

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; *Zygothiala jamaicensis*  
Bitter rot; *Colletotrichum* spp.  
White (Bot) rot; *Botryosphaeria dothidea*  
Alternaria rot; *Alternaria* spp.

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### **Evaluation of OMRI-approved and conventional materials and mixtures for full season disease management on three apple cultivars, 2016.**

Eight treatments, aimed primarily at early season and early summer diseases, were compared for season-long fungal disease control and fruit finish effects on three apple cultivars. Treatments were evaluated on 27-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 2015 to allow powdery mildew inoculum to stabilize in the 2016 test trees. Dilute treatments were applied to the point of runoff with a single nozzle handgun at 250 psi as follows: 20 Apr (Bl, bloom, Red Delicious; Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug. Inoculum over each Golden Delicious test tree included cedar rust galls and wild blackberry canes with the sooty blotch and flyspeck fungi placed 26 Apr and bitter rot mummies placed 16 May. 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, Asana XL, Assail, Beleaf, Belt, BioCover, Danitol, Imidan, and Lannate LV. Foliar data represent averages of counts of ten terminal shoots 15 Jun (Golden Delicious), or 18 Jul (Rome). Post-harvest fruit counts are means of 25-fruit samples picked from each of four single-tree reps. Red Delicious was sampled 21 Sep and first rated 23 Sep then rated again for rots 11 Oct, after 20 days at 64-87°F (mean 71.6°F). Golden Delicious was sampled 27 Sep, first rated 28 Sep, then rated again for rots 17 Oct, after 20 days at 64-82°F (mean 69.8°F). Rome Beauty was sampled 4 Oct, first rated 5 Oct, then rated again for rots 20 Oct, after 16 days at 64-82°F (mean 70.0°F). Percentage data were converted by the square root arcsin transformation for statistical analysis.

Early season dry weather resulted in a delay of the first scab infection period until 22 Apr, two days after the first application at bloom. However, after this delayed start, 13 infection periods occurred in 15 days from 28 Apr-12 May, and 23 infection periods through 31 May. Under these conditions, scab incidence was somewhat reduced on leaves (Table 1), but residual activity of fungicides was tested when wet weather prevented applications during the first two weeks in May. SI fungicide resistance has been present in the area and this was confirmed by lack of improvement in scab control by including Rally with Sulfur (Microthiol Disperss, #1) vs. Sulfur alone (#8). Most treatments gave significant scab suppression on Red Delicious fruit and Golden Delicious leaves and fruit compared to non-treated trees, but were generally less effective on Rome. Kaligreen was among the weakest treatments for scab, significantly increasing foliar scab infection on Golden Delicious and Rome. Conidia from the causal pathogen of mildew were present 16 Mar, and there were 21 dry weather “mildew infection days” from 16 Mar until 5 May, resulting in moderate infection of non-treated trees (Table 1). Under these conditions, all treatments except OxiDate (#3) gave significant control of percent leaves and/or percent leaf area infected with mildew. Including Rally with Sulfur (Microthiol Disperss, #1), significantly improved mildew control vs. Sulfur alone (#8). Rust infection occurred mostly 22 Apr and 1 May- 12 May. Treatments involving Rally (#1 & 2), and Regalia + JMS Stylet-Oil gave the strongest cedar-apple rust control on foliage and control of cedar-apple and quince rusts under relatively heavy pressure on Rome fruit, which bloomed later and remained susceptible longer than other cultivars (Table 2). Summer disease pressures were moderate and most treatments gave significant control in this test. The 250-hr accumulated wetting hour threshold for sooty blotch/flyspeck (SBFS) activity, accumulating from 14 May, was reached as early as 21 Jun (after the 3rd cover application), and this resulted in strong SBFS test conditions (Table 3). Under these conditions, treatments involving Microthiol Disperss (#1, 7 & 8) gave the best SBFS control. Post-storage rots (mostly bitter rot, white rot, and some Alternaria, Table 4) were best controlled on Red Delicious and Rome by Rally + Microthiol Disperss (#1). Control of rots on Golden Delicious was less than adequate. OxiDate (#3) significantly increased russet of Red and Golden Delicious and opalescence of Red Delicious compared to non-treated fruit, and Regalia + JMS Stylet-Oil (#5) increased opalescence of Red Delicious and Rome (Table 5).

Table 1. Scab and powdery mildew.

