APPLE: *Malus domestica* Borkhausen 'Empire', 'Cortland', 'Jonagold', and 'Delicious'

EVALUATION OF SEASONAL INSECTICIDE PROGRAMS AGAINST NEW YORK APPLE PESTS, 2018

A. Agnello,
Cornell Agritech
630 West North Street
Geneva, NY 14456
Ph (315) 787-2341
Fax: (315) 788-2326
E-mail: ama4@cornell.edu

D. Combs
E-mail: dbc10@cornell.edu

Oriental fruit moth (OFM): *Grapholita molesta* (Busck)
Lesser appleworm (LAW): *Grapholita prunivora* (Walsh)
Codling moth (CM): *Cydia pomonella* (L.)
Internal fruit-feeding Lepidoptera (IL): OFM, LAW, CM
Obliquebanded leafroller (OBLR): *Choristoneura rosaceana* (Harris)
Plum curculio (PC): *Conotrachelus nenuphar* (Herbst)
Apple maggot (AM): *Rhagoletis pomonella* (Walsh)
Tarnished plant bug (TPB): *Lygus lineolaris* (Palisot de Beauvois)
Green stink bug (GSB) - *Chinavia hilaris* (Say)
Brown stink bug (BSB) - *Euschistus servus* (Say)
Brown marmorated stink bug (BMSB) - *Halyomorpha halys* (Stål)
Stink Bug (SB) – GSB, BMSB, BSB
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)

The objective of this test was to determine the effectiveness of seasonal applications against a variety of apple pests. Seasonal insecticide programs were applied with a Durand-Wayland airblast sprayer at 100 gpa. Treatments were applied at various rates and timings from bud stage 'tight cluster' (4 May) or 'petal fall' (24 May) and then approximately every 14d depending on weather conditions until 15 Aug. A full list of materials, rates and timings is listed in Table 1. Treatments, including an untreated check, were replicated 3 times in 4-tree blocks and arranged in an RCB design. Cultivars within the treatment blocks were 'Empire', 'Cortland', 'Jonagold', and 'Delicious'. The internal Lepidoptera (IL) complex of codling moth (CM), oriental fruit moth (OFM) and lesser appleworm (LAW) was assessed on 18 Jun and 9 Jul by inspecting fruit on the tree. Plum curculio (PC) oviposition scars were also assessed on 18 Jun also by inspecting fruit on the tree. Fruit damage from 1st generation San Jose scale (SJS) was sampled on 6 Jul. Harvest samples were taken by picking and destructively sampling 100 fruits in each replicate on 17-18 Sep. All data was transformed and subjected to an AOV with JMP. Means were separated with Student's t-test. Phytotoxicity was not observed in the any of the treatments. This research was supported in part by industry gift(s) of pesticides and research funding.

First generation internal Lepidoptera samples are often low in the test orchard, and damage generally increases substantially at harvest, especially in the untreated check plot. The 2018 growing season was no exception to this, and all treatments were significantly lower in damage than the UTC. While there were few differences in the 1st generation samples, those taken at harvest seem to indicate the importance of timing.

Treatments with a 4th cover application of an effective material did not have as many instances of internal worm damage as those that had the same materials applied at 5th cover. This indicates that not only is the material an important choice, but the timing of application is a determinant as well. Imidan 70WSB at 4th cover did suppress 2nd generation internal Lepidoptera significantly compared with the UTC, but did not control it as well as Altacor and Delegate at this same timing. In treatments where these same materials were applied at 5th cover, there were differences in efficacy, again indicating that the 4th cover timing was essential for control in 2018. The damage category of 'sting' indicates suspected internal Lepidoptera damage, but which does not proceed more than 1/8" into the fruit; however, there is not enough separation between treatments make any assumptions for this category. SJS has been sporadic in the test orchard for the past several years; however, harvest data indicates that numbers are once again rising. While very few significant differences occurred, it is important to note that this pest seems to have even distribution throughout the test orchard, and that several treatments exhibited control. The combination of early season Sivanto/Movento gave excellent season-long control, as did the season-long Imidan plot. An abridged program of Avaunt/Altacor also gave acceptable control; however, neither material is known to be effective against this pest. Damage from OBLR, AM, PC, TPB and stink bug showed either very few significant differences or instances were so low that determining efficacy was difficult.

