

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

Trial name.....	Santa Maria Strawberry Powdery Mildew Trial, 2003
Location	DB Specialty Farms, Prell Rd., Santa Maria
Investigators.....	Doug Gubler, 530.752.0304; Ken Dell, 752.4982, Frank Laemmlen 805.934.6240
Cooperators.....	Darren Gee, Hank Guerrero
Crop	Strawberry cv 'Ventana'
Disease.....	Powdery mildew (<i>Sphaerotheca macularis</i> f. sp. <i>fragariae</i>)

Trial layout and method

Objective.....	Efficacy of fungicides for control of fruit and/or leaf powdery mildew		
Experimental design....	Treatments consist of fungicide applications to single bed plots, in a randomized complete block design, with 4 replications in trial 1 and 5 replications in trial 2.		
Application method.....	CO ₂ Sprayer (R&D sprayer) at 50 psi, 16" T-wand w/4 nozzle TX6 sprayjet tips		
Plant spacing.....	16" / 4 plants	Bed spacing.....	64", 48" tops, 4 row beds
Treatment unit.....	20 plants trial 1, 16 plts trial 2	Treatment unit area	T1: 64" x 80" T2: 64"x 64"
Area/Treatment, sq ft ...	142.2 ft ²	Area/Treatment, acre	0.003265
Vol. Water/acre, gal ...	150	Vol. water/trt, liter	1.85 (150 gpa)
Apps. Start	21 Feb	Apps. End	6 apps; 31 April
Treatment interval.....	10 - 14 days	Evaluation stage	14 May
Evaluation method	mildew severity on leaves and fruit, horticultural symptoms on plots.		

trial 1

Treatments protocol

#	Sponsor	Materials	Interval / timing	FP/ac		Tol
1	Lab	Non-treated				Y
2	Lab	Quintec 250SC	10-28 index	4.0	fl oz	N
3	Uniroyal	Procure 50WS	10-14d	6.0	oz	Y
4	Uniroyal	Procure 50WS	10-14d	8.0	oz	Y
5	Dow	Quintec 250SC	10-14d	4.0	fl oz	N
6	Dow	Quintec 250SC	10-14d	6.0	fl oz	N
7	Dow	Rally 40W	10-14d	4.0	oz	Y
8	Dow	Rally 40W alt/w Quintec 250SC	10-14d	4.0 4.0	oz fl oz	N
9	Arvesta	TM402	10-14d	1.5	lb	Y
10	Arvesta	TM-45002	10-14d	5.25	lb	N
11	Bayer	Scala 400L+ Flint 50WG	14d	20.5 1.5	fl oz oz	N
12	Syngenta	Switch 62.5WG	10-14d	10	oz	Y
13	Syngenta	Switch 62.5WG	10-14d	14	oz	Y
14	Syngenta	Switch 62.5WG alt/w Quadris 2.08F	10-14d	14 15	oz fl oz	Y

trial 2

#	Sponsor	Materials	Interval	FP/ac		Tol
15	IR4	BAS516 38WG	10-14d	18.9	oz	Y
16	BASF	BAS516 38WG	10-14d	23.2	oz	Y
17	Labstd	Rally 40W	10-14d	4.0	oz	Y
18	Lab	Non-treated				Y

Note: 'Tol' denotes Federal tolerance for the active ingredient on the specified crop. Treatments marked with a 'N' will be crop destruct.

Materials list

Trt sponsor	Product name	Active Ing.	Conc. AI	Tol	Mfr
Arvesta	TM402	Fenhexamid	50%	Y	Arvesta
	TM-45002	TM-45002	n/a	N	Arvesta
	Microthiol Special	Sulfur	80%	Y	Cerexagri
Dow Agro	Quintec 250SC	Quinoxifen	250g/L	N	Dow Agro
	Rally 40W	Myclobutanil	40%	Y	Dow Agro
Uniroyal	Procure 50WS	Triflumizol	50%	Y	Uniroyal
Lab	Rally 40WP	Myclobutanil	40%	Y	Dow Agro
	Quintec	Quinoxifen	250g/L	N	Dow Agro
Bayer	Scala 400	Pyrethinal	400g/L	N	Bayer
	Flint 50WG	Trifloxystrobin	50%	N	Bayer
Syngenta	Switch 62.5WG	Cyprodinil + Fludioxinil	37.5% 25%	Y Y	Syngenta
	Quadris 2.08F	Azoxystrobin	2.08lb/gal	Y	Syngenta
IR4	BAS516 04 F	BAS500 F BAS510 F	n/a n/a	Y	BASF
BASF	BAS516 04 F	BAS500 F BAS510 F	n/a n/a	Y	BASF

