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

EVALUATION OF SEASONAL INSECTICIDE PROGRAMS AGAINST NEW YORK APPLE PESTS, 2016

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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)
San Jose scale (SJS): *Quadraspidiotus perniciosus* (Comstock)
European red mite (ERM): *Panonychus ulmi* (Koch)
Predaceous mite (TP): *Typhlodromus pyri* (Scheuten)

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 ‘pink’ (3 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 a RCB design. Cultivars within the treatment blocks were 'Empire', 'Cortland', 'Jonagold', and 'Delicious'. Damage was assessed from foliage for obliquebanded leaf roller (OBLR) on 3 Jun. The internal Lepidoptera complex of codling moth (CM), oriental fruit moth (OFM) and lesser appleworm (LAW) was sampled on 1 Jul and 4 Aug by inspecting fruit on the tree. Plum curculio (PC) oviposition scars were also assessed on 17 Jun also by inspecting fruit. San Jose scale (SJS) fruit injury was assessed on 1 Jul and 4 Aug. European red mite (ERM) was sampled on 5 Aug by brushing 25 ‘Delicious’ leaves per replicate, counting ERM motiles, eggs and predatory mites. Harvest samples were taken by picking and destructively sampling 100 fruit in each replicate on 14 -16 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

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Pressure from the internal Lepidoptera complex in the test orchard was substantially higher in 2016 than in the 2015 growing season. While damage counts taken after the first and second generations had emerged seemed low during the season, harvest data indicates that these pests are quite numerous. All treatments were significantly lower in damage from that in the untreated plot; however, there was some separation among them. Treatments using Minecto Pro targeting the second generation had an odd rate response. The highest and lowest rates were statistically similar, while the two middle rates exhibited the same control. All of these treatments used Dipel DF against the first generation. Harvanta 50SL was targeted against the first generation, followed by 2 applications of Delegate WG. Both treatments controlled leps well during the season; however, there were not any applications against the second generation. Harvest data indicates this clearly when compared with the damage found earlier in the season. Delegate was also used in other treatments in rotation with Exirel. One material was applied twice against each generation, and then the materials were reversed in the second treatment. While not significantly different, the treatment where Delegate was used early had nearly half the amount of damage at harvest as the treatment where Exirel was used against the first generation. The grower standard treatment of a season-long program of Imidan 70WSB had excellent control compared with the untreated plot. Fruit injury from OBLR has traditionally been low in the research orchard. Foliage counts during mid-season indicated that this pest was present at relatively even numbers throughout the block, with leaf damage being slightly higher in the untreated plot. Harvest data also indicates an even distribution, and many of the plots are not significantly different from the untreated check. In most fruit regions of New York, the 3rd cover application is generally the most critical for control of the summer brood, and many of the treatments did not have an application at this timing, or the material used was not effective. In treatments 1 through 4, Endigo ZC was used at this timing, and it seems to have had little efficacy against OBLR. Also, as noted above, these treatments received Dipel DF for 3 consecutive applications prior to the Endigo ZC application. Treatments 5 through 8 did not have a 3rd cover application; however, treatment 8 did have 2 applications of Exirel at 1st and 2nd cover, which seems to have effected some control of OBLR, whereas treatment 7 had Delegate WG for 1st and 2nd cover and did not exhibit this same control. Again, the season-long applications of Imidan 70WSB had good efficacy against this pest. Pressure from AM, PC and TPB are low and sporadic, making any type of assessment difficult. SJS has been a major pest in the test orchard; however, it is theorized that several years of inclement weather has affected the population. SJS damage has decreased the past two seasons to levels that, again, make efficacy ratings difficult to assess. ERM and predacious mites sampled late season were extremely low. The 2016 growing season was above average in temperature and also drought conditions, which traditionally have been conditions that lead to ERM outbreaks. While populations are nearly non-existent, it can be assumed that the materials being used did not aid in flaring this pest.

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Table 1.