Table 1

Trt	Material	Rate	Timing	TC	P	PF	1C	2C	3C	4C	5C	6C
1	Verdepryn 100SL	22.0	PF, 1C, 4C, 5C			5/24	6/4			7/12	7/26	
2	Avaunt 30WDG	5.0 oz	PF, 1C			5/24	6/4					
	Altacor 35 WDG	4.5 oz	4C, 5C							7/12	7/26	
3	Venerate XC +	64.0 oz	2 sprays gainst each summer sjs gen 7 days apart					6/18	6/11		8/6	
	NuFilmP											
	Altacor 35 WDG	4.5 oz	1C, 2C				6/4	6/18				
	Delegate 25WG	6.5 oz	5C, 6C								7/26	8/15
4	Venerate XC +	64.0 oz	1 spray gainst each summer sjs gen						6/11		8/6	
	NuFilmP											
	Altacor 35 WDG	4.5 oz	1C, 2C				6/4	6/18				
	Delegate 25WG	6.5 oz	5C, 6C								7/26	8/15
5	Sivanto Prime SC+	14.0 oz	TC, Pink	5/4	5/9							
	LI-700											
	Altacor 35 WDG	4.5 oz	1C, 2C				6/4	6/18				
	Delegate 25WG	6.5 oz	5C, 6C								7/26	8/15
6	Sivanto Prime SC+	12.8 oz	TC, Pink	5/4	5/9							
	LI-700	0.13%										
	Movento 240SC +	6.4 oz	PF			5/24						
	LI-700	0.25%										
7	Imidan 70WSB	3.0 lb	PF, 3C, 4C			5/24			6/29	7/12		
	Assail 30SG	6.0 oz	1C, 2C				6/4	6/18				
	Delegate 25WG	6.0 oz	5C, 6C								7/26	8/15
8	Imidan 70WSB	3.0 lb	PF, 3C, 4C			5/24			6/29	7/12		
	Delegate 25WG	6.0 oz	1C, 2C				6/4	6/18				
	Enkounter 39DF	1.0 lb	5C, 6C								7/26	8/15
9	Imidan 70WSB	3.0 lb	PF, 3C, 4C			5/24			6/29	7/12		
	Enkounter 39DF	1.0 lb	1C, 2C				6/4	6/18				
	Delegate 25WG	6.0 oz	5C, 6C								7/26	8/15
10	Imidan 70WSB	3.0 lb	PF, 3C, 4C			5/24			6/29	7/12		
	Delegate 25WG	6.0 oz	1C, 2C				6/4	6/18				
	Assail 30SG	6.0 oz	5C, 6C								7/26	8/15
11	Avaunt 30WG	5.0 oz	PF			5/24						
	Delegate 25WG	6.0 oz	1C, 2C				6/4	6/18				
	Altacor 35 WDG	4.5 oz	4C, 5C							7/12	7/26	
	Imidan 70WSB	3.0 lb	6C									8/15
12	Avaunt 30WG	5.0 oz	PF			5/24						
	Altacor 35 WDG	4.5 oz	1C, 2C				6/4	6/18				
	Delegate 25WG	6.0 oz	4C, 5C							7/12	7/26	
	Imidan 70WSB	3.0 lb	6C									8/15
13	Imidan 70WSB		PF, 1-6C			5/24	6/4			7/12	7/26	8/15
14	Avaunt 30WG	5.0 oz	PF			5/24						
	Novaluron	20.0 oZ	PF			5/24						
	Altacor 35 WDG	4.5 oz	1C, 2C				6/4	6/18		7/12	7/26	
	Delegate 25WG	6.0 oz	4C, 5C									
15	Untreated Check											

Table 2

Treatment	mean % fruit damage from internal Lepidoptera	
	18 Jun	9 Jul
1	3.3 bc	6.0 ab
2	5.3 abc	11.3 ab
3	6.7 ab	9.3 ab
4	5.3 ab	7.0 ab
5	6.3 ab	5.7 ab
6	4.7 abc	5.0 ab
7	2.7 bc	5.3 ab
8	4.0 abc	8.7 ab
9	4.7 bc	5.3 ab
10	2.7 bc	5.7ab
11	0.3 c	4.7 b
12	3.7 bc	22.3 a
13	2.7 bc	5.7 ab
14	0.3 bc	4.7 b
15	12.3 a	11.7 ab