Treatment and formulated rate/100 gal dilute	Timing <sup>y</sup>	Scab, % leaves or fruit infected					Mildew, % leaves or fruit inf.		
		Red Del.	Golden Delicious		Rome		Golden Delicious		
			fruit	leaves	fruit	leaves	fruit	leaves	leaves
0 No fungicide	--	34 c <sup>z</sup>	20c	50f	42 bc	57 e	37 e	38 d	36 c
1 Rally 40WSP 1.25 oz + Microthiol Disperss 80% 2.5 lb	Bl-7C	2 a	13b	6 a	27 a	14 ab	5 a	6 a	3 a
2 Rally 40WSP 1.25 oz + Microthiol Disperss 2.5 lb	1,3,5,7,9	6 b	16bc	10 a-c	38 b	22 bc	13 bc	14 b	6 ab
Rally 40WSP 1.25 oz + OxiDate 2.0 29.1% 1 gal	2,4,6,8								
3 OxiDate 2.0 29.1% 1 gal	Bl-7C	14 b	21 c	21 b-d	49 cd	41 de	37 e	39 d	17 bc
4 Regalia 1 pt + JMS Stylet-Oil 1 gal	1,3,5,7,9	12 b	19c	21 cd	47 c	23 b-d	22 d	24 c	16 bc
Regalia 1 pt + OxiDate 2.0 29.1% 1 gal	2,4,6,8								
5 Regalia 1 pt + JMS Stylet-Oil 1 gal	Bl-7C	13 b	14 b	32 de	40 bc	32 cd	12 bc	25 c	6 ab
6 Kaligreen 81.9SP 12 oz	Bl-7C	27 c	29 d	42 ef	57 d	55 e	39 e	37 d	14 ab
7 Kaligreen 81.9SP 12 oz + Microthiol Disperss 2.5 lb	Bl-7C	1 a	6 a	10 b	21 a	8 a	12 b	14 b	8 ab
8 Microthiol Disperss 80% 2.5 lb	Bl-7C	1 a	13 b	7 a	25 a	9 a	18 cd	18 bc	14 ab

<sup>z</sup>Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Foliar infection rated on 10 shoots 15 Jun (Golden Delicious) or 18 Jul (Rome), or harvest counts of 25-fruit samples picked from each replicate tree 21 Sep (Red Delicious), 27 Sep (Golden Delicious), or 4 Oct (Rome).

Treatments applied dilute to runoff with a single nozzle handgun at 250 psi.

<sup>y</sup>Treatment dates: 20 Apr (Bl, bloom Red Delicious; Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug.

Table 2. Cedar-apple rust and quince rust.

Treatment and formulated rate/100 gal dilute	Timing <sup>y</sup>	Cedar-apple rust % leaves or lesions/leaf				Cedar-apple rust % fruit infected		Quince rust % fruit infected	
		Golden Del.		Rome		Golden		Golden	
		leaves	les/lf	leaves	les/lf	Del.	Rome	Del.	Rome
0 No fungicide	--	48 d <sup>z</sup>	8.3 b	64 f	10.6 b	4 a	35 c	11 a	19 c
1 Rally 40WSP 1.25 oz + Microthiol Disperss 80% 2.5 lb	Bl-7C	0 a	0 a	0 a	0 a	0 a	0 a	0 a	0 a
2 Rally 40WSP 1.25 oz + Microthiol Disperss 2.5 lb	1,3,5,7,9	<1 a	<0.1 a	0 a	0 a	0 a	0 a	0 a	0 a
Rally 40WSP 1.25 oz + OxiDate 2.0 29.1% 1 gal	2,4,6,8								
3 OxiDate 2.0 29.1% 1 gal	Bl-7C	21 c	1.1 a	40 ef	2.6 a	0 a	8 b	0 a	6 b
4 Regalia 1 pt + JMS Stylet-Oil 1 gal	1,3,5,7,9	3 ab	0.1 a	11 bc	0.5 a	0 a	4 ab	0 a	0 a
Regalia 1 pt + OxiDate 1 gal	2,4,6,8								
5 Regalia 1 pt + JMS Stylet-Oil 1 gal	Bl-7C	1 ab	<0.1 a	2 ab	0.1 a	0 a	1 a	0 a	0 a
6 Kaligreen 81.9SP 12 oz	Bl-7C	3 ab	<0.1 a	9 a-c	0.3 a	0 a	1 a	1 a	0 a
7 Kaligreen 81.9SP 12 oz + Microthiol Disperss 2.5 lb	Bl-7C	9 b	0.5 a	19 cd	1.5 a	0 a	3 ab	0 a	3 ab
8 Microthiol Disperss 80% 2.5 lb	Bl-7C	33 cd	2.4 a	33 de	3.9 a	0 a	8 b	1 a	9 b

<sup>z</sup>Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Foliar infection rated on 10 shoots 15 Jun (Golden Delicious) or 18 Jul (Rome), or harvest counts of 25-fruit samples picked from each replicate tree 21 Sep (Red Delicious), 27 Sep (Golden Delicious), or 4 Oct (Rome).

