

APPLE (*Malus domestica* 'Fuji')
Scab; *Venturia inaequalis*
Powdery mildew; *Podosphaera leucotricha*
Cedar-apple rust; *Gymnosporangium juniperi-virginianae*
Sooty blotch; disease complex
Flyspeck; *Zygothiala jamaicensis*
Bitter rot; *Colletotrichum* spp.
White rot; *Botryosphaeria dothidea*
Alternaria rot; *Alternaria* spp.
Fruit finish

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Scab and broad spectrum disease control by fungicides first applied to Fuji apple at petal fall, 2016.

Seventeen treatments tested mixing partners and sequential schedules on 21-year-old dwarf Fuji apple trees. The test was designed primarily to evaluate responses of selected treatments for scab control, but was continued through the cover sprays for summer disease management as well. Also, it is known that scab strains resistant to SI and QoI fungicides are present in the test area, so combinations of several fungicide classes were tested in an attempt to overcome this situation. Treatments were applied dilute to runoff with a single-nozzle handgun at 250 psi in a randomized block design with four single-tree replications as follows: 12 May (PF, petal fall); 1C-7C (1st-7th covers): 20 May, 10 Jun, 24 Jun, 8 Jul, 20 Jul, 3 Aug, 23 Aug. Because of the delay in the initial application, foliar data, recorded 11 Jul, are based on means of leaves beyond the eleventh leaf on ten shoots per tree, which corresponded to the youngest leaf at the time of the first application. Fruit data are based on 25 fruit per tree picked 7 Oct, first rated 18 Oct and held at ambient temperatures (64-82° F, mean 70.0° F), until the final rot evaluation 26 Oct after 19 days' incubation. Maintenance materials applied to the entire test block included: Admire Pro, Altacor, Assail, Asana XL, Biocover, Beleaf, Delegate, Imidan, and Lannate LV. Percentage data were converted by the square root arcsin transformation for statistical analysis.

Scab pressure was heavy in this test, with lesions from the first infection 22 Apr appearing on unprotected leaves near the time of the first application 12 May. Other pre-treatment scab infection periods occurred 28-29 Apr, 30 Apr-1 May, 1-2 May, 2-3 May, 3-4 May, 4-5 May, 5-7 May, 8 May, 9 May, 10 May, 10-11 May, and 11-12 May. In spite of the delay, treatments #16 and 17 (Luna Sensation or Merivon in combination with Inspire Super + Captan + Silwet) and several others (#3, 5, 8, and 15) still gave significant reduction in scab on foliage (Table 1). Infection was heavy (79%) on non-treated fruit. The combination of Aprovia + Inspire Super + Captan + Silwet (#15) completely protected against secondary fruit scab infection, and a parallel schedule of Merivon substituted for Aprovia (#16) was also very effective. Other combinations that were good for fruit scab control included Aprovia + Silwet (#4) and A 19649 + Silwet (#6), and rotations of these with Inspire Super (#5 and #7). Inspire Super + Ziram (#11) and combinations of several products (#8, 9 and 17) also gave good fruit scab control. Under these conditions, CX-10370 (#12-14) did not reduce scab on foliage, but significantly suppressed it on fruit, comparable to the protective schedule of Manzate + Captan/ Captan + Ziram (#1). Treatments #1-14 included Rally in the petal fall application to suppress cedar-apple rust infection that had also occurred in the previous 10-14 days. These and #15-17, which included Inspire Super, all gave good rust control on later developing leaves and also gave excellent quince rust control compared to non-treated trees (Table 1). The 250-hr accumulated wetting hour threshold for sooty blotch/flyspeck (SBFS) activity, accumulating from 14 May, was reached as early as 21 Jun (before the 3rd cover application), resulting in 100% SBFS infection of non-treated fruit. Under these conditions, several treatment schedules resulted in 1% or less of sooty blotch and flyspeck symptoms (Table 2), including Aprovia + Silwet (#4), Aprovia + Inspire Super + Silwet (#8), Inspire Super + Ziram (#11), Aprovia + Inspire Super + Captan + Silwet (#15), Merivon + Inspire Super + Captan + Silwet (#16), and Luna Sensation + Inspire Super + Captan + Silwet (#17). Post-storage rots included bitter rot, white rot, and Alternaria (Table 3), and excellent control of these was provided by combinations involving Merivon + Silwet (#2), Inspire Super + Ziram (#11), Merivon + Inspire Super + Captan + Silwet (#16), and Luna Sensation + Inspire Super + Captan + Silwet (#17). CX-10370 (#12-14) gave significant suppression of SBFS, bitter rot, and white rot compared to non-treated trees, but was less effective than the protectant standard (#1), and suppression was not consistently rate-related.

