

APPLE (*Malus domestica* 'Golden Delicious', 'Red Delicious', and 'Rome Beauty')
Scab; *Venturia inaequalis*
Powdery mildew; *Podosphaera leucotricha*
Cedar-apple rust; *Gymnosporangium juniperi-virginianae*
Quince rust; *Gymnosporangium clavipes*
Sooty blotch; disease complex
Flyspeck; *Zygophiala jamaicensis*
Bitter rot; *Colletotrichum* spp.
White (Bot) rot; *Botryosphaeria dothidea*
Alternaria rot; *Alternaria* spp.

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Evaluation of OMRI-approved and conventional products for disease management on three apple cultivars, 2017.

Nine treatments, aimed primarily at early season and early summer diseases, were also compared for season-long fungal disease control and fruit finish effects on three apple cultivars. Treatments were evaluated on 28-yr-old, three-cultivar tree sets in a four-replicate randomized block design. The Rome trees used in the test had not been treated in 2016 to allow powdery mildew inoculum to stabilize in the 2017 test trees. Dilute treatments were applied to the point of runoff with a single nozzle handgun at 350 psi as follows: 5 Apr (Rome 1/2 in. green-tight cluster; Golden Delicious tight cluster; Red Delicious open cluster-pink); 13 Apr (Rome, pink; Golden Delicious pink-bloom; Red Delicious bloom); 26 Apr (petal fall); 1C-7C (1st-7th covers): 9 May, 23 May, 7 Jun, 21 Jun, 10 Jul, 25 Jul, 8 Aug. Inoculum over each Golden Delicious test tree included cedar rust galls and wild blackberry canes with the sooty blotch and flyspeck fungi placed 20 Apr and bitter rot mummies placed 9 Jun. Other diseases developed from inoculum naturally present in the test area, including cedar-apple rust inoculum from red cedars in the vicinity. Maintenance sprays, applied separately to the entire test block with a commercial airblast sprayer, included: Altacor, Assail, Beleaf, Damoil, Danitol Delegate, Imidan, and Lannate LV, Sivanto, Voliam Flexi. Foliar data represent averages of counts of ten terminal shoots 19 Jun (Golden Delicious), or 31 Jul (Rome). Post-harvest fruit counts are means of 25-fruit samples picked from each of four single-tree reps. Red Delicious was sampled 20 Sep and first rated 19 Oct then rated again for rots 1 Nov, after 19 days at 62-82°F (mean 71.9°F). Golden Delicious was sampled 20 Sep, first rated 3 Oct, then rated again for rots 20 Oct, after 18 days at 55-82°F (mean 71.9°F). Rome Beauty was sampled 21 Sep, first rated 12 Oct, then rated again for rots 23 Oct, after 21 days at 55-82°F (mean 72.2°F). Percentage data were converted by the square root arcsin transformation for statistical analysis.

The first fungicide application was delayed until 13 Apr, after several primary scab infections had occurred, but before the start of secondary infection 22-26 Apr. Eight secondary infection periods occurred through the end of May, resulting in moderate scab pressure. Under these conditions, the best control was achieved by Luna Sensation alternated with Inspire Super (treatment #6) and by Microthiol Disperss + ProPhyt (Trt #8). OSO and Regalia + JMS Stylet-oil were generally weak for scab control (Table 1). Regalia + ProPhyt (#9) gave significantly better scab control than Regalia + JMS Stylet-oil (#4) on Rome leaves and fruit and Golden Delicious fruit. Mildew pressure was moderate with 39 infection days through 21 Jun. The experimental material Luna Care (Trt. #7) gave superior control (Table 1). Cedar rust pressure was heavy, with ten infection periods and heavy inoculum conditions through May. The best control was achieved by Luna Sensation alternated with Inspire Super (treatment #6, Table 2). Fruit mostly escaped quince rust infection. Treatment #6 also gave excellent control of rusts on fruit, as did Regalia + JMS Stylet-oil (Trt #4). Most treatments gave significant control of sooty blotch and flyspeck (SBFS). The conventional treatment ending with Captan + Ziram (Trt. #6) provided superior control, but ProPhyt in combination with Microthiol Disperss (Trt #8) or with Regalia (#9) also gave good SBFS control (Table 3). Among the OMRI-approved treatments, Regalia + JMS Stylet-oil (Trt #4), was slightly more effective on sooty blotch, but Microthiol Disperss (Trt #1) was significantly more effective than Regalia + JMS Stylet-oil (Trt #4) on flyspeck. The most common post-harvest rots were bitter rot and white rot (Table 4). Overall, Trt. #6, ending with Captan + Ziram, and the lower rate of OSO (Trt. #3), provided the most rot suppression. Compared to non-treated fruit, all of the treatments except Luna Care (#7) significantly increased russetting of Golden Delicious fruit (Table 5). All treatments except Luna Care (#7) and Microthiol Disperss + ProPhyt (#8) significantly increased opalescence of Rome, and several treatments (#1, 3, 4, 5, and 8) increased opalescence of Red Delicious.