<sup>y</sup>Treatment dates: 20 Apr (Bl, bloom Red Delicious; Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug.

Table 3. Sooty blotch and flyspeck.

Treatment and rate/100 gal dilute	Timing <sup>y</sup>	% fruit or fruit area infected, harvest counts										
		Sooty blotch						Flyspeck				
		Red Del.		G. Delicious		Rome		Red Del.		G. Delicious		Rome
fruit	area	fruit	area	fruit	area	fruit	area	fruit	area	fruit		
0 No fungicide	--	90 c <sup>z</sup>	7 c	100 e	10 e	100 c	16 c	72 d	4 e	99 d	6 d	95 e
1 Rally 1.25 oz + Microthiol Disperss 2.5 lb	Bl-7C	14 a	<1 a	0 a	0 a	28 a	2 a	3 a	<1 a	0 a	0 a	7 a
2 Rally 1.25 oz + Microthiol Disperss 2.5 lb	1,3,5,7,9											
Rally 40WSP 1.25 oz + OxiDate 2.0 1 gal	2,4,6,8	38 b	3 b	1 a	<1 a	28 a	2 a	12 b	<1 b	2 a	<1 a	20 a-c
3 OxiDate 2.0 29.1% 1 gal	Bl-7C	32 b	2 b	12 bc	<1 bc	37 a	3 ab	24 b	1 bc	15 b	<1 b	39 cd
4 Regalia 1 pt + JMS Stylet-Oil 1 gal	1,3,5,7,9											
Regalia 1 pt + OxiDate 2.0 29.1% 1 gal	2,4,6,8	33 b	2 b	10 b	<1 b	35 a	3 ab	23 b	1 c	17 b	1 b	36 cd
5 Regalia 1 pt + JMS Stylet-Oil 1 gal	Bl-7C	29 b	2 b	20 cd	1 cd	43 ab	3 ab	41 c	3 d	40 c	2 c	61 d
6 Kaligreen 81.9SP 12 oz	Bl-7C	42 b	3 b	23 d	1 d	66 b	5 b	46 c	3 d	43 c	3 c	61 d
7 Kaligreen 12 oz + Microthiol Disperss 2.5 lb	Bl-7C	12 a	<1 a	6 b	<1 b	28 a	2 a	4 a	<1 a	14 b	<1 b	30 bc
8 Microthiol Disperss 80% 2.5 lb	Bl-7C	10 a	<1 a	0 a	0 a	36 a	3 ab	1 a	<1 a	6 ab	<1 ab	12 ab

<sup>z</sup>Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Foliar infection rated on 10 shoots 15 Jun (Golden Delicious) or 18 Jul (Rome), or harvest counts of 25-fruit samples picked from each replicate tree, 21 Sep (Red Delicious), 27 Sep (Golden Delicious), or 4 Oct (Rome).

<sup>y</sup>Treatments applied dilute to runoff with a single nozzle handgun at 250 psi. Treatment dates: 20 Apr (Bl, bloom Red Delicious;

Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug.

Table 4. Post-harvest fruit rots.

Treatment and rate/100 gal dilute	Timing <sup>y</sup>	% G. Del. fruit inf. rot spots, at harvest	% fruit infected, post storage counts									
			Any rot			Bitter rot			White rot			Alternaria
			Red Del.	Gold. Del.	Rome	Red Del.	Gold. Del.	Rome	Red Del.	Gold. Del.	Rome	Red Delicious
0 No fungicide	--	35b <sup>z</sup>	18 b	63 a	55 c	4 a	13 b	10 bc	11 b	56 a	49 b	4 a
1 Rally 1.25 oz + Microthiol Disperss 2.5 lb	Bl-7C	10a	4 a	48 a	15 a	2 a	1 a	0 a	2 a	47 a	15 a	0 a
2 Rally 1.25 oz + Microthiol Disperss 2.5 lb	1,3,5,7,9											
Rally 40WSP 1.25 oz + OxiDate 2.0 1 gal	2,4,6,8	18a	9 ab	52 a	20 a	1 a	5 ab	4 ab	8 ab	49 a	16 a	0 a
3 OxiDate 2.0 29.1% 1 gal	Bl-7C	8a	12 ab	51 a	18 a	3 a	6 ab	6 bc	8 ab	49 a	12 a	1 a
4 Regalia 1 pt + JMS Stylet-Oil 1 gal	1,3,5,7,9											
Regalia 1 pt + OxiDate 2.0 29.1% 1 gal	2,4,6,8	9a	16 ab	40 a	27 ab	1 a	3 ab	4 ab	13 b	38 a	23 ab	2 a
5 Regalia 1 pt + JMS Stylet-Oil 1 gal	Bl-7C	13a	7 ab	63 a	25 ab	2 a	7 ab	4 ab	5 ab	56 a	21 ab	0 a
6 Kaligreen 81.9SP 12 oz	Bl-7C	20 ab	5 ab	43 a	23 ab	0 a	5 ab	4 ab	5 ab	38 a	20 a	0 a
7 Kaligreen 12 oz + Microthiol Disperss 2.5 lb	Bl-7C	13a	8 ab	43 a	43 bc	0 a	3 ab	17 c	7 ab	40 a	30 ab	1 a
8 Microthiol Disperss 80% 2.5 lb	Bl-7C	19 ab	11 ab	53 a	30 ab	2 a	8 ab	7 bc	10 b	44 a	25 ab	0 a