Table 1. Scab and rusts.

Treatment and rate/100 gal dilute	Timing ^y	Scab			Cedar-apple rust		Quince
		% lvs infected	lesions/leaf	% fruit	% leaves infected	% fruit	rust, % fruit infected
0 No fungicide	---	39 fg ^z	3.1 a-c	79 h	7.5 b	14 b	9 b
1 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Manzate Pro-Stick 75DF 12 oz + Captan 80WDG 10oz	1C-3C						
Captan 80WDG 10 oz + Ziram 76DF 12oz	4C-7C	39 fg	3.8 a-c	28 ef	0.9 a	3 a	0 a
2 Rally 40WSP 12.5 oz + Manzate 12 oz + Captan 80WDG 10oz	PF						
Merivon 4.18SC 1 oz + Silwet 114 ml	1C-7C	35 d-f	2.9 a-c	26 ef	0.2 a	0 a	0 a
3 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Merivon 4.18SC 1 oz + Silwet 114 ml	1C,3C,5C,7C						
Inspire Super 2.82EW 3 fl oz	2C,4C,6C	20 a-e	1.5 ab	13 d	0.2 a	0 a	0 a
4 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml	1C-7C	29 c-f	2.5 a-c	7 cd	0.2 a	0 a	0 a
5 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml	1C,3C,5C,7C						
Inspire Super 2.82EW 3 fl oz	2C,4C,6C	20 a-e	1.3 ab	4 bc	0 a	0 a	0 a
6 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
A 19649 200SC 0.69 fl oz + Silwet 114 ml	1C-7C	26 b-f	3.4 a-c	7 cd	0 a	0 a	0 a
7 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
A 19649 200SC 0.69 fl oz + Silwet 114 ml	1C,3C,5C,7C						
Inspire Super 2.82EW 3 fl oz	2C,4C,6C	25 b-f	2.2 ab	8 cd	0 a	0 a	0 a
8 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Aprovia 0.83EC 1.38 fl oz + Inspire Super 3 oz + Silwet 114 ml	1C-7C	21 a-e	1.5 ab	5 bc	0 a	1 a	0 a
9 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Aprovia 0.83EC 1.38 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	1C-7C	17 a-c	1.8 ab	4 bc	0.2 a	0 a	0 a
10 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Inspire Super 2.82EW 3 oz + Captan 80WDG 10 oz	1C-7C	19 a-c	1.6 ab	15 de	0 a	0 a	0 a
11 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
Inspire Super 2.82EW 3 oz + Ziram 76DF 12 oz	1C-7C	26 b-f	1.4 ab	9 cd	0.2 a	0 a	0 a
12 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
CX-10370 7.2% 0.5 gal	1C-7C	36 ef	2.4 a-c	32 fg	0 a	0 a	0 a
13 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
CX-10370 7.2% 1 gal	1C-7C	57 g	6.8 c	43 g	0 a	0 a	0 a
14 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz	PF						
CX-10370 7.2% 2 gal	1C-7C	43 fg	5.7 bc	28 fg	0 a	0 a	0 a
15 Aprovia 0.83EC 1.5 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	20 a-d	0.8 a	0 a	0 a	0 a	0 a
16 Merivon 4.18SC 1.37 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	11 ab	0.3 a	2 ab	0 a	0 a	0 a
17 Luna Sensation 500SC 1.37 fl oz+ Inspire Super 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	9 a	0.3 a	7 b-d	0.2 a	0 a	0 a

^z Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Four single-tree replications, ratings starting with the eleventh leaf on each of 10 shoots/tree, 11 Jul. Fruit ratings were of 25-fruit samples per replication, taken 7 Oct, and held in warm storage until the first evaluation 18 Oct.