Application schedule

Date.....	21 Feb		7 Mar		21 Mar		2 Apr	
App.#	1		2		3		4	
Stage	Bearing		fruit/ high flower		fruit/flower		fruit/flower	
Vol/trt.....	1.9 L		1.9 L		1.9L		1.9L	
Trt#								
1	--		--		--		--	
2	Quintec	0.39ml			Quintec	0.39ml	Quintec	0.39ml
3	Procure	0.56g	Procure	0.56g	Procure	0.56g	Procure	0.56g
4	Procure	0.74g	Procure	0.74g	Procure	0.74g	Procure	0.74g
5	Quintec	0.39ml	Quintec	0.39ml	Quintec	0.39ml	Quintec	0.39ml
6	Quintec	0.58ml	Quintec	0.58ml	Quintec	0.58ml	Quintec	0.58ml
7	Rally	0.37g	Rally	0.37g	Rally	0.37g	Rally	0.37g
8	Rally	0.37g	Quintec	0.39ml	Rally	0.37g	Quintec	0.39ml
9	TM402	2.22g	TM402 Microthiol	2.22g 5.9g	TM402	2.22g	TM402	2.22g
10	TM45002	7.78g	TM45002 Microthiol	7.78g 5.9g	TM45002	7.78g	TM45002	7.78g
11	Scala Flint	1.98ml 0.14g	Scala Flint	1.98ml 0.14g	Scala Flint	1.98ml 0.14g	Scala Flint	1.98ml 0.14g
12	Switch	0.93g	Switch	0.93g	Switch	0.93g	Switch	0.93g
13	Switch	1.30g	Switch	1.30g	Switch	1.30g	Switch	1.30g
14	Switch	1.30g	Quadris	1.45ml	Switch	1.30g	Quadris	1.45ml
15			BAS516	1.75g	BAS516	1.75g	BAS516	1.75g
16			BAS516	2.14g	BAS516	2.14g	BAS516	2.14g
17			Rally	0.37g	Rally	0.37g	Rally	0.37g
18			--		--		--	

Date.....	17 Apr		31 Apr	
App.# ...	5		6	
Stage	Bearing		Bearing	
Vol/trt...	1.9 L		1.9 L	
Trt#				
1	--		--	
2	--		Quintec	0.39ml
3	Procure	0.56g	Procure	0.56g
4	Procure	0.74g	Procure	0.74g
5	Quintec	0.39ml	Quintec	0.39ml
6	Quintec	0.58ml	Quintec	0.58ml
7	Rally	0.37g	Rally	0.37g
8	Rally	0.37g	Quintec	0.39ml
9	TM402	2.22g	TM402	2.22g
10	TM45002	7.78g	TM45002	7.78g
11	Scala Flint	1.98ml 0.14g	Scala Flint	1.98ml 0.14g
12	Switch	0.93g	Switch	0.93g
13	Switch	1.30g	Switch	1.30g
14	Switch	1.30g	Quadris	1.45ml
15	BAS516	1.75g	BAS516	1.75g
16	BAS516	2.14g	BAS516	2.14g
17	Rally	0.37g	Rally	0.37g
18	--		--	

