FRESH MARKET TOMATO

2006
Powdery Mildew and Late Blight Disease Control Trials in Stanislaus County

University of California
Cooperative Extension
3800 Cornucopia Way, Ste. A
Modesto, CA 95358

ACKNOWLEDGEMENTS

Much appreciation is extended to Mr. Ed Beckman and the California Tomato Commission for supporting the late blight and powdery mildew fungicide efficacy trials. Additional support for the fungicide trials was provided by participating chemical manufacturers. Financial support for the insecticide efficacy trial was provided by Bayer CropScience (Arlene Kurokawa). Fresh market tomato pest management trials are costly to conduct and the studies described in this report would not have been possible without their support. The grower-cooperation of Mr. Leroy Deldon and Del Mar Farms is also greatly appreciated. Special thanks to John Campos whose time and assistance were instrumental in the establishment of these trials. Dennis Gault (Western Farm Service) provided regular updates on field conditions and activities. This was very much appreciated because it enabled us to better time pesticide applications and efficacy evaluations.

Comparative Efficacy of Fungicides Against Tomato Powdery Mildew

The test was established in a commercial, fresh market tomato production field located in Patterson, CA. On 14 Jul, tomato cultivar 'QualiT-23' was single-row transplanted into raised 60-in. wide beds of soil classified as Zacharias gravelly clay loam. Plants within rows were spaced 12-in. apart. Sprinkler irrigation was applied immediately after transplanting and every 5-7 days thereafter. Furrow irrigation was initiated on 5 Sep and continued until harvest. The trial area was subjected to the same cultural operations that the grower applied to the larger field, but all pest management activities were conducted by the researcher. The test consisted of twelve treatments arranged in a randomized complete block design with four blocks. A replicate consisted of a single, 25-ft-long bed. Treatments were prepared in a 50 gallon per acre spray volume equivalent and delivered over and into the tomato canopy using a $C0_2$-pressurized handheld boom at 35 psi. Treatments were first applied on 13 Aug prior to powdery mildew onset with subsequent applications occurring on 21 Aug; and 1, 15, and 28 Sep. Disease incidence, the proportion of leaflets with symptoms of powdery mildew, was assessed for twelve petioles sampled from each plot. On 10 Oct, fruit from plants in the middle 10-ft. of each plot were hand-harvested, sorted into four classes (red, green, sunburned and other cull fruit) and weighed. All percentage data were arcsine-transformed prior to statistical analysis using SAS software. When the two-way ANOVA indicated that there were significant treatment differences, the means were separated using Fisher's protected least significant difference test.

Powdery mildew was moderately severe in this test. All of the treatments except Procure 50WS, Procure 50WS + Sonata ASO, and V-10118 0 5EC + Sonata ASO significantly reduced powdery mildew severity compared to the non-treated control treatment. Quadris 2.08SC, Microthiol Disperss, and the rotation of Rally 40WP, Serenade Max, Microthiol Disperss and Cabrio 20EG provided the best powdery mildew control, overall. None of the treatments affected total fruit yield or the percentage of marketable, sunburned, and other cull fruit. Blossom end rot and catfacing, rather than sunburn, were the main factors contributing to the unusually high proportion of culled fruit. Phytotoxicity was not observed for any of the treatments evaluated.

Table 1. Treatment effects on powdery mildew incidence and fruit yields.

Treatment and rate/A	Days after first application[z]	Disease Incidence[y] (%)	Total Yield (t/A)	Proportion of Total Fruit Yield (%)		
				Marketable[x]	Sunburn	Other Culls[w]
Quadris 2.08SC 6.2 fl oz	0, 19, 44					
Rally 40WP 5 oz……....	8, 33	19.3 a[v]	16.0 a	84.5 a	0 a	15.5 a
Microthiol Disperss 5 lb ……	0, 8, 19, 33, 44	27.3 ab	17.4 a	87.2 a	0 a	12.8 a
Rally 40WP 5 oz	0, 44					
Serenade Max 2 qt	8					
Microthiol Disperss 5 lb	19					
Cabrio 20EG, 12 oz …….....	33	33.1 abc	14.3 a	88.0 a	0 a	12.0 a
Cabrio 20EG, 12 oz	0, 44					
Serenade Max, 2 qt	8					
Microthiol Disperss, 5 lb	19					
Rally 40WP 5 oz …….....	33	33.9 bc	14.7 a	84.5 a	0 a	15.5 a
Rally 40WP 5 oz	0, 19, 44					
Flint 50WG 3 oz ……	8, 33	36.7 bc	15.2 a	88.5 a	0 a	11.5 a
Cabrio 20EG 12 oz	0, 19, 44					
Rally 40WP 5 oz …….....	8, 33	37.5 bc	11.7 a	81.7 a	0 a	18.3 a
Flint 50WG 3 oz	0, 19, 44					
Microthiol Disperss 5 lb.....	8, 33	37.9 bc	17.6 a	89.8 a	0 a	10.2 a
V-10118 0.5EC 9.4 fl oz …….....	0, 8, 19, 33, 44	40.3 bc	15.1 a	84.6 a	0 a	15.4 a
Procure 50WS 4 oz	0, 8, 19, 33, 44					
Sonata ASO, 2 qt …….	0, 8, 19, 33, 44	45.0 cd	14.8 a	85.2 a	0 a	14.8 a
Procure 50WS 8 oz …….....	0, 8, 19, 33, 44	46.1 cde	14.7 a	87.4 a	0 a	12.6 a
V-10118 0.5EC 4.7 fl oz	0, 8, 19, 33, 44					
Sonata ASO 2 qt ……..……	0, 8, 19, 33, 44	59.7 e	17.6 a	85.9 a	0 a	14.1 a
Non-treated Control ……...	Not applicable	54.8 de	14.3 a	88.9 a	0 a	11.1 a