^y Treatment applications: 12 May (PF, petal fall); 1C-7C (1st-7th covers): 20 May, 10 Jun, 24 Jun, 8 Jul, 20 Jul, 3 Aug, 23 Aug.

Pre-treatment scab infection periods: 22-23 Apr, 28-29 Apr, 30 Apr-1 May, 1-2 May, 2-3 May, 3-4 May, 4-5 May, 5-7 May, 8 May, 9 May, 10 May, 10-11 May, 11-12 May.

Table 2. Sooty blotch and flyspeck.

Treatment and rate/100 gal dilute	Timing ^y	% fruit or fruit area infected at harvest			
		Sooty blotch		Flyspeck	
		fruit	area	fruit	area
0 No fungicide	---	100 g ^z	21 f	100 g	13 g
1 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Manzate Pro-Stick 75DF 12 oz + Captan 80WDG 10oz Captan 80WDG 10 oz + Ziram 76DF 12oz	PF 1C-3C 4C-7C	7 c-e	<1 cd	10 d	1 de
2 Rally 40WSP 12.5 oz + Manzate 12 oz + Captan 80WDG 10oz Merivon 4.18SC 1 oz + Silwet 114 ml	PF 1C-7C	3 a-d	<1 a-c	5 cd	<1 b-d
3 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Merivon 4.18SC 1 oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C,7C 2C,4C,6C	2 a-c	<1 a-c	5 cd	<1 b-d
4 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml	PF 1C-7C	0 a	0 a	1 ab	<1 ab
5 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C,7C 2C,4C,6C	4 b-e	<1 b-d	9 d	1 de
6 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz A 19649 200SC 0.69 fl oz + Silwet 114 ml	PF 1C-7C	6 de	<1 cd	6 cd	<1 cd
7 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz A 19649 200SC 0.69 fl oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C,7C 2C,4C,6C	2 a-c	<1 a-c	4 bc	<1 a-c
8 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Inspire Super 3 oz + Silwet 114 ml	PF 1C-7C	1 ab	<1 ab	1 ab	<1 ab
9 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF 1C-7C	0 a	0 a	0 a	0 a
10 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Inspire Super 2.82EW 3 oz + Captan 80WDG 10 oz	PF 1C-7C	5 c-e	<1 cd	7 d	<1 cd
11 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz Inspire Super 2.82EW 3 oz + Ziram 76DF 12 oz	PF 1C-7C	1 ab	<1 ab	0 a	0 a
12 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 0.5 gal	PF 1C-7C	29 f	2 e	31 f	2 f
13 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 1 gal	PF 1C-7C	11 e	1 d	18 e	1 ef
14 Rally 40WSP 1.25 oz + Manzate 75DF 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 2 gal	PF 1C-7C	25 f	1 e	26 ef	1 f
15 Aprovia 0.83EC 1.5 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	0 a	0 a	0 a	0 a
16 Merivon 4.18SC 1.37 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	1 ab	<1 ab	0 a	0 a
17 Luna Sensation 500SC 1.37 fl oz+ Inspire Super 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-7C	1 ab	<1 ab	0 a	0 a

^z Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Four single-tree replications, Fruit ratings were of 25-fruit samples per replication, taken 7 Oct, put in warm storage then evaluated 18 Oct.

^y Treatment applications: 12 May (PF, petal fall); 1C-7C (1st-7th covers): 20 May, 10 Jun, 24 Jun, 8 Jul, 20 Jul, 3 Aug, 23 Aug.

