Cooperative Research Project, Doug Gubler, U.C. Davis Dept. of Plant Patholog

Trial name	Apple scab trial, 2004, Final report, 30 Aug, 2004
Location	Camino, CA El Dorado County
Investigators.....	Doug Gubler, 530.752.0304; Ken Dell, 752.4982; Lynn Wunderlich, 621.5505
Cooperators	Bud & Sharon Olsem 'HoneyBear Ranch' 530.644.3934
Crop.....	Apple 'Red delicious'
Disease	Apple scab '*Venturia inequalis'*

Trial layout and method

Objective	Efficacy of fungicides for control of fruit and/or leaf scab		
Experimental design.....	Treatments consist of fungicide applications to single tree plots, in a randomized complete block design, with 4 replications.		
Application method.....	Backpack Sprayer (Stihl SR400)		
Tree spacing	8 ft	Row spacing	16 ft
Treatment unit	2 trees	Treatment unit area.....	256 f^2
Area/Treatment, sq ft ...	1024 f^2	Area/Treatment, acre	0.0235078
Vol. Water/acre, gal	150	Vol. water/trt, liter.....	13.3 L (+5%=14.0)
Apps. Start.....	½" green	Apps. End	Cover sprays as needed
Treatment interval	A=1/4" green, B=1/2" green, C=tight cluster, D=pink, E=bloom, F=petal fall	Evaluation stage	End of applications, harvest
Evaluation method	Leaves and fruit rated for severity of scab lesion		

Treatments protocol

#	Spons	Color	Materials	Timing	FP/A		FP/Trt		+5%	Notes	Tol
1	lab	W	Untreated check								Y
2	lab	B	Dithane 75DF +	BDEF	3.0	lb	32.0	g	33.6	2520gai/ha	Y
			Rally 40W		4.0	oz	2.67	g	2.80	112gai/ha	
3	Syngent	R	Vangard 75WG	B	5.0	oz	3.34	g	3.51	263gai/ha	N
			Score	D	2.7	fl oz	1.88	ml	1.97	50gai/ha	
			Difenoconazole 250EC	EF							
4	Syngent	O	Vangard 75WG	B	5.0	oz	3.34	g	3.51	263gai/ha	N
			Score	D	4.0	fl oz	2.78	ml	2.92	73gai/ha	
			Difenoconazole 250EC	EF							
5	Syngent	Y	Vangard 75WG	B	5.0	oz	3.34	g	3.51	263gai/ha	N
			Score +	D	4.0	fl oz	2.78	ml	2.92		
			Vangard 75WG		3.0	oz	2.00	g	2.10		
			Difenoconazole 250EC+	EF	4.0	fl oz	2.78	ml	2.92	73gai/ha	
			Vangard 75WG		3.0	oz	2.00	g	2.10	158gai/ha	
6	Syngent	P	Vangard 75WG	B	5.0	oz	3.34	g	3.51	263gai/ha	N
			Score +	D	2.7	fl oz	1.88	ml	1.97		
			Vangard 75WG		3.0	oz	2.00	g	2.10		
			Difenoconazole 250EC+	EF	2.7	fl oz	1.88	ml	1.97	50gai/ha	
			Vangard 75WG		3.0	oz	2.00	g	2.10	158gai/ha	
7	Syngent	GBD	Vangard 75WG	B	5.0	oz	3.34	g	3.51	263gai/ha	N
			Score +	D	4.0	fl oz	2.78	ml	2.92		
			Flint 50WG		2.0	oz	1.34	g	1.40		
			Difenoconazole 250EC	E	4.0	fl oz	2.78	ml	2.92	73gai/ha	
			Flint 50WG	F	2.0	oz	1.34	g	1.40	70gai/ha	
8	BASF	O/B	Pristine 38WG	BDEF	14.7	oz	9.81	g	10.30	0.35 lbai	N
9	Bayer	Y/B	Scala 600SC alt/w	BD	10	fl oz	6.96	ml	7.31		N
			Flint 50WG	EF	2.0	oz	1.34	g	1.40		
10	Lab	BKC	Champion WP	B	12	lb	128	g	134.4	8-16lb	Y
			Kumulus DF	DEF	15	lb	160	g	167.9	10-20lb	

Notes:

1. Tol indicates whether all products in the treatment have an EPA tolerance for apples, and the crop can be harvested.
2. FP/trt amount is with 10% tank buffer.

