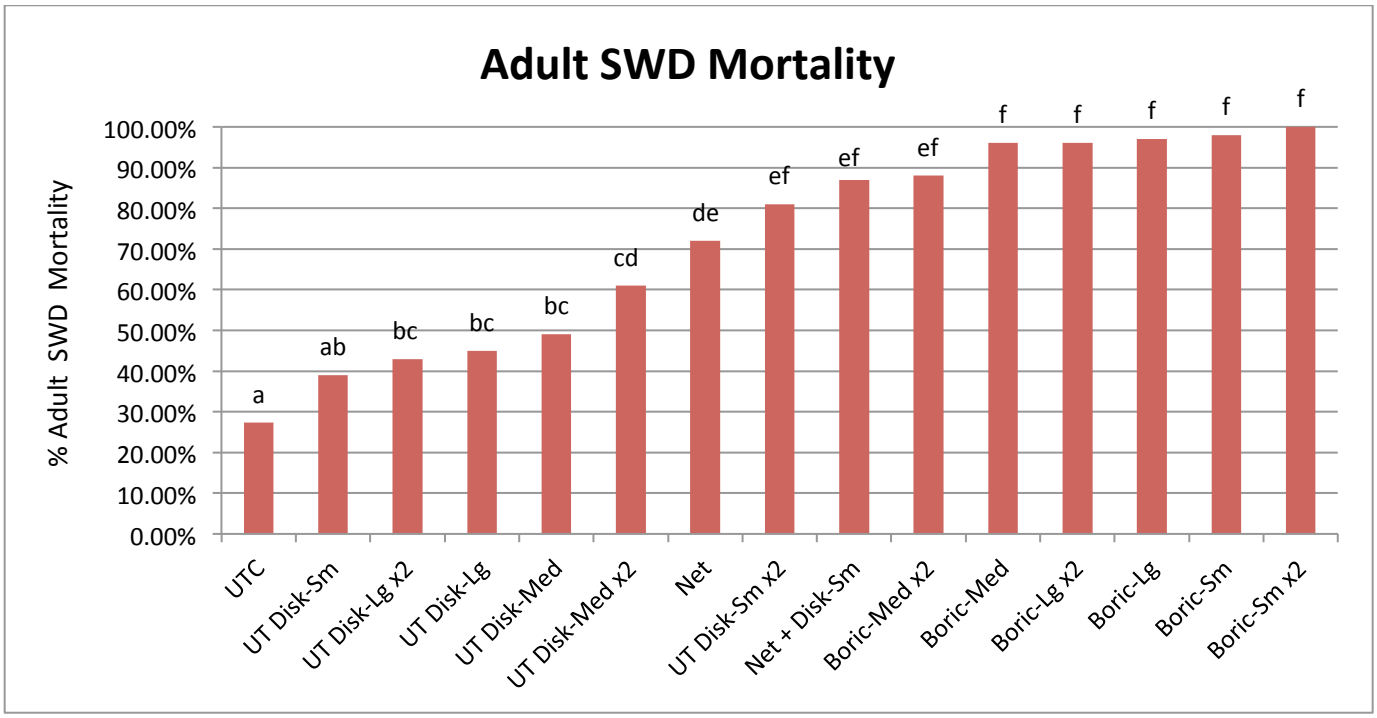
	Mean incidence of adult mortality and oviposition in fruit	
Treatment	% Mortality	Eggs Per Gram
1 UTC	27.4 a	1.6 c
2 Boric- Lg	97.0 f	0.6 ab
3 Boric- Med	96.0 f	0.3 ab
4 Boric- Med x2	88.0 ef	0.2 a
5 Boric- Sm	98.0 f	0.5 ab
6 Boric- Sm x2	100.0 f	0.5 ab
7 Boric-Large x2	96.0 f	0.1 a
8 Net w/no Disk	72.0 de	1.2 ab
9 Net + Disk	87.0 ef	0.6 ab
10 UT Disk Lg	45.0 bc	1.2 ab
11 UT Disk Med	47.0 bc	1.0 ab
12 UT Disk Med x2	61.0 cd	0.6 ab
13 UT Disk Sm	39.0 ab	1.4 bc
14 UT Disk Sm x2	81.0 ef	0.4 ab
15 UT Disk- Lg x2	43.0 bc	0.3 a
P Value	0.0001	0.003

Analysis of Variance (ANOVA) performed on dataset. Significance figures obtained via Fishers Protected LSD. Different letters indicate statistical separation.