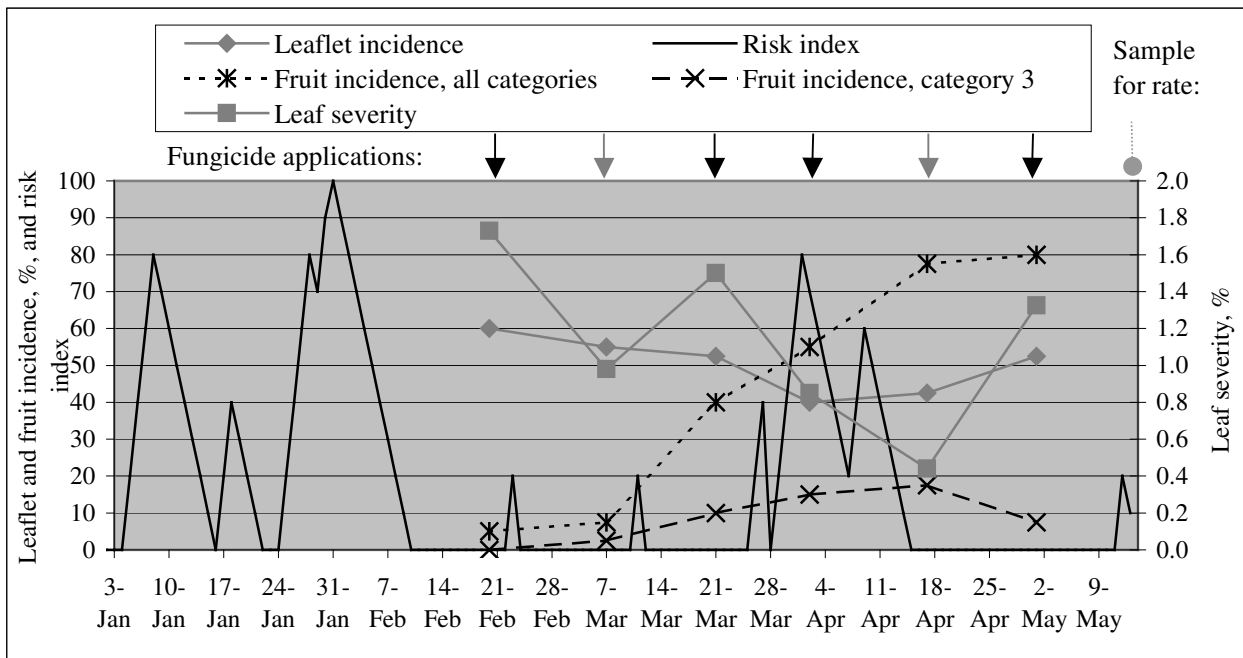
Calendar of events

Date	Activity
Dec'02- Feb'03	Grower applied fungicides: 12/13 Topsin M 70W 1.0 lb + Rally 40W 4.0 oz + Elevate 50WDG 1.5 lb 1/11 Rovral 4F 1.0 qt + Quadris 12.0 oz/ac 1/18 Rovral 4F 1.0 qt/ac 1/29 Microthiol 4.0 lb/ac 2/13 Topsin M 70W 1.0 lb/ac + Captan 50WP 3.0 lb/ac 2/21 Elevate 50WDG 1.5 lb/ac + Microthiol 3.0 lb/ac (not to trial plots)
20 Feb	Set up plot at Donovan Ranch; mildew scouting: 10/20 leaf , 1/20 fruit infected (2 others with possible old infection sites);. Rosemary ranch scouting: 1/30 leaf, 0/25 fruit infected. Set up Adcon station ' Blosser'
21 Feb	Treat Donovan plots 7:45 – 9am. Calm. 70F, sunny. Sample from untreated plots 5 lvs/plot selected at random (rated later = 90% incidence). Plots w/o tol. marked yellow 'do not pick' tape, crop to be dropped.
7 Mar	KD, FL. Trial 1: App. #2; trial 2: establish and app. #1. Application 8 – 9:30am; clear, 70F, calm. Count freshly opened flowers and collect and rate 10 fruit/plot from trt 1 trial 1 w/Eric; Eric to continue weekly. Collect 10leaflets/plot from trt 1 trial 1 for later rate. Flower count = avg 27 flowers/20 plants. Treatment 9 and 10 + microthiol @3.25lb/A
21 Mar	KD, FL; trial 1 App #3; trial 2 app #2. 7:30-9am, calm, 70F, clear. Count flowers, sample 10 fruit & 10 leaflets/ plot 1,15,30,46. Tag flowers plots 77-88; agar plates placed plots 1, 15, 30, 46, 77, 81, 84, 87. Adcon stn new leaf wetness sensors (slope NNW) installed (cable bad on old lower) lower to I/O B, upper to I/O A.
2 Apr	KD, FL; app #4 & 3; index 80 so app to trt #2. Count flowers, sample 10 fruit, 10 leaflets plots 1,15,30,46. Tag flowers plots 77-88; BSTM plates placed plots 1, 15, 30, 46, 77, 81, 84, 87.
17 Apr	KD, FL app #5; 7-9am, 65F, calm, clear. Flower count, leaflet and fruit sample, BSTM plates.
31 Apr	KD; app #6; 7-8:30am, 60F, cloudy, calm, dry. Flower count, leaflet and fruit sample dis prog.
15 May	KD, FL sample fruit and leaves for later rate.
21 May	KD, EE rate fruit.

Results

Disease progress. Disease levels on untreated foliage and fruit were monitored biweekly by observing the abaxial surface of 40 leaflets and estimating the percent of leaflet surface affected by mildew (severity), and observation of 40 fruit with rating as above. Disease levels on foliage were high initially and trended downward while disease levels on fruit were low initially and trended upward. At trials' end, 80% of fruit were infected with powdery mildew, and at the peak, 17% of fruit were infected severely (category 3). Environmental conditions, as measured by an experimental index (modified Gubler-Thomas grape powdery mildew risk index), were favorable for powdery mildew during January, unfavorable during February and March, and briefly favorable during early April (Figure 1).