[z] First application was 13 Aug.
[y] Disease incidence = the proportion of leaflets on a petiole with powdery mildew symptoms.
[x] Marketable fruit is the combined yield of red and green fruit.
[w] The other culls class consists of fruit with catfacing, worm damage, and blossom end rot.
[v] Means in a column followed by the same letter are not statistically different according to Fisher's protected LSD test at P=0.05.

Evaluation of Fungicides for Late Blight Management in Fresh Market Tomatoes

The trial was conducted with cooperation by Dimare, Inc. and grower Tim Gomes. The trial was established in an alternate-row, furrow-irrigated field having a history of late blight and located just south of Gustine, CA. The trial area was subjected to the same cultural operations that the grower applied to the larger field but all pest management activities were conducted by the researcher. The test consisted of 12 treatments arranged in a randomized complete block design with 4 blocks. A replicate consisted of a single, 25-ft-long bed. Treatments were delivered to plants using a CO_2-pressurized, 60-inch-wide handheld boom fitted with 3 DG 8003 flat-fan nozzles and calibrated to deliver 50 gal/A at 35 psi. Treatments were applied on 23 Aug, 30 Aug, 6 Sep, 15 Sep, 23 Sep, and 3 Oct. Powdery mildew was managed with each late blight treatment by rotating Rally at 5 oz/A with Microthiol Disperss at 5 lbs/A. Worm pests were controlled with Success at 12 fl oz/A + CS-7 Latron at 0.13% (v/v) on 23 Aug, Asana XL at 9.6 fl oz/A + Silwet at 0.1% (v/v) on 30 Aug, Proclaim at 2.4 oz/A + Silwet at 0.1% (v/v) on 15 Sep, Intrepid at 12 fl oz/A + CS-7 Latron at 0.13% (v/v) on 23 Sep, and Avaunt at 3.5 oz/A + Silwet at 0.1% (v/v) on 3 Oct.

Late blight was first observed in the test plot in mid-September on the lowest leaves of plants in all of the plots. The spreading growth habit of the commercial variety planted combined with the grower's alternate furrow irrigation practice prevented ground applications to the test plot after 3 Oct. Plants outside of the test plot, however, had been treated aerially with late blight fungicides approximately once a week. Fruit yield and sizing data and fruit and foliar disease incidence and severity data were not collected on 16 Oct as planned because we were informed that the test plot had been aerially treated, twice in October, with late blight materials. Therefore, the trial was terminated and the plot was destroyed.

Table 1. Tomato late blight fungicides for evaluation in 2006 market tomato field trials.

Treatment	Formulation	Product/A	Treatment Timing[z]
1. Dithane	75DF	2 lb	ACE
Echo 720		2 pt	BDF
2. Quadris	2.08SC	6 fl oz	ACE
Echo 720		2 pt	BDF
3. Previcur Flex		16 fl oz	ACE
Dithane	75DF	2 lb	ACE
Echo 720		2 pt	BDF
4. Gavel	75DF	2 lb	ACE
Echo 720		2 pt	BDF
5. Cabrio	20EG	12 oz	ACE
Echo 720		2 pt	BDF
6. Tanos	50WG	8 oz	ACE
Dithane	75DF	2 lb	ACE
Echo 720		2 pt	BDF
7. Reason	4.17EC	8.3 fl oz	ACE
Dithane	75DF	2 lb	ACE
Penetrator		0.25% (v/v)	ACE
Echo 720		2 pt	BDF
8. Sonata		2 qt	ACE
Phosphite		2 qt	ACE
Dithane	75 DF	2 lb	BDF
9. Sonata		2 qt	ACE
Kocide 2000		2 lb	ACE
Dithane	75 DF	2 lb	BDF
10. Serenade Max		2 qt	ACE
Kocide 2000		2 lb	ACE
Dithane	75DF	2 lb	BDF
11. Forum	500SC	6.1 fl oz	ABEF
Dithane	75DF	2 lb	ACE
Penetrator		0.25% (v/v)	ABCDEF
Cabrio	20EG	16 oz	BCF
Endura	70WG	4 oz	D
12. Untreated Control	-----	-----	-----