Large(Lg): 9cm, Medium(Med): 6.5cm, Small(Sm): 5cm, UT: Untreated

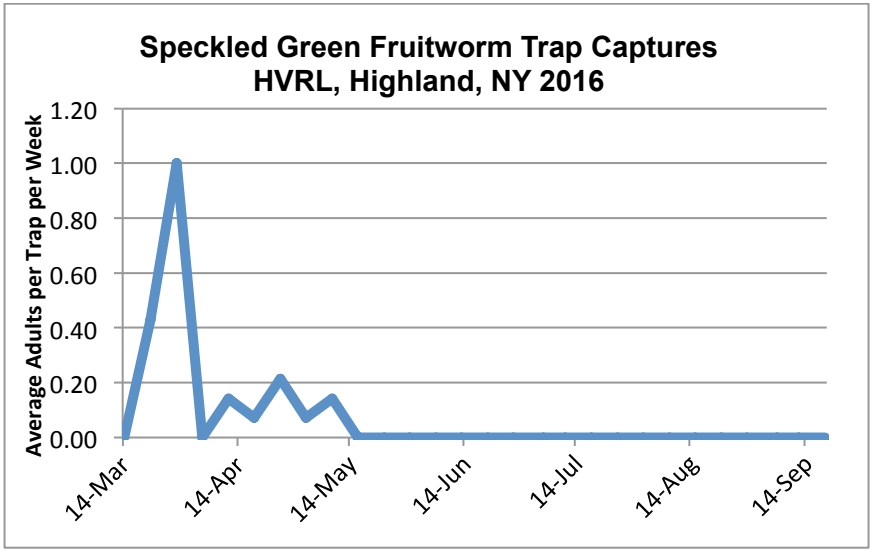


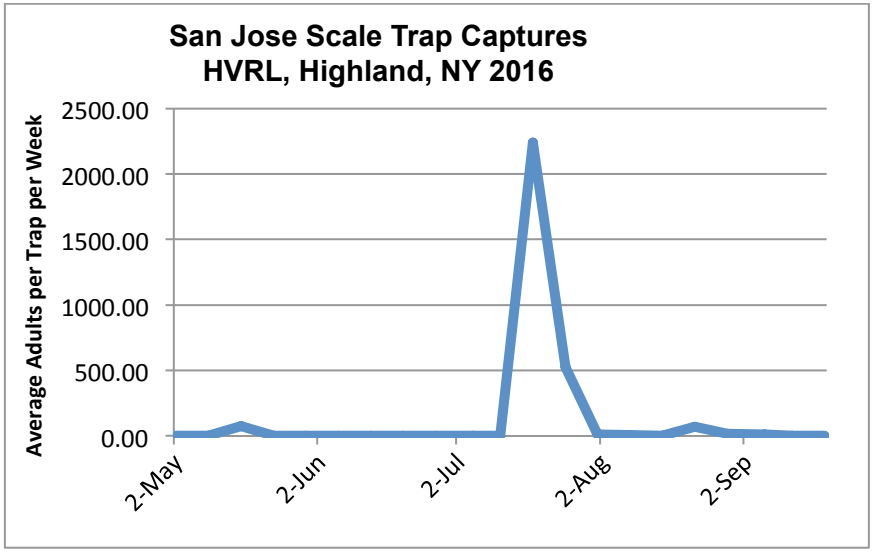
Graph 1 SWD oviposition (eggs / G. berry weight) of 5 organic raspberry in caged studies with AtK stations over 48 hrs..

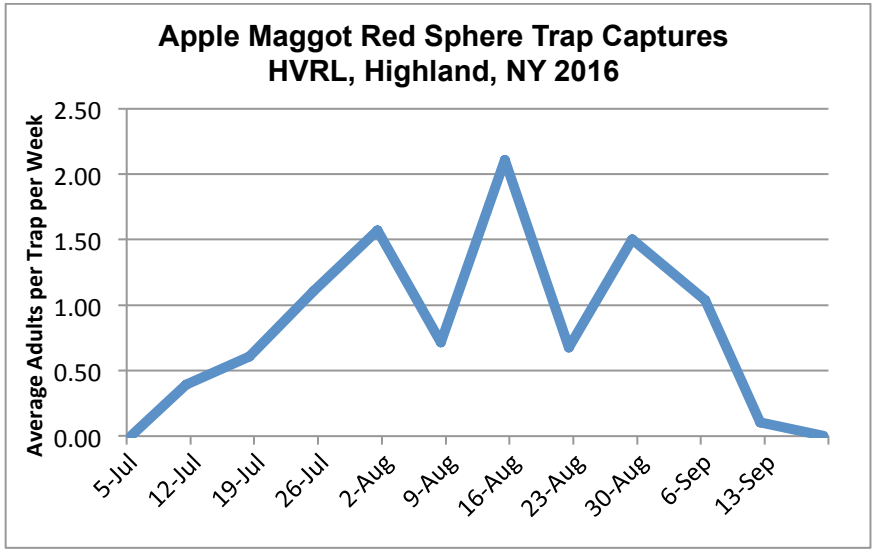


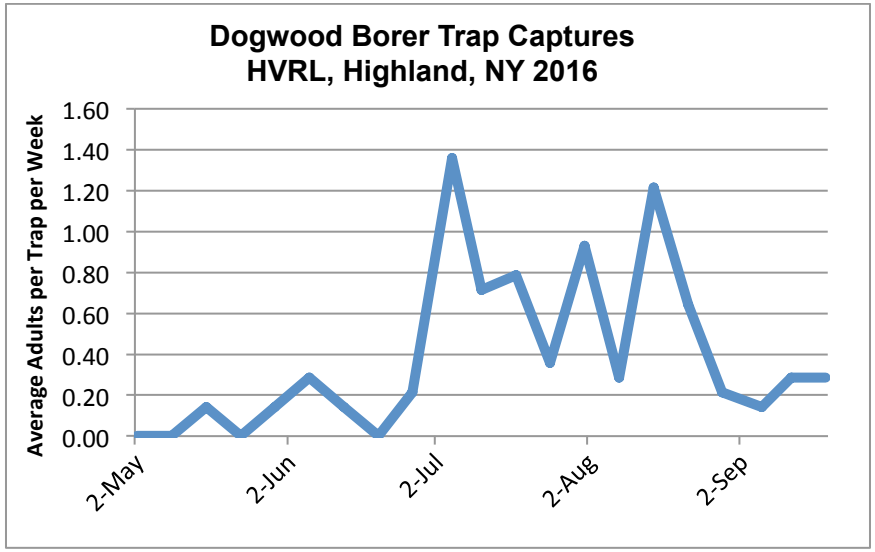
Graph 2 SWD mortality of 25 adults in caged studies with AtK stations over 48 hours.