Figure 1. Powdery Mildew on untreated leaves and fruit, and experimental risk index. Fungicide application arrows in grey indicate a skip for treatment #2 (application interval lengthened to 28 days when the risk index is below 30).



Fungicide applications. Fungicides were applied 6 times at 14 day intervals to all treatments in trial 1 except treatment #2, Quintec at 10-28 day intervals according to the risk index, which was applied 4 times. If the index was below 30 at the time of normal application, treatment #2 was withheld until either a 28 day interval or the index had risen. Treatments 9 and 10 included micronized sulfur @ 3.25lb/A at application #2 (7 March). In trial 2, fungicides were applied 5 times at 14 day intervals.

Fruit rating. Twenty red fruit from each plot were sampled at random on 15 May, 2003. Fruit samples were wrapped in a paper towel and placed inside a plastic bag and stored in a refrigerator until rating approx. 1 week later. Fruit were inspected by eye under close illumination, and suspected mildew was confirmed with a hand lens or microscope. Mildew infection severity on fruit was categorized as follows: 1 to 4 achenes infected (or an equivalent fruit surface area) = category 1; 5 to 9 achenes infected = category 2; 10 or more achenes infected = category 3. Severity and incidence (the % of fruit with any mildew) ratings were averaged for each plot and analyzed by analysis of variance. Treatment effects that were found to be significant by ANOVA at P=0.05 were separated by Fisher's LSD test at P=0.05.

Trial 1. Treatments were found to be a significant effect on both mildew severity and incidence, and all treatments significantly reduced disease compared to untreated plots (Table 1). Quintec treatments reduced disease to low levels at both 4.0 and 6.0 fluid ounces per acre. Quintec applied according to the risk index (trt #2) was applied four times compared to six calendar applications, and resulted in an approximate doubling of disease levels, although not a statistically significant increase. Switch 62.5WG was the most effective material among registered products tested.

Trial 2. Treatments were found to be a significant effect on both mildew severity and incidence. BAS516 38WG (Pristine) significantly reduced both mildew severity and incidence at both rates tested, compared to the untreated plots. The higher rate of BAS516 resulted in less disease than the lower rate, but the differences were not statistically significant. Treatment with Rally 40W resulted in a non-significant reduction compared to the untreated plots.

Table 1. Trial 1 treatment fruit rating.

Trt #	Treatment material, rate/A	Severity, %	Incidence, %
5	Quintec 250SC, 4 foz	0.18 f	11.3 f
6	Quintec 250 SC, 6 foz	0.23 f	12.7 f
2	Quintec 250 SC, 4 foz, 10-28d RI	0.37 ef	24.1 ef
13	Switch 62.5WG, 14 oz	0.50 def	41.7 cde
12	Switch 62.5WG, 10 oz	0.59 def	33.9 de
11	Scala 400L, 20.5 foz + Flint 50WG, 1.5oz	0.66 cde	40.7 cde
8	Rally 40W, 4.0 oz alt/w Quintec 250SC, 4 foz	0.67 cde	31.7 de
14	Switch 62.5WG, 14 oz alt/w Quadris2.08F, 15 foz	0.78 cde	43.8 cd
7	Rally 40W, 4.0 oz	0.83 cd	46.5 bcd
4	Procore 50WS, 8 oz	0.89 cd	48.6 bcd
3	Procore 50WS, 6 oz	1.06 bc	54.2 bc
9	TM402, 1.5 lb	1.38 b	64.6 ab
10	TM-45002, 5.25 lb	1.41 b	59.0 bc
1	Non-treated	2.10 a	79.2 a
	LSD	0.43	18.6

Values in a column followed by the same letter are not significantly different according to Fisher's LSD test at p=0.05.

Table 2. Trial 2 treatment fruit rating

Trt #	Treatment material, rate/A	Severity, %	Incidence, %
16	BAS516 38WG 23.2 oz	0.37 b	23.3 b
15	BAS516 38WG 18.9 oz	0.40 b	25.0 b
17	Rally 40W 4 oz	1.03 a	58.3 a
18	Non-treated	1.26 a	71.6 a
	LSD	0.53	17.8

Values in a column followed by the same letter are not significantly different according to Fisher's LSD test at p=0.05.