Project Title: Tomato Powdery Mildew Control

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Summary

This past season there was lighter disease pressure from powdery mildew in commercial fields than we had observed in the previous three years. In our trial fields, there was a moderate level of powdery mildew by mid-September at three of the five 2010 trial locations. With the lighter disease pressure, we were not able to draw any conclusions about the comparisons between different control programs. At all three locations with mildew, most programs, regardless of products or timing, whether with one-week or two week intervals, provided sufficient control of mildew. However, nontreated plots did have significantly more mildew than fungicide-treated plots. No yield impacts from the mildew were observed, although soluble solids were significantly reduced by uncontrolled mildew at two locations.

Objective: To evaluate fungicide spray programs for their impact on powdery mildew control, fruit yield, and fruit quality.

Procedures

Five powdery mildew control trials were conducted in processing tomatoes in 2010. Three trials were located within commercial fields (north Dos Palos-area, Stockton/Delta and Dixon/ Davis - area), while another two were conducted at the UC West Side Research and Extension Center near Five Points and at the Plant Sciences/Vegetable Crops field facility at UC Davis. Trials were established in fields transplanted in May, four were in fields of the variety SUN 6366, while the Davis/Dixon-area trial was in a field of AB2. At each location, a minimum of eight treatments/control programs were evaluated. At some locations, additional treatments were added. Four of the treatments were variations on a spray program of a strobilurin + DMI fungicide (azoxystrobin + difenoconazole = Quadris Top 8 oz per acre) rotated with sulfur dust (50 lbs per acre). These four programs varied in the timing of the applications (i.e. varying intervals and treatment start dates). Other treatments evaluated sulfur alone either as a dust or wettable sulfur formulation (30 lbs per acre). The eighth treatment was a nontreated control. Spray program details for each trial are listed in Table 1. Fungicides were applied with a backpack sprayer operating at 32 to 40 psi and a hand-held boom. Spray volumes were

equivalent to 50 gallons water per acre. Sulfur dust was applied with a hand-crank operated duster. Plots consisted of a single 60- or 66-inch bed and were 50 to 75 feet in length. Each plot was replicated four times at each location, in a randomized complete block design. There were non-treated buffer rows between each treatment row and between the trial rows and the rest of the field. Plots were evaluated for powdery mildew severity, foliar necrosis severity, marketable yield, sunburn damage, and fruit quality as determined by analysis by PTAB. Results of each trial are reported separately due to differences in control programs and powdery mildew pressure between trial locations (see table 1 for trial details and control program/treatment descriptions).

Results

There were two trials in the southern Sacramento Valley area (Yolo & Solano counties); one in a commercial field (Dixon/Davis-area, Timothy & Viguie), and another on campus at UC Davis. In the Davis/Dixon-area trial, powdery mildew was first observed on August 18th, about one week after early fruit ripening and about one month prior to harvest. From that point, disease increased steadily to a moderate level in the nontreated plots (54% of non-treated foliage necrotic by September 21st). A weekly sulfur application was among the best treatments, regardless if the sulfur was a dust or wettable form. Fruit production was statistically similar among treatments Soluble solids levels were similar to each other, but slightly better with dusting over wettable sulfur forms. Sulfur dust program had less sunburn damage compared to the sprayed sulfur form. Blackmold levels were lower in the fungicide-treated plots, particularly in those programs that included Quadris Top. All results are presented in Table 2.

At the UC Davis campus trial, powdery mildew infection occurred in late August, about 3 to 4 weeks before harvest and developed slowly to a high level of leaf necrosis (93% of non-treated foliage necrotic by September 29th). There were significant differences in powdery mildew levels between nontreated controls and all control treatments as a group. The two forms of sulfur (dust vs wettable/sprayable) were comparable in this test. All treatments held up relatively well through to the last rating of the trial after harvest at the end of September, which was 30 days after the last applications were made. There were no significant differences in fruit yield or cull level among treatments. However, there was a highly significant difference in reduced soluble solids level in non-treated control (5.0 °Bx) compared to fungicide programs as a group which had soluble solids of 5.5 °Bx. There were no other significant differences in fruit quality; pH and color were not impacted significantly. All results are presented in Table 3.

At the Fresno County location (Five Points-area, UC WSREC), powdery mildew pressure began around August 12th, just over one month prior to harvest and disease increased to a moderate level of 16% of the foliage infected and 50% of the foliage necrotic in mid-September. All programs held up well under these conditions, all of them reduced disease compared to nontreated control, but there were no significant differences in disease severity between the programs. Yield and cull rates did not vary between treatments. However, there was a sizeable impact of the mildew on soluble solids; fungicide-treated plots as a group had soluble solids of 6.2 °Bx compared with 5.6 °Bx in the nontreated controls. All results are presented in Table 4.

At the San Joaquin County location (Stockton/Delta-area, Del Carlo), powdery mildew was not observed. Towards the end of August, about three to four weeks prior to harvest, the trial area began to decline from Phytophthora root rot. Therefore, no disease or harvest data are presented from this trial.