2016 HVRL Trapping Network (7d totals employing 1 trap in each two orchards blocks).

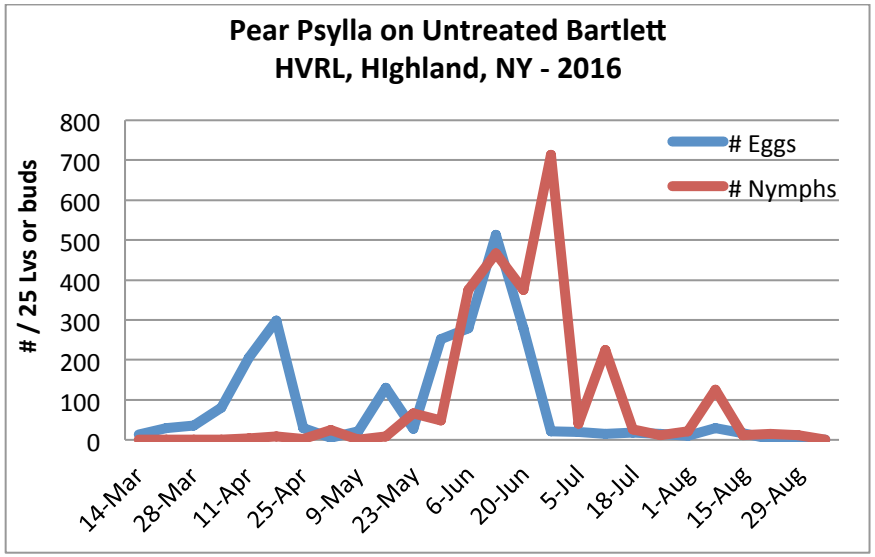


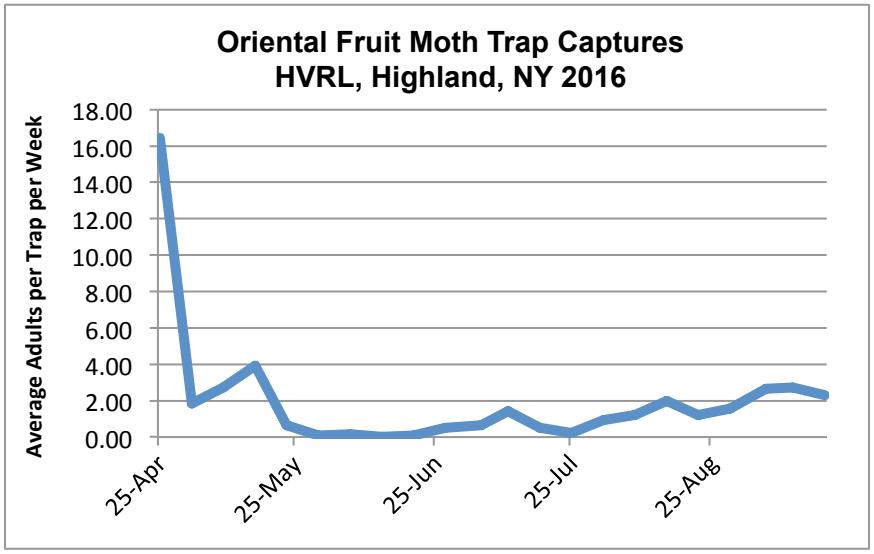


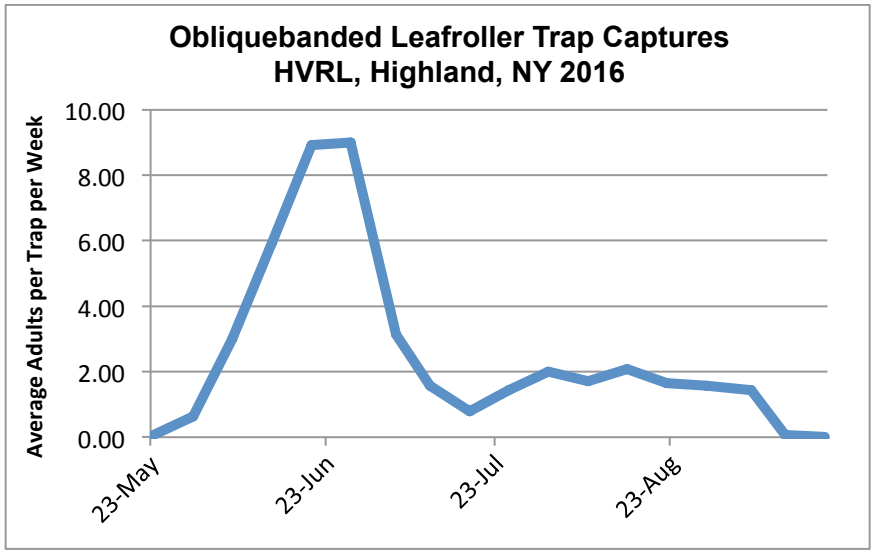


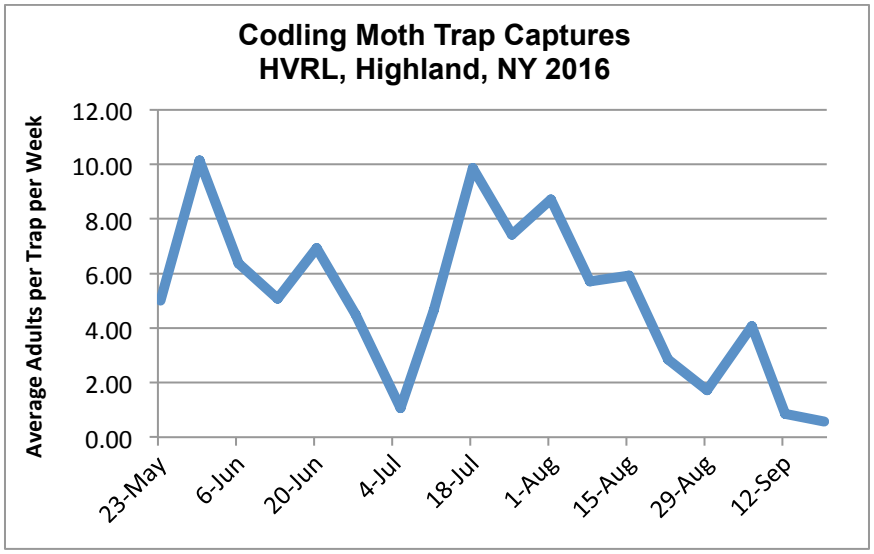