Materials

Sponsor	Product	Active Ing.	Conc ai	Tol	Manufctr	Contact
Syngenta	Flint 50WG	Trifloxystrobin	50%	Y	Bayer	Tim Tripp
	Dithane 75DF	Manganese^{++} Zinc^{++} Ethylene bisdithiocarbamate	15% 1.87% 58.1%	Y	Dow Agro	
	Score	Petroleum distillate Surfactant	87% 13%	Y		
	Difenoconazole	Difenoconazole		N		
lab	Champion WP	copper hydroxide (copper elemental)	77% (50%)	Y	Nufarm Americas	Bill@Agtrol
	Kumulus DF	Sulfur	80%	Y	MicroFlo	JGaggero
BASF	Pristine 38WG	Pyraclostrobin + Boscalid	12.8% 25.2%	N	BASF	Phil Munger
Bayer	Scala 600SC	Pyremethinal	600g/L	N	Bayer	Matt Elhardt
	Flint	Trifloxystrobin	50%	Y	Bayer	

Applications

Date..... App.#..... Stage..... Vol/trt..... Trt#	19 Mar 1 ½" green - tight cluster 14L		25 Mar 2 pink (tite clster – blm) 14L		13 Apr 3 1st cover (petal fall) 14L	
1	--		--		--	
2	Dithane Rally	32g 2.7g	Dithane Rally	32g 2.7g	Dithane Rally	32g 2.7g
3	Vangard	3.3g	Score	1.9ml	Difenoconzaole	1.9ml
4	Vangard	3.3g	Score	2.8ml	Difenoconzaole	2.8ml
5	Vangard	3.3g	Score Vangard	1.9ml 2.0g	Difenoconzaole Vangard	2.8ml 2.0g
6	Vangard	3.3g	Score Vangard	1.9ml 2.0g	Difenoconzaole Vangard	1.9ml 2.0g
7	Vangard	3.3g	Score Flint	2.8ml 1.3g	Difenoconzaole	2.8ml
8	Pristine	9.8g	Pristine	9.8g	Pristine	9.8g
9	Scala	7ml	Scala	7ml	Flint	1.3g
10	Champion	128g	Kumulus	160g	Kumulus	160g

Calendar

Date	Activity
16 Mar	¼" to ½" green
19 Mar	½" green to tight cluster. App. #1, 8:15 – 10:15am; calm, warm, clear. 14L per trt, 80 sec/replicate 2 trees; 40 sec per side; sprayer with nozzle on volume #6.
25 Mar	App. #2; 7:30 – 9 am; cool, cloudy, calm. 14L per trt. No scab observed. 'Score' adjuvant applied in place of 'Difenconazole' due to mix up. Sprinkles noticed few hours after appliciation in Placerville. CIMIS stn reports approx. 1 inch of precip. Thursday afternoon, followed by 100% RH thru the nite.
13 Apr	App. #3; 7:30-9:30am; cool, clear, calm to slight breeze. 14L full tank, 80 sec/replicate. Small amount of leaf scab observed.

10 May	Sprinkles
21 May	Thunder storm, heavy rain during night.
27May	Rate fruit, 100 per replicate: 25 per tree per side. # and % lesion coverage per fruit.
19 Aug	Drop all crop trts # 3-9; w/ Paul..

Plot map

Map of apple scab trial plot 2004; 2-tree treatment units with 1 in-row buffer tree between treated trees, and 4 replications. Trt #-color = treated tree; b = buffer tree; x = undersized tree. Shaded trees are crop destruct. N

18											
17							5 Y				
16		6 P	5 Y	3 R	4 O	7 GBD	5 Y	8 O/B			
15		6 P	5 Y	3 R	4 O	7 GBD	x	8 O/B	x		
14	X	b	b	b	B	b	b	b	x		
13		7 GBD	2 B	2 B	1 W	4 O	10 BC	2 B			
12		7 GBD	2 B	2 B	1 W	4 O	10 BC	2 B			
11		b	b	b	B	b	x	b		9 Y/B	
10		10 BC	1 W	9 Y/B	8 O/B	6 P	1 W	5 Y	4 O	9 Y/B	
9	X	10 BC	1 W	9 Y/B	8 O/B	6 P	1 W	5 Y	4 O	b	x
8		b	b	b	B	b	b	b	b	1 W	
7		3 R	4 O	5 Y	10 BC	9 Y/B	2 B	x	6 P	1 W	
6		3 R	4 O	5 Y	10 BC	9 Y/B	2 B	3 R	6 P		
5		b	b	b	B	b	b	3 R	b		Block 4
4		8 O/B	9 Y/B	6 P	7 GBD	3 R	8 O/B	b	10 BC		
3		8 O/B	9 Y/B	6 P	7 GBD	3 R	8 O/B	7 GBD	10 BC		
2								7 GBD			x
T1		Block 1		Block 2		Block 3			x		
	R1	2	3	4	5	6	7	8	9	10	11

