Final Report Cooperative Research Project, Doug Gubler, U.C. Davis Dept. of Plant Pathology

Trial name.....	Apple scab trial, 2003		
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'		
Crop	Apple 'Red delicious'	Age	25 years
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 5 replications.		
Application method.....	Backpack Sprayer (Stihl SR400)		
Tree spacing.....	8 ft	Row spacing.....	16 ft
Treatment unit.....	2 trees	Treatment unit area	256 ft^2
Area/Treatment, sq ft ...	1024 ft^2	Area/Treatment, acre	0.0235078
Vol. Water/acre, gal	135 - 157	Vol. water/trt, liter	11.5 – 14.0
Apps. Start	½" green	Apps. End	Cover sprays as needed
Treatment interval.....	7 day at A=1/2" green, B=pink, C=bloom/petal fall, D=covers	Evaluation stage.....	End of applications, harvest
Evaluation method	Leaves and fruit rated for severity of scab lesion		

Treatments protocol

#	Color	Materials	Interval / timing	FP/A		Tol
1	W	Untreated check				Y
2	P	Procure 50WS + Dithane 75DF	ABCD	12.0 3.0	oz lb	Y
3	YBD	Flint 50WG/ Procure 50WS+ Dithane 75DF	AC BD	2.5 12.0 3.0	oz oz lb	Y
4	Y	BAS516 04 F	ABCD	4.0	oz	N
5	R	Flint 50WG	ABCD	2.5	oz	Y
6	OBD	Champion WP Kumulus DF	A BCD	12 15	lb lb	Y
7	O	Dithane 75DF / Captan 50WP	ABC D	6.0 6.0	lb lb	Y
8	B	Champion WP / Serenade	A BCD	12 8	lb lb	Y

Notes:

1. Tol indicates whether all products in the treatment have an EPA tolerance for apples, and the crop can be harvested.

Materials list

Sponsor	Product	Active Ing.	Conc ai	Tol	Manufctr
Uniroyal	Procure 50WS	Triflumizol	50%	Y	Uniroyal
	Pristine 38WG	BAS516	38%	N	BASF
	Flint 50WG	Trifloxystrobin	50%	Y	Bayer Crop
	Dithane 75DF	Manganese^{++}	15%	Y	Dow Agro
		Zinc^{++}	1.87%		
		Ethylene bisdithiocarbamate	58.1%		
lab	Champion WP	copper hydroxide	77%	Y	Nufarm
		(copper elemental)	(50%)		Americas
	Kumulus DF	Sulfur	80%	Y	
lab	Dithane 75DF	Manganese^{++}	15%	Y	MicroFlo
		Zinc^{++}	1.87%		Dow Agro
		Ethylene bisdithiocarbamate	58.1%		
	Captan 50WP	Captan	50%	Y	Micro Flo
lab	Serenade	*Bacilis subtilis* (min. 5x10^{9}cfu/g)	10%	Y	Agraquest

Application schedule

Date.....	25 Mar		8 Apr		23 Apr		7 May	
App.#	1		2		3		4	
Stage	½" green		pink		Pink-bloom		Bloom-petal fall	
Vol/trt.....	11.5 L		13 L		14 L		14 L	
Trt#								
1	--		--		--		--	
2	Procure	8.01g	Procure	8.01g	Procure	8.01g	Procure	8.01g
	Dithane	32g	Dithane	32g	Dithane	32g	Dithane	32g
3	Flint	1.67g	Procure	8.01g	Flint	1.67g	Procure	8.01g
			Dithane	32g			Dithane	32g
4	BAS516	2.67g	BAS516	2.67g	BAS516	2.67g	BAS516	2.67g
5	Flint	1.67g	Flint	1.67g	Flint	1.67g	Flint	1.67g
6	Champion	128g	Kumulus	160g	Kumulus	160g	Kumulus	160g
7	Dithane	64g	Dithane	64g	Dithane	64g	Captan	64g
8	Champion	128g	Serenade	85.3g	Serenade	85.3g	Serenade	85.3g