2016 HVRL Trapping Network Con't.

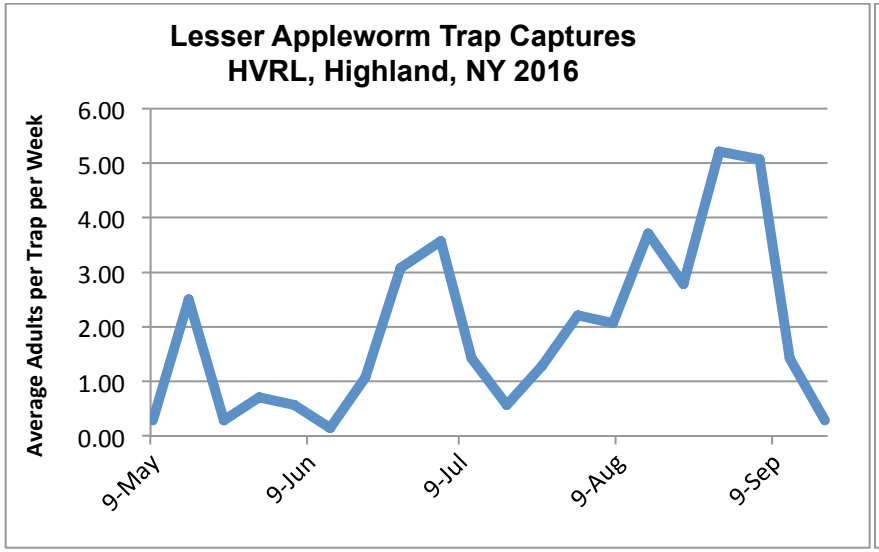


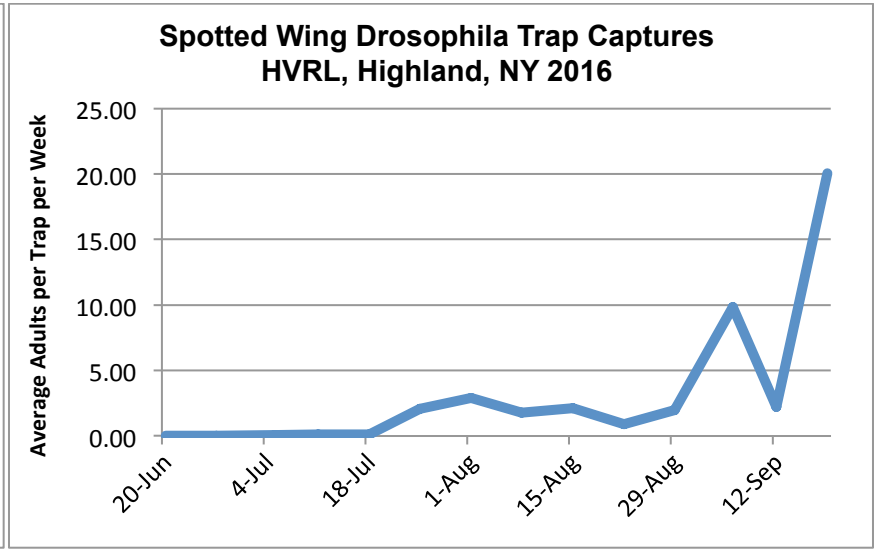


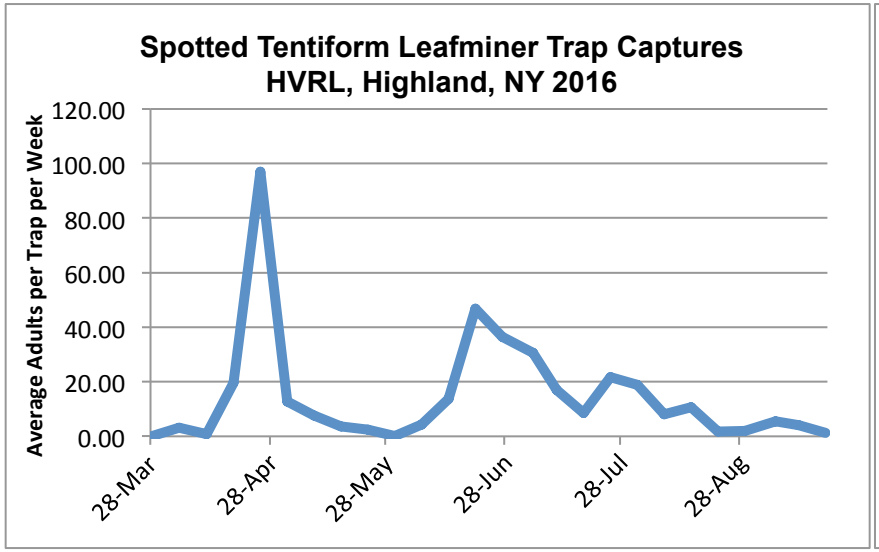


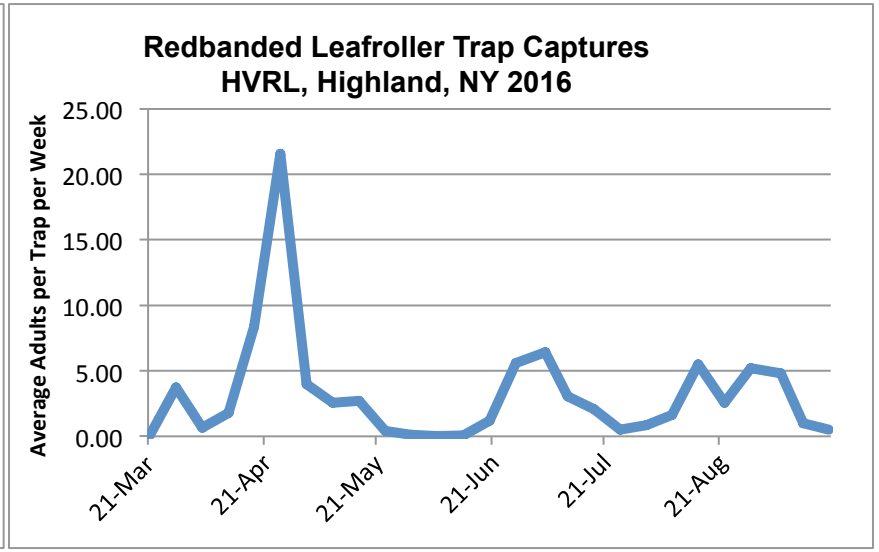


2016 HVRL Trapping Network Con't.