Results

Fungicide applications were made on 19 and 25 Mar, and 13 Apr. On 27 May, at ¾ - 1¼ " diameter fruit size, 100 fruit per replicate treatment unit (25 fruit per side from 2 trees each), were selected at random from 4' to 7' height. Fruit were rated for number of lesions and percent fruit surface coverage by scab lesion.

Mills table infection events were estimated from CIMIS station weather data in Camino, CA, approximately 2 miles from the field site. Events were categorized by spore type- conidia or ascospore, and severity- light, moderate, or heavy. Leaf wetness was assumed during precipitations and when relative humidity was over 94%. Rain occurred on 2 occasions during the primary scab season, on 25 and 26 Mar, and 17 through 20 Apr. The first rain followed the 2nd application by approximately 6 hours, and the Apr rains followed the 3rd application by 4 to 6 days. Infection events were triggered by rain on 19 Apr, conidia light, and by relative humidity on 23 and 30 Mar, conidia light, and 19 Apr, conidia heavy, ascospore moderate (Figure 1).

Scab was a significant disease affecting nearly 50% of the untreated fruit in our trial. The first sign of scab was observed on 13 Apr, on leaf tissue. The March rain or humidity must have triggered infection to account for the early disease observation. All 3 fungicide application timings should be considered as contributing to disease control. The grower standard of 3 applications of Dithane plus Rally provided good disease control, as did an organic standard of Champion 1x followed by Kumulus 2x, each reducing the incidence of affected fruit to ½%. Other treatments with similar results included the sequence of Vangard / Flint + Score / Difenoconozole, and 3 applications of Pristine Table 1). Pristine is a new fungicide from BASF with an expected registration for use in 2005, Difenoconozole is an active ingredient provided by Syngenta and is not expected to be registered for 2005.

Table 1. Fungicide applications were made on 19 Mar at ½" green (A), on 25 May at pink (B), and on 13 Apr at petal fall (C), and fruit were rated for scab lesions on 27 May.

Trt#	Materials	Incidence[1], %	Severity[2], %
2	Dithane, 3 lb + Rally, 4 oz, ABC	0.5 c[3]	0.01 c[3]
10	Champion, 12 lb, A / Kumulus, 15 lb, BC	0.5 c	0.01 c
7	Vangard, 5 oz, A / Score, 4 foz + Flint, 2 oz B / Difenoconozole, 4f oz, C	1.0 c	0.01 c
8	Pristine, 14.7oz, ABC	2.5 c	0.04 c
5	Vangard, 5 oz, A / Score, 4 foz + Vangard, 3 oz, B / Difenoconozole, 4 foz + Vangard, 3 oz, C	22.8 b	0.38 bc
6	Vangard, 5 oz, A / Score, 2.7 foz + Vangard, 3 oz, B / Difenoconozole, 2.7 foz + Vangard, 3 oz, C	25.0 b	0.43 bc
4	Vangard, 5 oz, A / Score, 4 foz, B / Difenoconozole, 4 foz, C	37.8 ab	0.68 b
3	Vangard, 5 oz, A / Score, 2.7 foz, B / Difenoconozole, 2.7 foz, C	38.3 ab	0.74 b
9	Scala, 10 foz, AB / Flint, 2 oz, C	33.8 ab	0.77 b
1	Untreated	49.8 a	1.58 a

[1]Incidence is the percent of fruit with any scab lesions;
[2]Severity is the percent fruit surface covered with scab lesions;
[3]Values in a column followed by the same letter are not significantly different according to Tukeys HSD test at $P<0.05$.