At the Merced County location (north-dos Palos-area, Nickels Farming, San Juan Ranch), there was very little powdery mildew (range from 0 to 15% infection at harvest). Therefore, no disease control data are presented. The trial was hand-harvested and there was high variability between replicate blocks; there were no significant differences in yield, soluble solids or pH.

This season, powdery mildew pressure was lighter in our trials, as it was in most commercial fields as well. With lighter disease pressure, it becomes difficult to draw conclusions about the differences between different control programs with any confidence. Last year we saw a large impact of mildew control programs on yield at one location where mildew started early (about 2 months prior to harvest), while this year we saw no yield reductions. However, this year's data do corroborate our observations from last year's trials that when powdery mildew gets started around one month prior to harvest or later, yields are generally not significantly reduced, but fruit quality parameters may still be affected; soluble solids can be reduced and sunburn increased.

In future work our group will continue to investigate these yield and fruit quality impacts of powdery mildew, while striving to identify economical control programs.

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Table 1. Programs evaluated, trial details	Dixon/Davis-area trial	UC Davis trial	UC WSREC/Five Points trial	Stockton/Delta-area trial	Dos_palos area trial
Variety	AB2	SUN 6366	SUN 6366	SUN 6366	SUN 6366
transplant date	23-May	26-May	13-May	15-May	2-May
harvest date	27-Sep	16&17-Sep	16-Sep	not harvested	16-Sep
program 1: Quadris Top 8 oz alternate w/ sulfur dust 50 lb, 7-day interval	9 applications; 7/5 to 8/30	9 applications; 7/6 to 8/30	9 applications; 6/28 to 8/21	9 applications; 6/28 to 8/23	9 applications; 6/15 to 8/18
program 2: Quadris Top 8 oz alternate w/ sulfur dust 50 lb, 14-day interval	5 applications; 7/5 to 8/30	5 applications; 7/6 to 8/30	5 applications, 6/28 to 8/21	5 applications, 6/28 to 8/23	5 applications; 6/15 to 8/18
program 3: Quadris Top 8 oz alternate w/ sulfur dust 50 lb, 7-day interval, late start	5 applications; 8/2 to 8/30	5 applications; 8/3 to 8/30	4 applications, 8/2 to 8/21	5 applications, 7/26 to 8/23	5 applications, 7/20 to 8/18
program 4: Quadris Top 8 oz alternate w/ sulfur dust 50 lb, 7-day interval, early start	5 applications; 7/5 to 8/2	5 applications; 7/6 to 8/2	5 applications, 6/28 to 7/26	5 applications, 6/28 to 7/26	5 applications; 6/15 to 7/20
program 5; sulfur dust 50 lb, 7 day interval	9 applications; 7/5 to 8/30	9 applications; 7/6 to 8/30	9 applications; 6/28 to 8/21	9 applications; 6/28 to 8/23	9 applications; 6/15 to 8/18
program 6: sulfur dust 50 lb, 14-day interval	5 applications; 7/5 to 8/30	5 applications; 7/6 to 8/30	5 applications, 6/28 to 8/21	5 applications, 6/28 to 8/23	5 applications; 6/15 to 8/18
program 7 sulfur wettable 30 lb, 14-day interval	5 applications; 7/5 to 8/30	5 applications; 7/6 to 8/30	5 applications, 6/28 to 8/21	5 applications, 6/28 to 8/23	5 applications; 6/15 to 8/18
program 8: Non-treated control	none	none	none	none	none
program 9: optional, varies with the trial	sulfur wettable, 7-day int 9 applications; 7/5 to 8/30	sulfur wettable, 7-day int 9 applications; 7/6 to 8/30	sulfur/Luna/Quadris Top/Luna/Quadris Top; 14-day int; 5 applications		grower std: 2 sulfur dusts fb 2 Cabrio applications 7/1 to 8/18

Table 2. Evaluation of tomato powdery mildew control programs; effect on disease severity, yield and fruit quality, Dixon/Davis-area trial 2010.

	Treatments	Interval (days)	sprays (#)	Necrosis (%) 25-Aug	1-Sep	9-Sep	21-Sep		Yield (ton/a)	Sunburn (%)	Blackmold (%)	Soluble solids (°Bx)	Color	pH
8	Nontreated	-	-	12.75	24.5	28.0	53.8	a	41.09	5.1	4.3	5.03	22.5	4.24
3	Sulfur dust alt w/ QuadrisTop (late start)	7	5	10	21	31.5	38.8	ab	41.62	6.4	1.9	5.23	22.8	4.26
6	Sulfur dust	14	5	10	21.75	24.5	38.8	ab	41.09	4.9	3.3	5.23	22.3	4.25
7	Wettable sulfur	14	5	12.75	22.5	35.3	35.3	bc	40.28	6.0	3.8	4.90	22.5	4.28
1	Sulfur dust alt. w/ QuadrisTop	7	9	10	21.75	28.3	31.8	bc	42.60	6.6	1.5	5.15	22.5	4.24
2	Sulfur dust alt w/ QuadrisTop	14	5	15.5	28	28.0	31.5	bc	39.16	7.0	1.4	5.38	22.3	4.25
4	Sulfur dust alt w/ QuadrisTop (early start)	7	5	10	12.75	24.5	31.5	bc	40.38	4.9	1.8	5.23	22.0	4.26
5	Sulfur dust	7	9	10	18.25	21.0	21.0	c	38.26	4.6	2.2	5.38	22.8	4.24
9	Wettable sulfur	7	9	10	21.75	24.5	21.0	c	40.14	6.4	2.6	5.08	21.8	4.25
			LSD	NS	NS	NS	15.92		NS	1.6	1.6	NS	NS	NS
			CV	26.29	41.8	30.56	32.8		8.55	19.1	45	5.52	2.74	0.63