<sup>z</sup> Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Post-harvest fruit counts are means of 25-fruit samples picked from each of four single-tree reps. Red Delicious sampled 21 Sep, rated for rots after 20 days incubation at ambient 64-87°F (mean 71.6°F). Golden Delicious sampled 27 Sep, first rated 28 Sep, then rated for rots after 20 days incubation at ambient temperatures 64-82°F (mean 69.8°F). Rome sampled 4 Oct, first rated 5 Oct, then rated for rots after 16 days incubation at ambient temperatures 64-82°F (mean 70.0°F).

Treatments applied dilute to runoff with a single nozzle handgun at 350 psi.

<sup>y</sup> Treatment dates: 20 Apr (Bl, bloom Red Delicious; Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug.

Table 5. Fruit finish effects.

Treatment and rate/100 gal dilute	Timing <sup>x</sup>	Fruit finish ratings (0-5) <sup>y</sup>					Russet ratings,	
		Russet			Opalescence		Golden Delicious	
		Red Delicious	Golden Delicious	Rome	Red Delicious	Rome	X-fancy/ Fancy	US#1 + Utility
0 No fungicide	--	1.9a <sup>z</sup>	3.8 a-c	0.6 ab	1.1 a	1.2 ab	21 a-c	79 a-c
1 Rally 1.25 oz + Microthiol Disperss 80% 2.5 lb	Bl-7C	2.0 ab	3.3 a	0.4 a	1.3 ab	1.1 ab	33 ab	67 ab
2 Rally 40WSP 1.25 oz + Microthiol Disperss 2.5 lb	1,3,5,7,9	3.8 e	4.6 e	0.6 ab	2.0 cd	1.1 ab	5 de	95 de
Rally 40WSP 1.25 oz + OxiDate 2.0 29.1% 1 gal	2,4,6,8							
3 OxiDate 2.0 29.1% 1 gal	Bl-7C	3.8 e	4.5 de	0.7 ab	1.6 bc	1.0 a	2 e	98 e
4 Regalia 1 pt + JMS Stylet-Oil 1 gal	1,3,5,7,9	3.4 d	4.2 c-e	0.6 ab	2.2 d	1.1 ab	10 c-e	90 c-e
Regalia 1 pt + OxiDate 2.0 29.1% 1 gal	2,4,6,8							
5 Regalia 1 pt + JMS Stylet-Oil 1 gal	Bl-7C	2.0 a	3.4 a	0.9 b	2.8 e	2.1 c	28 a-c	72 a-c
6 Kaligreen 81.9SP 12 oz	Bl-7C	1.9 a	4.0 b-d	0.7 ab	1.3 ab	1.2 ab	16 b-d	84 b-d
7 Kaligreen 12 oz + Microthiol Disperss 2.5 lb	Bl-7C	2.5 c	3.3 a	0.8 ab	1.5 ab	1.3 b	41 a	59 a
8 Microthiol Disperss 80% 2.5 lb	Bl-7C	2.4 bc	3.5 ab	0.7 ab	1.2 ab	1.3 b	30 a-c	70 a-c

<sup>z</sup> Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Harvest counts of 25-fruit samples picked from each of four single-tree replications 21 Sep (Red Delicious), 27 Sep (Golden Delicious), or 4 Oct (Rome).

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

Treatments applied dilute to runoff with a single nozzle handgun at 350 psi.

<sup>x</sup> Treatment dates: 20 Apr (Bl, bloom Red Delicious; Bl-PF, petal fall, Golden Delicious; pink, Rome); 29 Apr (petal fall); 1st-7th covers: 18 May, 31 May, 14 Jun, 29 Jun, 14 Jul, 28 Jul, 22 Aug.