Table 1. Scab and powdery mildew control.

Treatment and formulated rate/100 gal dilute	Timing	Scab, % leaves or fruit infected					Mildew, infection (%)		
		Red Del. fruit	Golden Delicious		Rome		Golden Delicious leaves	Rome	
			leaves	fruit	leaves	fruit		leaves	fruit
0 No fungicide	--	24 bc*	5 a-c	30 d	13 bc	54 c	33 g	43 f	13 b
1 Microthiol Disperss 80% 2 lb	TC-7C	5 a-c	8 c	7 ab	5 ab	7 a	23 de	24 c	8 ab
2 OSO 5%SC 3.25 fl oz	TC-7C	33 c	8 c	12 bc	27 d	25 b	26 ef	39 ef	8 ab
3 OSO 5%SC 1.63 fl oz	TC-7C	21 bc	7 c	26 d	16 cd	23 b	35 gh	37 ef	3 ab
4 Regalia 5% 1 pt + JMS Stylet-oil 1 gal	TC-7C	16 a-c	2 ab	25 cd	11 bc	29 b	18 cd	28 cd	3 ab
5 OSO 5%SC 1.63 fl oz	#1,3,5,7	29 bc	5 a-c	21 cd	14 bc	26 b	30 fg	34 de	10 ab
Regalia 1 pt + JMS Stylet-oil 1 gal	#2,4,6								
OSO 5%SC 1.63 fl oz	5C-7C								
6 Luna Sensation 500SC 1.25 fl oz	#1,3,5,7	0 a	1 a	1 a	6 a-c	2 a	10 b	16 b	3 ab
Inspire Super 2.82EW 3 fl oz + Manzate 75DF 12 oz	#2,4,6								
Captan 80WDG 7.5 oz + Ziram 76DF 12 oz	5C-7C								
7 Luna Care 10.7 oz	TC-7C	4 ab	3 a-c	6 ab	10 bc	3 a	6 a	10 a	1 a
8 Microthiol Disperss 80% 2 lb + ProPhyt 4.2L 1 pt	TC-7C	2 ab	3 a-c	1 a	3 a	2 a	16 c	24 c	1 a
9 Regalia 1 pt + ProPhyt 4.2L 1 pt	TC-7C	3 ab	5 bc	7 ab	3 a	8 a	41 h	36 d-f	10 ab

*Mean separation by Waller-Duncan K-ratio t-test (p=0.05).

Table 2. Control of cedar-apple rust and quince rust.

Treatment and formulated rate/100 gal dilute	Timing	Cedar-apple rust, % leaves or lesions/leaf					Quince rust, % fruit infected	
		Golden Delicious		Rome		% fruit	G. Del	Rome
		leaves	les./leaf	leaves	les./leaf			
0 No fungicide	--	48 c-e*	16.2 cd	41 a	6.7 a	17 c	8 b	8 a
1 Microthiol Disperss 80% 2 lb	TC-7C	53 e	17.7 d	53 b	9.8 ab	19 bc	3 ab	6 a
2 OSO 5%SC 3.25 fl oz	TC-7C	54 e	18.6 d	51 b	11.7 ab	4 a-c	4 ab	5 a
3 OSO 5%SC 1.63 fl oz	TC-7C	51 e	13.7 b-d	54 b	12.0 ab	9 a-c	0 a	5 a
4 Regalia 1 pt + JMS Stylet-oil 1 gal	TC-7C	25 b	1.6 a	53 b	9.6 ab	1 ab	0 a	0 a
5 OSO 5%SC 1.63 fl oz	#1,3,5,7	40 c	10.2 bc	56 b	11.2 ab	13 a-c	2 ab	4 a
Regalia 1 pt + JMS Stylet-oil 1 gal	#2,4,6							
OSO 5%SC 1.63 fl oz	5C-7C							
6 Luna Sensation 500SC 1.25 fl oz	#1,3,5,7	15 a	0.7 a	36 a	6.9 a	0 a	0 a	0 a
Inspire Super 3 fl oz + Manzate 75DF 12 oz	#2,4,6							
Captan 80WDG 7.5 oz + Ziram 76DF 12 oz	5C-7C							
7 Luna Care 10.7 oz	TC-7C	53 e	16.8 cd	58 b	15.6 b	24 c	3 ab	6 a
8 Microthiol Disperss 80% 2 lb + ProPhyt 1 pt	TC-7C	50 de	11.4 b-d	54 b	11.4 ab	12 a-c	4 ab	4 a
9 Regalia 1 pt + ProPhyt 1 pt	TC-7C	41 cd	6.4 ab	52 b	11.6 ab	9 a-c	3 ab	3 a