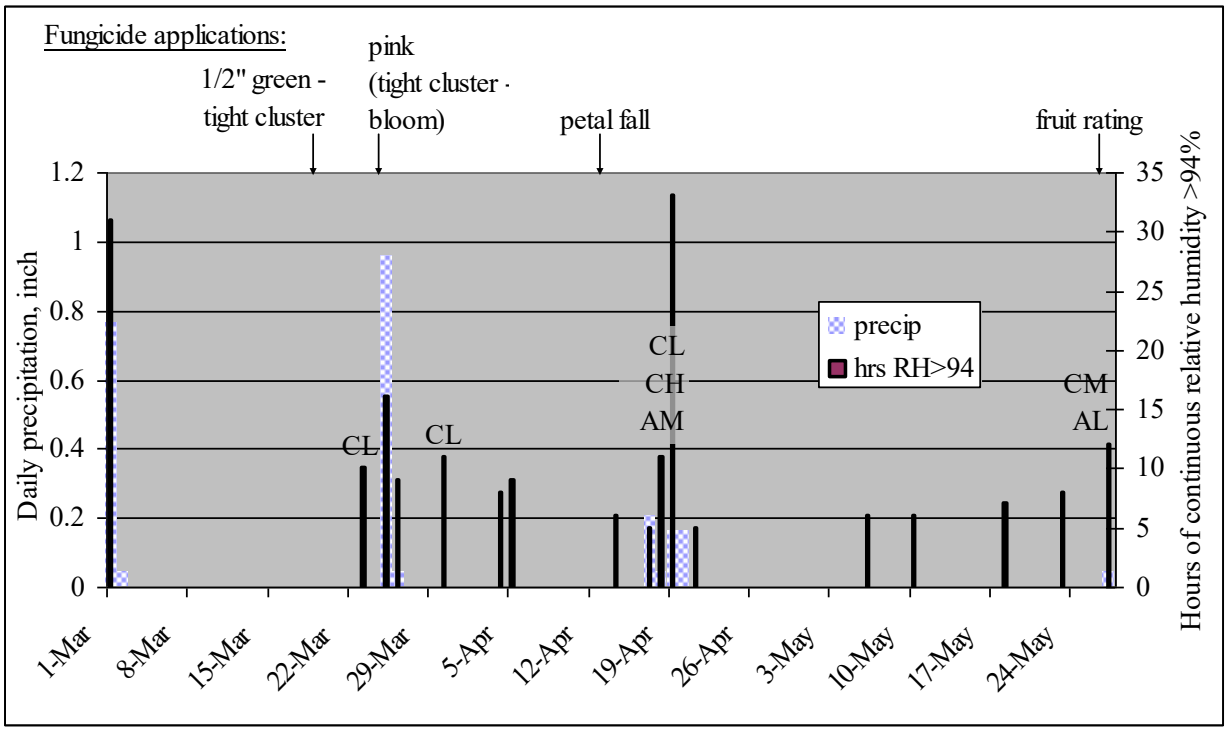

Figure 1. Weather events affecting apple scab infection and fungicide applications. Mills table infection periods are shown by spore type (Conidia or Ascospore) and severity (Light, Moderate, Heavy) for each event; all events were derived from relative humidity > 94% except the CL on 19 Apr, which was derived from precipitation. Weather data from CIMIS station in Camino, CA

***Venturia inequalis* infection events estimation in Camino, CA, 2004**

Table 2. Mills table severity index estimation was compiled using CIMIS data from station 13 – Camino. Continuous wetness assumed for precipitation and relative humidity of 95% or higher when no drying period of more than 4 hours occurred between wetness events. Type indicates whether wetness was from precipitation (p) or relative humidity (rh)

Date, 2004	Duration, hr	Avg temp	Type	Mills severity index	
1-Mar	10	40.2	p	ascospore	conidial
1-Mar	31	38.9	rh		
23-Mar	10	48.7	rh		light
25-Mar	7	44.6	p		
25-Mar	16	41.3	rh		
26-Mar	9	41.7	rh		
30-Mar	11	47.0	rh		light
4-Apr	8	44.7	rh		
5-Apr	9	40.7	rh		
14-Apr	6	41.1	rh		
14-Apr	8	43.5	rh		
17-Apr	13	39.8	p		
17-Apr	5	39.0	rh		
17-Apr	11	39.1	rh		
18-Apr	11	40.7	rh		
19-Apr	14	46.4	p		light
19-Apr	33	46.4	rh	Mod	heavy
21-Apr	5	43.9	rh		
6-May	6	44.3	rh		
10-May	6	43.9	rh		
18-May	7	44.7	rh		
23-May	8	45.4	rh		
27-May	6	54.3	p		
27-May	12	52.5	rh	Light	mod