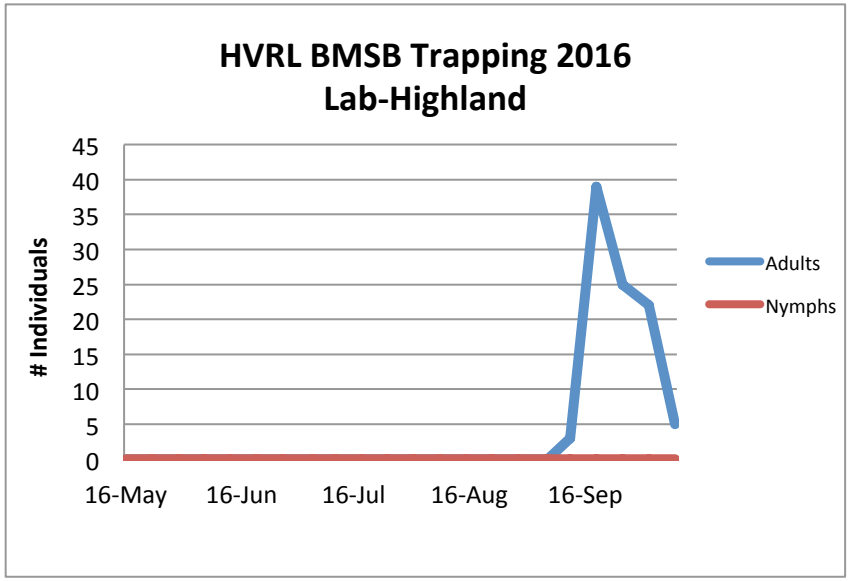


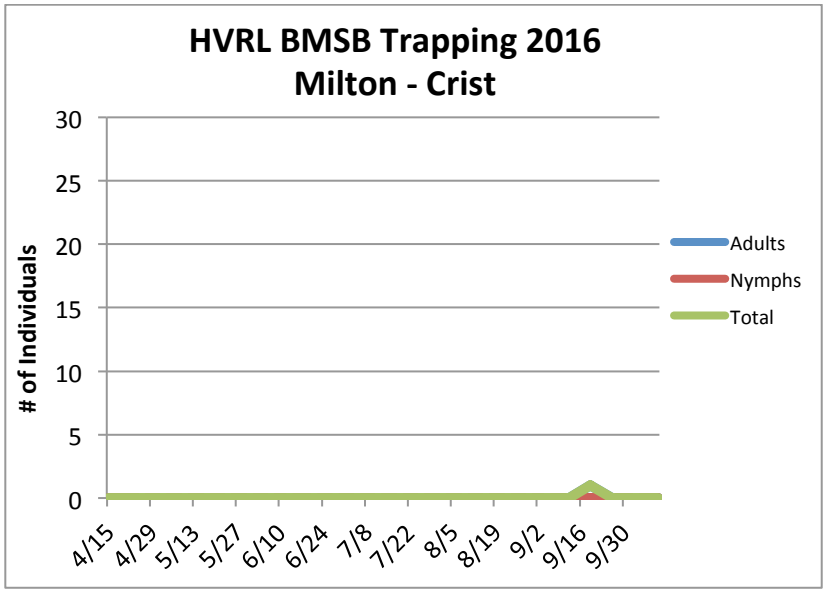


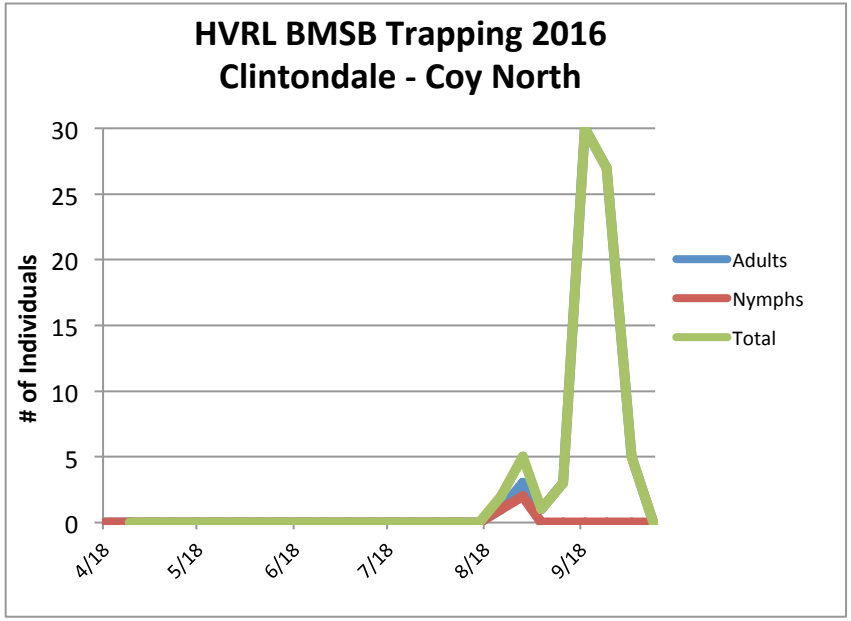


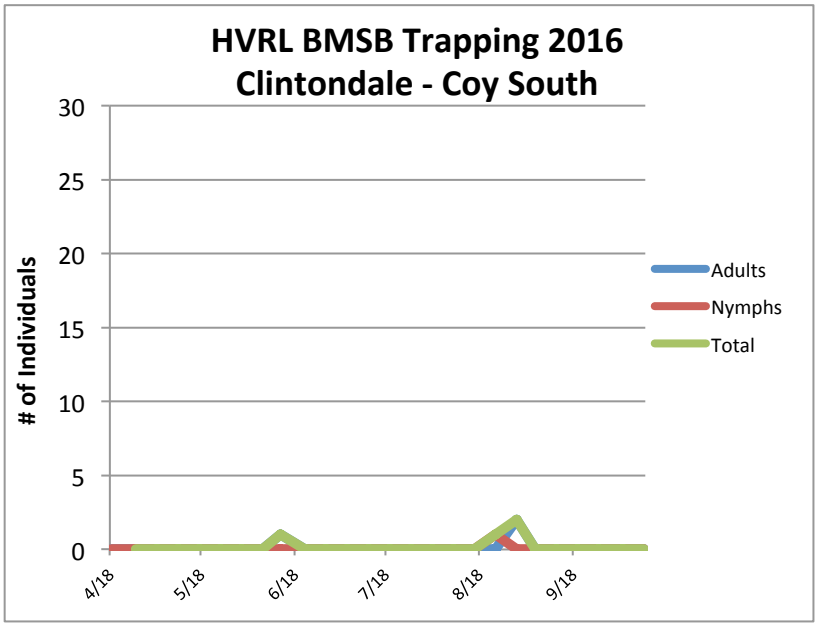


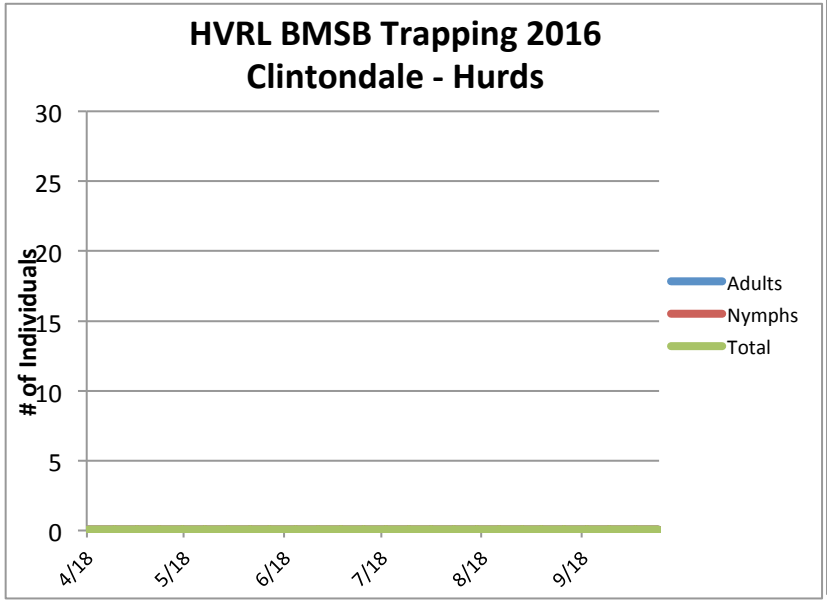
2016 HVRL Trapping Network Con't.