Trt	Material	Rate	Timing	Pink	PF	1C	2C	3C	4C	5C	6C
1	Dipel DF	2.0lb	PF, 1C, 2C		5/24	6/10	6/24				
	Endigo ZC	5.0 oz	3C					7/6			
	Minecto Pro+	8.0 oz	4C, 6C						7/19		8/15
	LI-700										
2	Dipel DF	2.0lb	PF, 1C, 2C		5/24	6/10	6/24				
	Endigo ZC	5.0 oz	3C					7/6			
	Minecto Pro+	10.0 oz	4C, 6C						7/19		8/15
	LI-700										
3	Dipel DF	2.0lb	PF, 1C, 2C		5/24	6/10	6/24				
	Endigo ZC	5.0 oz	3C					7/6			
	Minecto Pro+	12.0 oz	4C, 6C						7/19		8/15
	LI-700										
4	Dipel DF	2.0lb	PF, 1C, 2C		5/24	6/10	6/24				
	Endigo ZC	5.0 oz	3C					7/6			
	Exirel+	13.5 oz	4C, 6C						7/19		8/15
	LI-700										
5	Harvanta 50SL	16.4 oz	Pink, PF	5/3	5/24						
	Movento+	6.0 oz	PF		5/24						
	LI-700										
	Delegate WG	5.2 oz	1C, 2C			6/10	6/24				
6	Harvanta 50SL	22.0 oz	Pink, PF	5/3	5/24						
	Movento+	6.0 oz	PF		5/24						
	LI-700										
	Delegate WG	5.2 oz	1C, 2C			6/10	6/24				
7	Delegate WG	5.2 oz	PF, 1C		5/24	6/10					
	Exirel+	13.5 oz	4C, 5C						7/19	8/1	
	LI-700										
8	Exirel+	13.5 oz	PF, 1C		5/24	6/10					
	LI-700										
	Delegate WG	5.2 oz	4C, 5C						7/19	8/1	
9	Imidan 70WSB	3.0 lb	PF, 1C-6C		5/24	6/10	6/24	7/6	7/19	8/1	8/15
10	UTC										

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Table 2.

Treatment	% Terminals with OBLR damage 3 Jun
1	2.3 bc
2	2.3 bc
3	3.3 ab
4	2.7 bc
5	2.3 bc
6	1.0 bc
7	2.0 bc
8	1.0 c
9	3.7 ab
10	7.7 a

Table 3.

Treatment	% fruit damaged by PC 17 Jun
1	1.0 ab
2	4.0 a
3	0.0 b
4	0.0 b
5	0.0 b
6	0.0 b
7	0.0 b
8	0.0 b
9	0.0 b
10	0.0 b

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

Table 4.

Treatment	% fruit infested with IL 16 Jul	% fruit infested with IL 4 Aug
1	5.7 ab	4.3 a
2	1.7 bc	1.7 abc
3	7.3 a	4.0 ab
4	3.3 abc	2.7 abc
5	1.0 bc	1.3 bc
6	0.0 c	0.3 c
7	0.3 c	2.3 abc
8	0.3 c	0.7 c
9	1.0 bc	0.3 c
10	5.0 ab	4.3 a

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

Table 5.

Treatment	% fruit infested with SJS 16 Jul	% fruit infested with SJS 4 Aug
1	3.3 a	4.3 a
2	0.7 a	1.7 a
3	0.7 a	2.3 a
4	1.7 a	2.7 a
5	0.0 a	1.0 a
6	0.0 a	0.0 a
7	1.0 a	1.3 a
8	0.0 a	0.3 a
9	0.0 a	1.0 a
10	5.0 a	2.3 a

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

Table 6.

Treatment	Phytophagous mites/ lf 5 Aug	Phytophagous mite eggs/lf 5 Aug	Predacious mites/lf 5 Aug
1	0.04 a	0.01 a	0.03 a
2	0.08 a	0.0 a	0.01 a
3	0.01 a	0.01 a	0.01 a
4	0.07 a	0.0 a	0.0 a
5	0.09 a	0.03 a	0.01 a
6	0.1 a	0.03 a	0.03 a
7	0.08 a	0.03 a	0.01 a
8	0.03 a	0.0 a	0.0 a
9	0.03 a	0.01 a	0.01 a
10	0.08 a	0.01 a	0.04 a

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

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Table 7.
% Fruit Damage at Harvest

Treatment	IL	OBLR	AM	PC	TPB	SJS	% Clean Fruit at Harvest
1	22.0 bc	10.0 ab	0.3 a	1.7 a	2.0 a	0.3 b	59.3 b
2	10.7def	3.7 bc	0.0 a	3.7 a	2.0 a	1.0 ab	77.0 ab
3	10.7cdef	6.7 abc	0.7 a	1.3 a	2.0 a	3.0 ab	73.0 ab
4	14.0 bcde	8.3 ab	0.0 a	1.0 a	1.0 a	2.0 ab	71.0 ab
5	22.7 b	6.3 abc	0.3 a	0.7 a	0.7 a	0.3 b	65.3 b
6	18.0 bcd	9.0 ab	0.6 a	1.0 a	2.3 a	1.0 ab	67.7 b
7	6.3 f	6.0 abc	0.3 a	0.0 a	2.7 a	5.0 ab	76.0 ab
8	11.0 bcdef	2.3 c	0.0 a	0.3 a	1.0 a	7.7 a	71.7 ab
9	5.7 ef	3.3 bc	0.0 a	0.3 a	0.7 a	0.3 b	86. 7 a
10	49.0 a	15.3 a	0.7 a	4.0 a	2.0 a	8.3 a	33.7 c

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