*Mean separation by Waller-Duncan K-ratio t-test (p=0.05).

Table 3. Control of sooty blotch and flyspeck.

Treatment and rate/100 gal dilute	Timing	% fruit or fruit area infected, harvest counts											
		Sooty blotch						Flyspeck					
		Red Del.		Golden Del.		Rome		Red Del.		Golden Del.		Rome	
		fruit	area	fruit	area	fruit	area	fruit	area	fruit	area	fruit	area
0 No fungicide	--	77f*	7.3e	88e	9.3e	99f	12.3e	65d	3.9d	93d	6.4d	99f	6.7f
1 Microthiol Disperss 80% 2 lb	TC-7C	21cd	1.3cd	25bc	1.4bc	39cd	2.5cd	9b	0.5b	7a	0.4a	29c	1.5c
2 OSO 5%SC 3.25 fl oz	TC-7C	32c-e	1.7cd	62d	4.3d	51de	3.1d	35c	2.0c	62c	4.5cd	47d	2.7d
3 OSO 5%SC 1.63 fl oz	TC-7C	45e	2.6d	51cd	2.9cd	62e	3.8d	44c	2.3c	59c	3.7c	70e	4.7e
4 Regalia 1 pt + JMS Stylet-oil 1 gal	TC-7C	12a-c	0.6a-c	13b	0.9b	23bc	1.4bc	27c	1.5c	31b	1.9b	22c	1.2c
5 OSO 5%SC 1.63 fl oz	#1,3,5,7												
Regalia 1 pt + JMS Stylet-oil 1 gal	#2,4,6												
OSO 5%SC 1.63 fl oz	5C-7C	41de	2.1d	29bc	1.5bc	51de	3.1d	35c	1.8c	52bc	2.8bc	67e	4.4e
6 Luna Sensation 500SC 1.25 fl oz	#1,3,5,7												
Inspire Super 3 fl oz + Manzate 12 oz	#2,4,6												
Captan 80WDG 7.5 oz + Ziram 12 oz	5C-7C	2a	0.1a	0a	0a	8a	0.5a	0a	0a	1a	0.1a	2ab	0.1ab
7 Luna Care 10.7 oz	TC-7C	32c-e	1.7cd	10b	0.5b	28bc	1.5bc	5ab	0.3ab	4a	0.2a	3ab	0.2ab
8 Microthiol Disperss 2 lb + ProPhyt 1 pt	TC-7C	14bc	0.8bc	11b	0.6b	18ab	0.9ab	1ab	0.1ab	2a	0.1a	0a	0a
9 Regalia 1 pt + ProPhyt 1 pt	TC-7C	7ab	0.3ab	11b	0.7b	16ab	1.0ab	0a	0a	7a	0.3a	3b	0.2b

*Mean separation by Waller-Duncan K-ratio t-test (p=0.05).

Table 4. Control of post-harvest fruit rots.