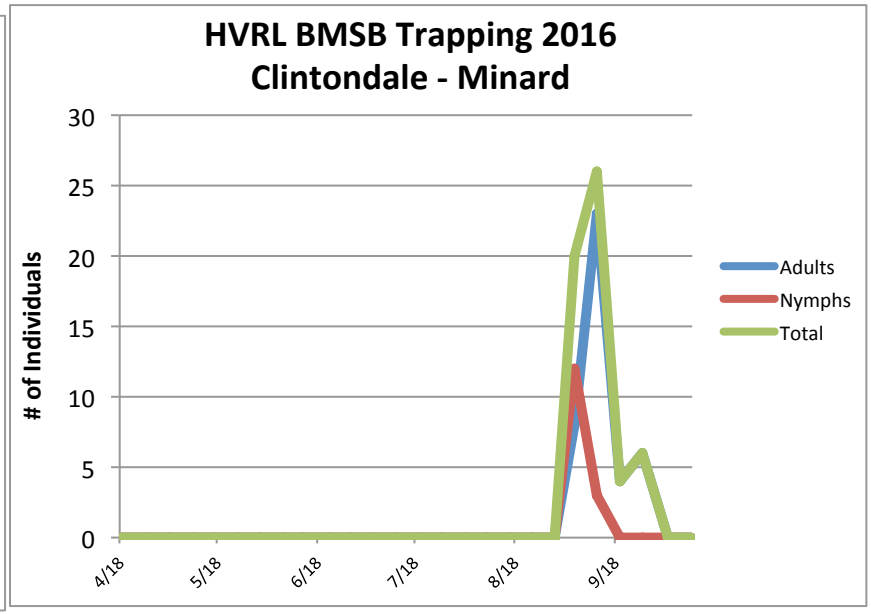


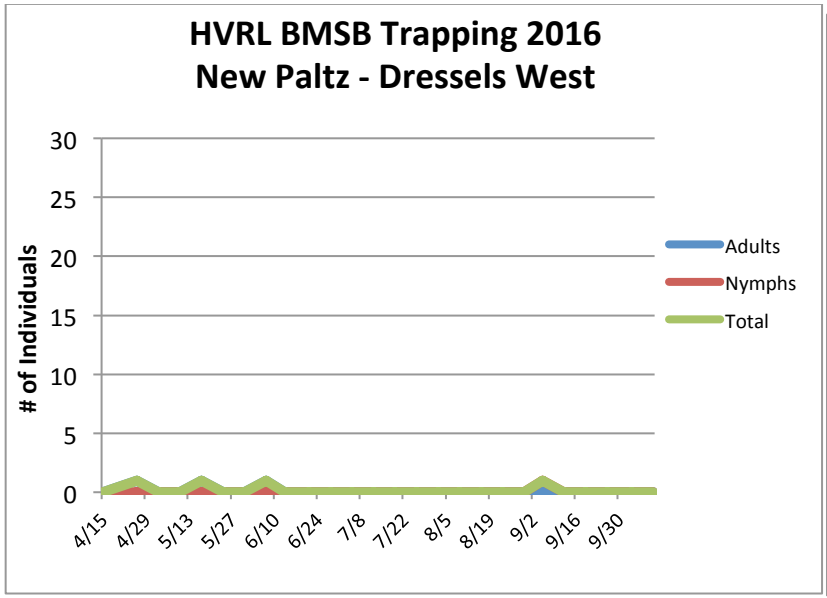


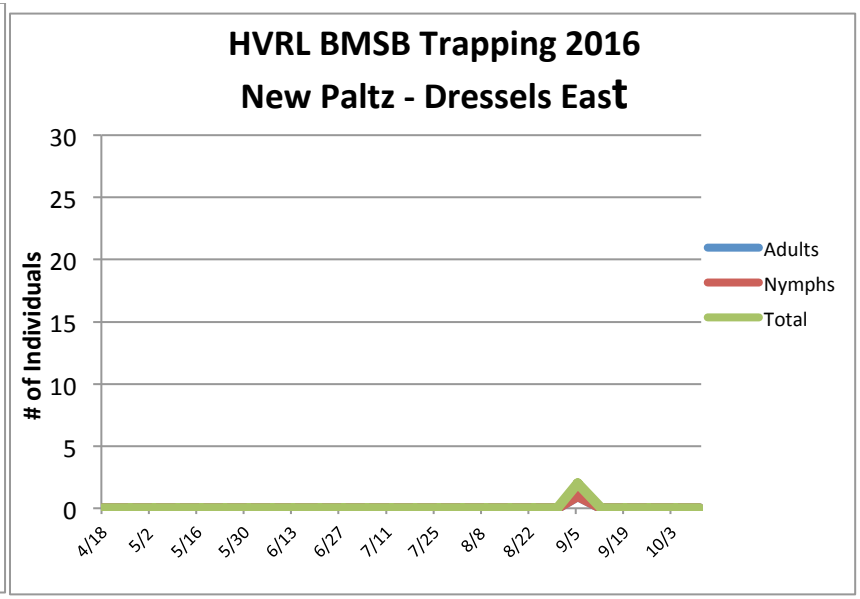


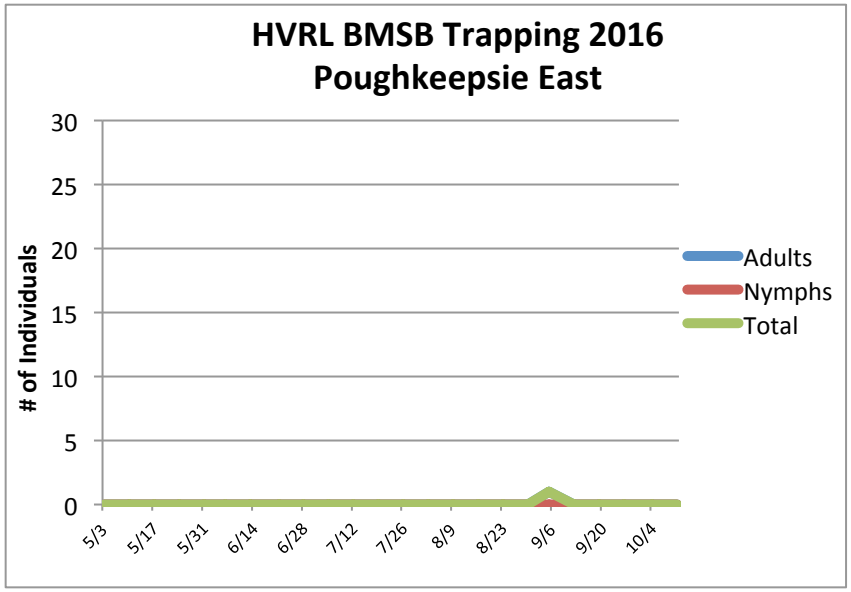


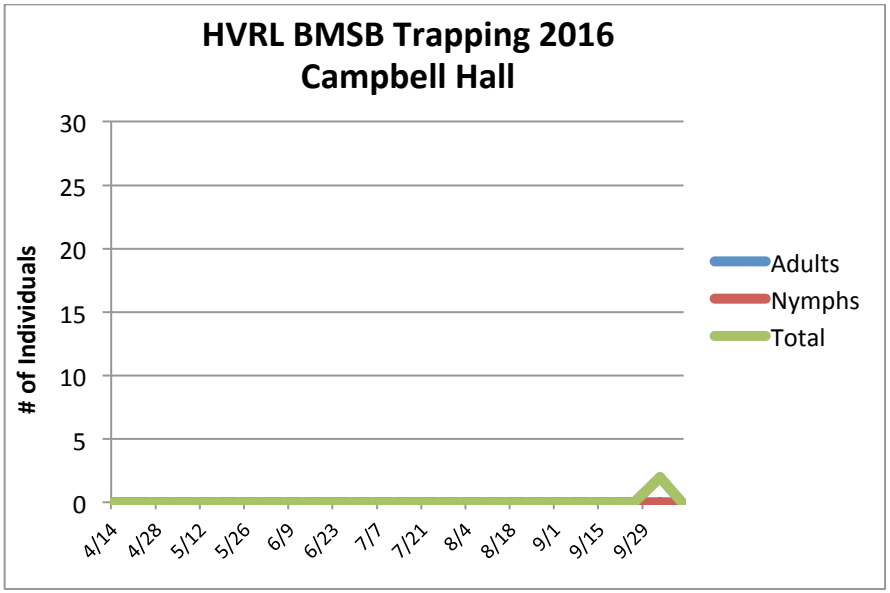

HVRL BMSB Trapping 2016
Clintondale - Hurds
# of Individuals
30
25
20
15
10
5
0
4/18
5/18
6/18
7/18
8/18
9/18
Adults
Nymphs
Total

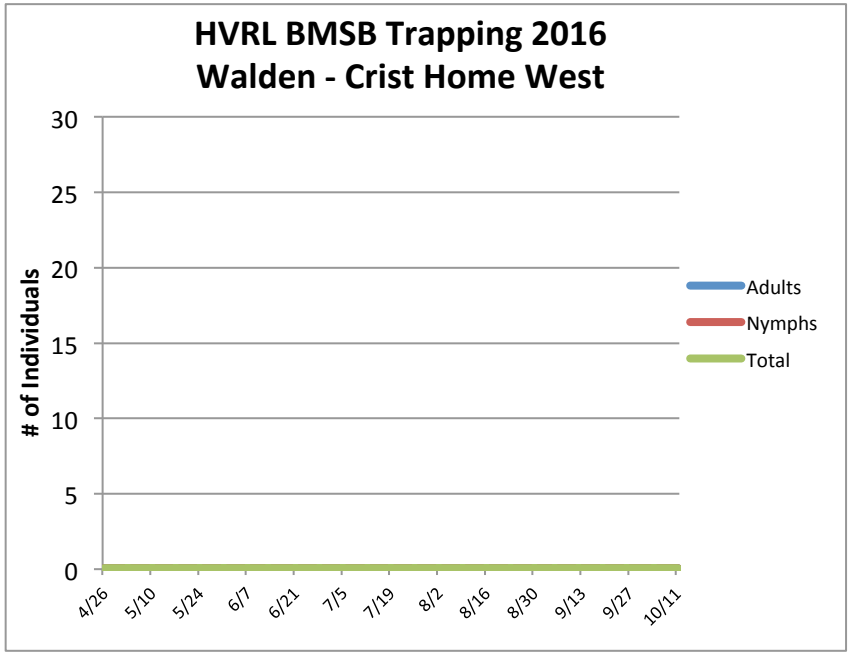

HVRL BMSB Trapping 2016
Clintondale - Minard
# of Individuals
30
25
20
15
10
5
0
4/18
5/18
6/18
7/18
8/18
9/18
Adults
Nymphs
Total

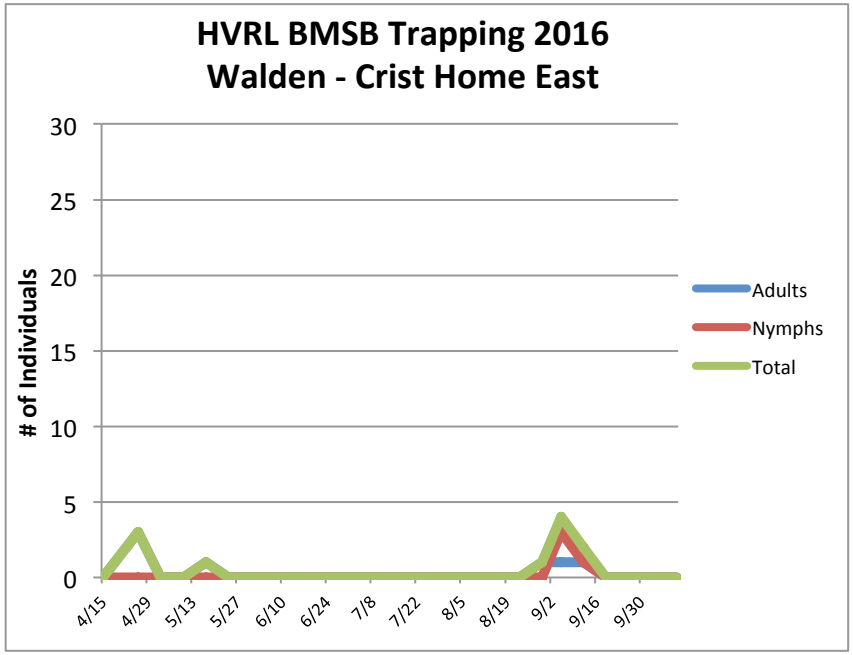

HVRL BMSB Trapping 2016
New Paltz - Dressels West
# of Individuals
30
25
20
15
10
5
0
4/15
4/29
5/13
5/27
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
Adults
Nymphs
Total


HVRL BMSB Trapping 2016
New Paltz - Dressels East