Note: Means in the same column followed by the same letter are not significantly different. NS = not significant

Table 3. Evaluation of tomato powdery mildew control programs; effect on yield, fruit quality and fruit maturity, UC Davis campus trial, 2010.

	Treatments	Spray interval (days)	sprays (#)	Infection (%) 30-Aug		6-Sep		Necrosis (%) 6-Sep	12-Sep		29-Sep			Yield (ton/a)	Sunburn (%)	Soluble solids (°Bx)	Color	pH
8	Nontreated	-	-	22	a	57	a	54	76	a	93	a		57.79	4.3	5.0	24.3	4.33
6	Sulfur dust	14	5	3	b	3	b	32	18	b	43	bcd		55.27	3.4	5.4	23.5	4.40
4	Sulfur dust alt w/ QuadrisTop (early start)	7	5	3	b	3	b	46	24	b	39	bcde		54.33	5.4	5.7	23.0	4.39
7	Wettable sulfur	14	5	3	b	5	b	22	22	b	39	bcde		60.38	2.2	5.1	23.5	4.38
9	Wettable sulfur	7	9	3	b	3	b	29	18	b	29	cde		53.24	3.9	5.7	23.8	4.39
2	Sulfur dust alt w/ QuadrisTop	14	5	3	b	3	b	29	16	b	28	cde		58.42	3.6	5.6	23.3	4.36
3	Sulfur dust alt w/ QuadrisTop (late start)	7	5	4	b	13	b	28	21	b	25	de		59.65	3.5	5.3	25.0	4.35
1	Sulfur dust alt. w/ QuadrisTop	7	9	3	b	3	b	32	22	b	22	e		56.66	3.2	5.5	25.5	4.37
5	Sulfur dust	7	9	3	b	3	b	22	18	b	22	e		56.54	2.4	5.4	24.0	4.35
			LSD	7.8		16.3		18.5	20.0		18.2			NS	NS	NS	NS	NS
			CV	110.5		102.0		39.7	49.5		29.0			10.9	45.2	7.1	5.4	1.0

Note: Means in the same column followed by the same letter are not significantly different. NS = not significant

Table 4. Evaluation of tomato powdery mildew control programs; effect on disease and fruit yield and quality, UC WSREC trial, 2010.

	Treatments	Spray interval (days)	Spray interval sprays (#)	Infection (%) 12-Aug		Infection (%) 27-Aug	Infection (%) 14-Sep		Necrosis (%) 8-Sep		Yield (ton/a)	Sunburn (%)	Soluble solids (°Bx)		Color	pH
8	Nontreated	-	-	5.8	a	11.8	16.0	a	50.0	a	24.06	18.1	5.60	b	24	4.51
9	Sulfur/Luna/Quadris Top	14	5	0.3	c	1.5	5.3	b	30.0	b	21.97	20.5	6.18	a	23.5	4.49
2	Sulfur dust alt w/ QuadrisTop	14	5	0.5	bc	0.3	3.0	bc	26.3	b	21.84	20.7	6.18	a	23	4.53
1	Sulfur dust alt w/ QuadrisTop	7	9	0.5	bc	0.0	1.8	c	27.5	b	25.24	12.8	6.13	a	22.5	4.51
6	Sulfur dust	14	5	0.8	bc	0.0	1.5	c	26.3	b	25.68	17.5	6.18	a	22.75	4.49
4	Sulfur dust alt w/ QuadrisTop (early start)	7	5	1.5	bc	1.0	1.3	c	31.3	b	23.12	13.7	6.15	a	22.75	4.50
7	Wettable sulfur	14	5	0.8	bc	0.3	1.0	c	26.3	b	23.68	17.1	6.13	a	22.75	4.52
3	Sulfur dust alt w/ QuadrisTop (late start)	7	4	3.3	ab	0.8	0.8	c	31.3	b	23.04	23.4	6.23	a	22.75	4.51
5	Sulfur dust	7	9	0.3	c	0.0	0.8	c	27.5	b	23.14	14.1	6.23	a	22.75	4.54
			LSD	2.75		----[y]	2.26		13.73		NS	NS	0.34		1.04	0.05
			CV%	125.75		124.87	44.69		30.66		13.25	39.3	3.82		3.09	0.83

Note: Means in the same column followed by the same letter are not significantly different.

[y] Unresolved non-additivity NS = not significant