Treatment and rate/100 gal dilute	Timing	% Gold. Del. fruit infected "rot" spots", at harvest	% fruit infected, post storage counts								
			Any rot			Bitter rot			White rot		
			Red Del.	Gold. Del.	Rome	Red Del.	Gold. Del.	Rome	Red Del.	Gold. Del.	Rome
0 No fungicide	--	22c*	8b	50e	25b	4b	19de	8b	5a	32d	18c
1 Microthiol Disperss 80% 2 lb	TC-7C	20c	2ab	19b-d	19ab	1a	4a-c	6ab	1a	16cd	13bc
2 OSO 5%SC 3.25 fl oz	TC-7C	11bc	0a	17a-c	6ab	0a	6bc	0a	0a	12bc	6a-c
3 OSO 5%SC 1.63 fl oz	TC-7C	8b	3ab	6a	4a	0a	3a-c	2ab	3a	3ab	3ab
4 Regalia 1 pt + JMS Stylet-oil 1 gal	TC-7C	14bc	0a	36de	5ab	0a	8cd	2ab	0a	29d	3a-c
5 OSO 5%SC 1.63 fl oz	#1,3,5,7										
Regalia 1 pt + JMS Stylet-oil 1 gal	#2,4,6										
OSO 5%SC 1.63 fl oz	5C-7C	12bc	1ab	15a-c	10ab	1a	11cd	3ab	0a	4ab	6a-c
6 Luna Sensation 500SC 1.25 fl oz	#1,3,5,7										
Inspire Super 3 fl oz + Manzate 12 oz	#2,4,6										
Captan 80WDG 7.5 oz + Ziram 12 oz	5C-7C	0a	0a	6a	6ab	0a	0a	0a	0a	6a-c	6a-c
7 Luna Care 10.7 oz	TC-7C	6b	1ab	8ab	14ab	0a	7bc	6ab	1a	1a	9a-c
8 Microthiol Disperss 2 lb + ProPhyt 1 pt	TC-7C	8b	5ab	28c-e	9ab	0a	21e	5ab	5a	7a-c	4a-c
9 Regalia 1 pt + ProPhyt 1 pt	TC-7C	7b	5ab	8ab	2a	0a	3ab	2ab	5a	5ab	0a

*Mean separation by Waller-Duncan K-ratio t-test (p=0.05).

Table 5. Fruit finish effects.

Treatment and rate/100 gal dilute	Timing	Fruit finish ratings (0-5)**					Golden Delicious, % USDA grade X-Fancy/Fancy
		Russet			Opalescence		
		Red Del.	Golden Del.	Rome	Red Del.	Rome	
0 No fungicide	--	1.3 bc*	0.9 a	0.5 a	0.5 ab	0.5 a	98 a
1 Microthiol Disperss 80% 2 lb	TC-7C	1.2 bc	2.0 b-d	0.9 a	1.2 d	1.0 bc	73 c-e
2 OSO 5%SC 3.25 fl oz	TC-7C	0.9 ab	1.7 bc	0.7 a	0.7 bc	1.1 bc	86 a-d
3 OSO 5%SC 1.63 fl oz	TC-7C	1.2 bc	1.9 b-d	0.9 a	1.0 cd	1.0 bc	77 b-e
4 Regalia 1 pt + JMS Stylet-oil 1 gal	TC-7C	1.4 c	2.8 e	0.8 a	1.9 e	1.6 d	55 e
5 OSO 5%SC 1.63 fl oz	#1,3,5,7	1.0 ab	2.1 cd	0.9 a	1.0 cd	1.2 c	80 b-e
Regalia 1 pt + JMS Stylet-oil 1 gal	#2,4,6						
OSO 5%SC 1.63 fl oz	5C-7C						
6 Luna Sensation 500SC 1.25 fl oz	#1,3,5,7	0.8 a	2.0 cd	0.9 a	0.4 a	0.8 b	87 ab
Inspire Super 3 fl oz + Manzate 75DF 12 oz	#2,4,6						
Captan 80WDG 7.5 oz + Ziram 76DF 12 oz	5C-7C						
7 Luna Care 10.7 oz	TC-7C	0.7 a	1.3 ab	0.5 a	0.5 ab	0.8 ab	92 a-c
8 Microthiol Disperss 80% 2 lb + ProPhyt 1 pt	TC-7C	1.5 c	2.2 c-e	0.8 a	1.2 d	0.8 ab	79 b-e
9 Regalia 1 pt + ProPhyt 1 pt	TC-7C	1.3 bc	2.5 de	0.8 a	0.6 bc	0.9 bc	68 de

*Mean separation by Waller-Duncan K-ratio t-test ($p=0.05$).

** Fruit finish rated on a scale of 0-5 (0=perfect finish; 5=severe opalescence or russet, presumed not to be mildew).