# of Individuals
30
25
20
15
10
5
0
4/18
5/2
5/16
5/30
6/13
6/27
7/11
7/25
8/8
8/22
9/5
9/19
10/3
Adults
Nymphs
Total


HVRL BMSB Trapping 2016
Poughkeepsie East
# of Individuals
30
25
20
15
10
5
0
5/3
5/17
5/31
6/14
6/28
7/12
7/26
8/9
8/23
9/6
9/20
10/4
Adults
Nymphs
Total


HVRL BMSB Trapping 2016
Campbell Hall
# of Individuals
30
25
20
15
10
5
0
4/14
4/28
5/12
5/26
6/9
6/23
7/7
7/21
8/4
8/18
9/1
9/15
9/29
Adults
Nymphs
Total


HVRL BMSB Trapping 2016
Walden - Crist Home West
# of Individuals
30
25
20
15
10
5
0
4/26
5/10
5/24
6/7
6/21
7/5
7/19
8/2
8/16
8/30
9/13
9/27
10/11
Adults
Nymphs
Total


HVRL BMSB Trapping 2016
Walden - Crist Home East
# of Individuals
30
25
20
15
10
5
0
4/15
4/29
5/13
5/27
6/10
6/24
7/8
7/22
8/5
8/19
9/2
9/16
9/30
Adults
Nymphs
Total