Calendar of events

Date	Activity
19 Feb	Scout site w/Lynn; collect leaves from ground for examination, kept in fridge.
5 Mar	Examine leaves: most populated with other perethecial ascomycete, 1 leaf with Venturia psuedothecia, approx. half asci mature, half immature; many psuedothecia on well-lesioned leaf.
6 Mar	Budswell. Flag plots w/Lynn. Set up spore trap.
14 Mar	Some green tip
25 Mar	KD (LW) App. #1; 6:45 – 8 am; calm, 60F, cloudy. Stage ½" green average (tight bud to 1" green); Posted 4 corner trees with 'experimental pesticide' signs. Met grower -may treat for moth. Rain forecast.
8 Apr	KD, LW, App. #2; 7:30-8:45am; calm, 60F, clear. Stage: Green bud to first flower, average= pink. No sign of scab symptoms.
23 Apr	KD App. #3; 6:40 – 8:10am; calm, cloudy, 60F. 14L/trt, 38 sec. per tree. Pink to bloom, very slow development and rain forecast, 15 day interval since last app. Scab lesions found on leaves and flower base and stem on untreated trees. Lesions examined w/LW, Fusicladium type conidia found.
7 May	KD app #4; 7-8:30am; calm, 60F, cloudy, dry.. Scab lesions found on leaves Untrt, Sulfur, Serenade.
10 Jun	KD, LW, Jenna; rate leaf scab
3 Jul	KD, Jenna; rate fruit scab

Summary -Evaluation of fungicides for control of apple scab, 2003.

Apple (*Malus domestica* 'red delicious')
Apple scab; *Venturia inequalis*

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Method

The trial was conducted in a 25 year old 'Red Delicious' apple orchard in Camino, El Dorado County, CA. The trees were spaced 8 ft apart and 16 ft between rows. The experimental design was a randomized complete block with 4 replications of two-tree treatment units. Treatments consisted of 4 fungicide applications with a backpack motorized air-assisted sprayer (Stihl SR2100), in a spray volume of 137-157 gallons water per acre, and an untreated check. Fungicides were applied on 25 Mar at 1/2 in green, 8 Apr at pink bud, 23 Apr at early-bloom, and 7 May at late-bloom/petal-fall. Plots were evaluated for leaf scab on 10 Jun and fruit scab on 3 Jul using 100 leaves and 50 fruit per experimental tree, selected at random between four to seven foot height. Percent surface coverage with scab lesions (severity) was estimated. Weather data was recorded by a CIMIS station located approximately 2 miles away. Monthly rainfall totals were: Mar with 9 rain days totaling 4.6 in; Apr, 16 rain days and 10.1 in; May with 5 rain days and 2.4 in; 1 to 15 Jun, zero. Severity and incidence data were analyzed by ANOVA; if treatment effects were significant at $p \leq 0.05$, treatment means were separated with the Waller-Duncan K-ratio t-Test at $p = 0.05$.

Results

Mills table infection periods were estimated from duration of continuous rain or relative humidity ≥95% as indicators of leaf wetness. Eleven conidial infection periods were identified by this method: 7 light, 3 moderate, and 1 heavy, occurring from 15 Mar to 12 Jun (Figure 1). Due to the frequent rainfall and high humidity throughout the treatment period, all treatment applications were considered necessary. Scab symptoms were first observed on 23 Apr, at the 3rd application. All fungicide treatments, except Champion followed by Serenade, gave significantly reduced apple scab incidence and severity compared to check trees (Table 1). Champion WP, Kumulus DF, and Serenade are listed by O.M.R.I. (Organic Materials Review Institute) as organic materials. Treatment with Champion WP followed by Kumulus DF resulted in similar levels of fruit scab as the non-organic materials.