Table 3. Post-harvest fruit rots.

Treatment and rate/100 gal dilute	Timing	% fruit infected after indicated days' incubation ^z						
		11 days			19 days			
		Any rot	Bitter rot	White rot	Any rot	Bitter rot	White rot	Alter-naria
0 No fungicide	---	33 d	15 b	21 d	70 g	34 e	41 e	7 cd
1 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Manzate Pro-Stick 75DF 12 oz + Captan 80WDG 10oz Captan 80WDG 10 oz + Ziram 76DF 12oz	PF 1C-3C 4C-6C	1 ab	0 a	1 ab	14 b-e	4 a-c	10 bc	0 a
2 Rally 40WSP 12.5 oz + Manzate 12 oz + Captan 80WDG 10oz Merivon 4.18SC 1 oz + Silwet 114 ml	PF 1C-6C	0 a	0 a	0 a	0 a	0 a	0 a	0 a
3 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Merivon 4.18SC 1 oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C 2C,4C,6C	0 a	0 a	0 a	6 b-d	5 bc	1 a	0 a
4 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml	PF 1C-6c	0 a	0 a	0 a	12 c-e	4 a-c	6 ab	2 a-c
5 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C 2C,4C,6C	3 ab	2 a	1 ab	16 de	9 cd	9 bc	0 a
6 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz A 19649 200SC 0.69 fl oz + Silwet 114 ml	PF 1C-6C	0 a	0 a	0 a	10 b-e	8 cd	1 a	1 ab
7 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz A 19649 200SC 0.69 fl oz + Silwet 114 ml Inspire Super 2.82EW 3 fl oz	PF 1C,3C,5C 2C,4C,6C	2 ab	2 a	0 a	11 b-e	5 a-c	4 ab	2 a-c
8 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Inspire Super 3 oz + Silwet 114 ml	PF 1C-6C	0 a	0 a	0 a	6 b-d	2 a-c	3 ab	1 ab
9 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Aprovia 0.83EC 1.38 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF 1C-6C	0 a	0 a	0 a	7 b-d	1 ab	4 ab	2 a-c
10 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Inspire Super 2.82EW 3 oz + Captan 80WDG 10 oz	PF 1C-6C	6 a-c	1 a	5 ab	20 e	7 cd	10 b	3 bc
11 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz Inspire Super 2.82EW 3 oz + Ziram 76DF 12 oz	PF 1C-6C	0 a	0 a	0 a	5 bc	4 a-c	1 a	0 a
12 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 0.5 gal	PF 1C-6C	0 a	0 a	0 a	16 de	6 cd	9 b	2 ab
13 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 1 gal	PF 1C-6C	8 bc	0 a	8 bc	38 f	16 d	21 cd	4 bc
14 Rally 40WSP 1.25 oz + Manzate 12 oz + Captan 80WDG 10 oz CX-10370 7.2% 2 gal	PF 1C-6C	11 c	1 a	10 cd	46 f	17 d	27 de	12 d
15 Aprovia 0.83EC 1.5 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-6C	1 ab	0 a	1 ab	8 ab	0 a	8 ab	1 ab
16 Merivon 4.18SC 1.37 fl oz + Inspire Super 2.82EW 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-6C	0 a	0 a	0 a	5 bc	2 a-c	0 a	3 a-c
17 Luna Sensation 500SC 1.37 fl oz+ Inspire Super 3 fl oz + Captan 80WDG 10 oz + Silwet 114 ml	PF-6C	0 a	0 a	0 a	4 a-c	2 a-c	2 ab	0 a

^z Mean separation by Waller-Duncan K-ratio t-test (p=0.05). Post-harvest counts of 25-fruit samples picked from each of four single-tree reps. Sampled 7 Oct and placed in warm storage; rated for rots 18 Oct and 26 Oct after 19 days at ambient temperatures 64-82°F (mean 70.0°F).