2015 MAXIMUM AND MINIMUM TEMPERATURES AND PRECIPITATION

Hudson Valley Research Lab, Highland, NY

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

	MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPTEMBER		
Date	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain	Max	Min	Rain
1	44.5	25.2	0.0	74.2	54.7	0.0	50.0	42.2	0.25	83.9	60.6	0.0	80.2	61.6	0.73	75.7	66.0	0.21	79.2	66.8	0.07
2	48.7	23.3	0.16	53	41.2	0.13	59.4	42.2	0.61	79.9	57.0	0.0	76.1	59.0	0.01	75.2	64.3	0.24	76.9	57.8	0.0
3	32.7	19.7	0.0	40.3	28.5	0.11	52.6	47.5	0.59	68.9	60.3	0.11	80.1	55.7	0.0	81.7	60.3	0.0	75.6	59.2	0.0
4	36.1	19.9	0.0	***28.5**	**23.9**	0.0	51.2	47.5	0.16	80.6	63.4	0.0	83.7	58.0	0.0	82.9	60.1	0.0	79.2	59.0	0.0
5	33.5	21.2	0.0	***35.4**	**18.9**	0.1	56.9	46.5	0.0	70.3	63.8	1.42	87.5	67.9	0.07	83.4	64.4	0.0	81.9	56.3	0.0
6	41.5	24	0.0	44	21.6	0.03	55.0	48.5	0.74	81.6	64.6	0.01	89.8	66.7	0.0	87.5	70.3	0.05			
7	59.5	27.8	0.0	59.1	41.5	0.21	57.4	50.1	0.01	79.6	61.9	0.06	86.8	69.8	0.05	86.1	63.4	0.0			
8	61.3	36.8	0.0	46.2	34.2	0.02	63.2	47.3	0.11	62.5	55.0	0.03	86.3	69.6	0.54	82.9	60.8	0.0			
9	78.6	42.6	0.0	42.7	28.2	0.0	68.1	47.0	0.0	68.9	50.8	0.0	68.8	64.6	0.42	84.9	59.4	0.0			
10	69.2	59.0	0.11	48.6	28.2	0.0	66.0	37.9	0.0	75.2	48.7	0.0	80.4	65.3	0.01	85.5	71.8	0.85			
11	57.0	39.6	0.06	51.8	38.9	0.09	74.8	42.2	0.0	77.4	47.7	0.37	76.2	60.3	0.0	88.5	74.5	0.08			
12	63.4	30.5	0.0	53.8	39.8	0.57	+80.7	48.4	0.0	76.4	57.8	0.01	84.0	58.2	0.0	91.1	71.2	0.25			
13	55.9	49.4	0.0	52.8	31.8	0.0	63.3	52.9	0.29	69.4	53.5	0.0	85.2	66.8	0.0	92.1	72.5	0.06			
14	48.7	37.9	0.02	56.9	36.7	0.0	71.5	52.8	0.02	77.0	51.1	0.0	85.0	72.0	0.0	90.4	72.8	0.34			
15	56.1	38.9	0.02	61.7	37.1	0.0	53.9	42.8	0.0	81.8	54.6	0.0	88.9	71.3	0.0	86.7	70.5	0.0			
16	64.4	44.0	0.04	63.8	42.8	0.0	62.8	38.7	0.0	78.5	62.7	0.04	86.9	67.3	0.0	84.8	70.1	0.03			
17	60.9	46.5	0.08	74.7	41.0	0.0	67.2	45.6	0.0	80.0	61.7	0.0	88.2	67.7	0.0	81.3	70.5	0.0			
18	49.3	38.2	0.0	76.5	49.7	0.0	68.6	48.2	0.0	85.8	55.8	0.0	89.4	67.3	0.7	86.3	67.6	0.12			
19	43.4	28.4	0.0	64.1	51.9	0.0	70.8	51.7	0.0	89.2	61.9	0.0	80.4	63.5	0.01	83.8	67.5	0.0			
20	37.9	24.3	0.0	61.5	47.8	0.0	73.9	46.1	0.0	87.5	59.6	0.0	82.2	56.4	0.0	87.1	64.2	0.0			
21	46.9	30.3	0.0	73.4	40.2	0.0	67.5	52.5	0.0	82.6	64.5	0.0	90.5	59.5	0.0	84.9	70.5	0.78			
22	52.9	28.6	0.0	77.9	59.6	0.0	70.0	52.5	0.0	79.7	55.2	0.03	95.1	69.7	0.0	74.5	59.9	0.0			
23	65.0	39.4	0.0	62.1	50.8	0.07	77.6	50.9	0.0	81.8	54.7	0.0	92.9	70.7	0.0	79.7	51.6	0.0			
24	58.2	33.0	0.0	60.7	40.7	0.0	68.6	55.5	0.34	84.6	60.5	0.0	89.5	64.2	0.0	84.5	58.1	0.0			
25	69.0	36.8	0.12	+65.3	48.2	0.0	88.5	52.7	0.0	86.2	58.7	0.0	91.8	68.2	0.41	82.8	64.9	0.0			
26	51.4	33.3	0.0	51.8	42.2	0.3	86.4	60.0	0.0	87.2	63.7	0.0	86.9	67.5	0.01	88.2	72.4	0.0			
27	53.5	37.5	0.0	61.3	38.5	0.0	85.1	67.9	0.0	85.0	65.5	0.18	89.9	63.2	0.0	86.0	63.0	0.0			
28	53.9	37.6	0.58	57.0	39.3	0.0	91.7	67.8	0.0	76.9	65.8	0.35	91.8	64.2	0.0	87.1	65.6	0.0			
29	47.8	36.4	0.0	55.5	41.0	0.41	88.2	69.8	0.0	82.0	65.5	0.01	86.3	70.6	0.11	85.3	69.9	0.0			
30	58.3	27.8	0.0	60.9	41.9	0.03	81.6	62.4	0.28	83.1	60.4	0.0	82.0	67.9	0.12	83.1	59.3	0.0			
31	70.2	43.0	0.0				84.1	64.5	0.0				71.3	67.0	2.25	78.6	63.9	0.0			
High / Low / Total																					
	78.6	19.7	1.19	77.9	18.9	2.07	91.7	37.9	3.4	89.2	47.7	2.62	95.1	55.7	5.44	92.1	51.6	3.01	81.9	56.3	0.07
Ave Temp.	43.7			48.4			60.4			69			74.7			74.5			69.1		

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}	
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	**4/15**	**4/27**	**5/4**	**5/7**	**5/16**	**5/24**	595.0	382.0	**High**
Mean	**6 April**	**14 April**	**22 April**	**28 April**	**3 May**	**13 May**	**484.7**	**267.3**	

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

4/7 (+/-20.5D)

4/14 (+/-20D)

4/22 (+/-14D)

5/1 (+/-15D)

5/7 (+/-16.5D)