Means within a column followed by the same letter are not significantly different (Student's t-Test, $P \leq 0.05$).
Data was transformed using arcsine (Sqrt *x*) prior to analysis

Table 3

Treatment	Mean % fruit Damage from PC, 18 Jun
1	0.0 c
2	0.3 bc
3	3.3 a
4	3.7 a
5	2.3 abc
6	2.0 abc
7	0.7 abc
8	2.0 abc
9	0.7 abc
10	2.0 abc
11	1.3 abc
12	0.0 c
13	0.0 c
14	1.0 abc
15	2.0 ab

Means within a column followed by the same letter are not significantly different (Student's t Test, $P \leq 0.05$).
Data was transformed using arcsine (Sqrt *x*) prior to analysis

Table 4

Treatment	mean % fruit damage from 1st gen SJS, 6 Jul
1	0.0 b
2	0.0 b
3	1.7 a
4	0.3 ab
5	0.0 b
6	0.0 b
7	0.0 b
8	1.3 ab
9	0.0 b
10	0.0 b
11	2.7 a
12	0.3 ab
13	0.0 b
14	1.7 a
15	0.3 ab

Means within a column followed by the same letter are not significantly different (Student's t-Test, $P \leq 0.05$).
Data was transformed using arcsine (Sqrt *x*) prior to analysis

Table 5

Treatment	Internal Lep		Sting		Late OBLR		AM		PC		TPB		SJS		Stink bug		Clean	
1	5.7	ef	4.3	ab	2.0	b	0.3	d	1.0	ef	4.0	a	4.3	ab	1.7	abcd	77.3	a
2	3.3	f	5.7	ab	3.3	b	1.3	abcd	3.7	bcde	3.7	a	2.0	b	1.0	bcd	76.3	a
3	20.0	c	10.0	a	6.3	ab	2.7	abcd	9.7	a	5.0	a	6.7	ab	2.7	ab	45.3	de
4	16.7	cd	7.7	ab	11.3	a	0.3	d	7.0	abc	4.0	a	7.7	ab	2.0	abcd	49.0	de
5	19.0	c	6.7	ab	4.3	ab	1.7	abcd	8.7	ab	3.0	a	4.0	ab	1.7	abcd	57.0	cde
6	38.0	b	5.7	ab	8.0	ab	4.0	ab	5.0	abcd	2.7	a	2.0	b	0.3	cd	43.3	e
7	11.7	cde	9.3	a	9.0	ab	3.0	abc	2.3	def	2.0	a	3.0	ab	2.7	ab	62.0	abcde
8	21.3	c	6.7	ab	6.3	ab	0.7	bcd	2.7	cdef	3.3	a	8.3	ab	0.7	bcd	58.3	bcde
9	12.3	cde	9.7	a	3.7	ab	1.3	abcd	1.0	ef	2.7	a	8.3	ab	0.0	d	64.3	abcd
10	19.7	c	5.0	ab	4.3	ab	1.0	cd	2.0	cdef	4.0	a	7.3	ab	1.0	bcd	61.7	abcde
11	6.0	ef	5.7	ab	3.3	ab	2.7	abcd	1.0	f	1.7	a	8.3	ab	1.0	bcd	73.0	abc
12	9.0	def	6.0	ab	8.3	ab	0.3	d	2.7	cdef	1.7	a	15.0	a	0.7	bcd	60.7	abcde
13	13.0	cde	6.0	ab	5.3	ab	1.7	abcd	2.7	cdef	2.3	a	1.7	b	1.7	abc	71.0	abc
14	8.3	def	4.3	b	7.7	ab	2.3	abcd	2.3	cdef	3.0	a	13.7	a	4.3	a	62.3	abcd
15	52.0	a	9.7	a	8.0	ab	4.7	a	2.3	cdef	3.0	a	16.7	a	2.0	abcd	23.0	f

Means within a column followed by the same letter are not significantly different (Student's t-Test, $P \leq 0.05$).

Data was transformed using arcsine (Sqrt *x*) prior to analysis