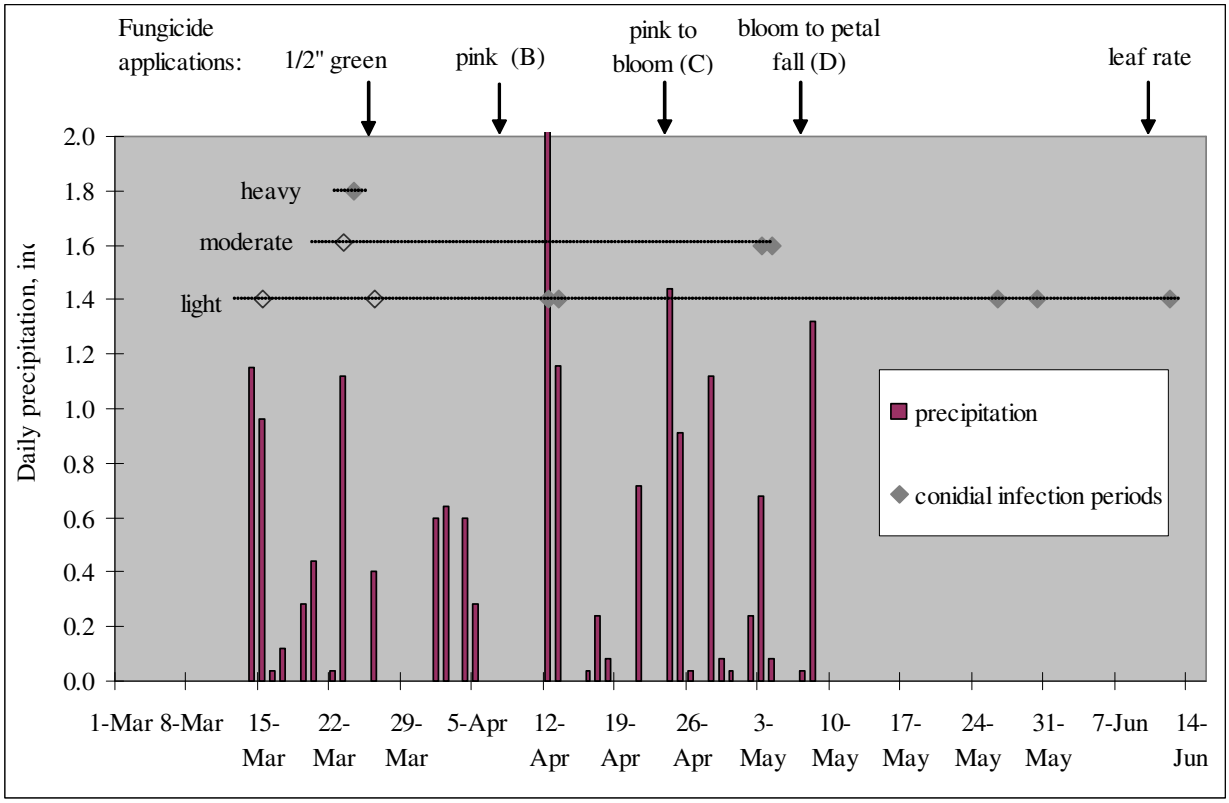

Figure 1. Fungicide application, precipitation, and calculated Mills Table infection periods. Infection periods with hollow markers are from duration of rain events, from solid markers are from duration of relative humidity ≥ 95%.

Table 1. Percent severity and incidence of fruit and leaf scab.

	Fruit		Leaf	
Material, rate/A, application timing	Severity	Incidence	Severity	Incidence
Procure 50WS, 12 oz + Dithane 75DF, 3 lb ABCD.....	0.3 c	6 c	0.1 c	7 de
Flint 50WG 2.5oz AC / Procure 12oz + Dithane 3 lb BD....	0.4 c	7 c	0.2 c	7 de
Champion WP 12 lb A / Kumulus DF 15 lb BCD	0.5 c	9 c	0.5 c	13 d
Flint 50WG 2.5oz ABCD.....	0.6 c	12 c	0.0 c	3 e
Dithane 75DF 6 lb ABC / Captan 50WP 6 lb D.....	1.9 c	25 b	1.7 c	26 c
Champion WP 12 lb A / Serenade 8 lb BCD	9.3 b	77 a	9.0 b	59 b
Untreated	17.7 a	85 a	17.5 a	67 a

[1] Severity is the estimated percent of fruit or leaf surface area covered with apple scab lesions
[2] Incidence is the percent of fruit or leaves rated with any scab lesions.
[3] Values in a column followed by the same letter are not significantly different according to the Waller-Duncan K-ratio t Test at p= 0.05