[z] Treatment timings were A=23 Aug, B=30 Aug, C=6 Sep, D=15 Sep, E=23 Sep, F=3 Oct

Comparison of NNI-0001 24WG, S-1812 35WP, and Success for Beet Armyworm Control in Fresh Market Tomatoes

The test was established in a commercial, fresh market tomato production field located in Patterson, CA. On 14 July, tomato cultivar 'QualiT-23' was single-row transplanted into raised 60-in wide beds of soil classified as Zacharias gravelly clay loam. Plant spacing within rows was 15 inches. Sprinkler irrigation was applied immediately after transplanting and every 5-7 days thereafter. Furrow irrigation was initiated on 5 Sept and continued until harvest. The trial area was subjected to the same cultural operations that the grower applied to the larger field but all pest management activities were conducted by the researcher. The test consisted of 6 treatments arranged in a randomized complete block design with 4 blocks. A replicate consisted of a single, 25-ft-long bed. Treatments were delivered to plants using a CO_2-pressurized, 60-inch-wide handheld boom fitted with 3 DG 8003 flat-fan nozzles and calibrated to deliver 50 gal/A at 35 psi. Treatments were applied on 21 Aug, 8 Sep, 21 Sep, and 3 Oct. Cabrio 20EG at 15 oz/A and Rally 40WP at 5 oz/A were alternately applied with each treatment application to manage powdery mildew. Aphid and whitefly pests were controlled on 21 Aug and 8 Sep with Provado 1.6F (3.8 fl oz/A) and with Oberon 2SC applied at 8 fl oz/A on 21 Aug and 3 Oct, respectively.

On 10 Oct, fruit were hand-harvested from plants from the middle 10' of each plot, sorted into 4 classes (red, green, worm-damaged, and other culls) and weighed. The proportion of the total yield that was marketable (red + green fruit), cull, and worm-damaged was then calculated A sample of 50-100 marketable fruit from each plot was retained and on the following day, the proportion of extra-large, large, medium, and small fruit was determined using USDA-issued sizing rings. The arcsine square root transformation was applied to all proportion data prior to conducting a two-way analysis of variance. When a significant F test resulted from the ANOVA, Fisher's least significant difference test (P=0.05) was used to separate the treatment means.

Despite abundant trap catches of tomato fruitworm, cabbage looper, and western yellowstripe armyworm adults, only small numbers of beet armyworm larvae feeding on tomato leaves and fruit were observed. Non-treated control plots yielded significantly more damaged fruit (>15%) than treated plots (<3%). Feeding by beet armyworm larvae in plots sprayed with NNI-0001 resulted in no more than 1% of the total yield culled for worm damage as compared to 1.7% and 2.9% yield loss to worm feeding in plots sprayed with S1812 35WP and Success, respectively. No treatment differences were observed, however, for total yield, marketable yield, cull yield, or fruit size composition. No phytotoxic effects were observed following the application of any of these materials.

Table 1. Yield and size of fruit from plots treated with and without insecticides.

Treatment, product/A[x]	Total Yield (t/A)	Percentage of Total Yield[z]			Fruit Size (%)[y]			
		Marketable	Culls	Worm Damaged	XL	L	M	S
Success, 8 fl oz (1) or 12 fl oz (2-4)	15.9 a[w]	80.3 a	16.8 a	2.9 a	20.6 a	27.9 a	37.3 a	14.2 a
NNI 0001 24WG, 1 oz	14.1 a	76.1 a	22.9 a	1.0 a	29.3 a	28.8 a	25.3 a	16.6 a
NNI 0001 24WG, 2 oz	17.5 a	77.3 a	22.6 a	0.1 a	27.3 a	34.0 a	25.0 a	13.7 a
NNI 0001 24WG 3 oz	17.1 a	80.7 a	18.7 a	0.6 a	20.8 a	28.3 a	37.4 a	13.5 a
S-1812 35WP, 6.9 oz	17.0 a	85.1 a	13.2 a	1.7 a	29.2 a	31.2 a	32.6 a	7.0 a
Non-treated Control	17.0 a	71.5 a	13.1 a	15.5 b	31.3 a	31.9 a	28.2 a	8.6 a

[z] Marketable yield = red + green fruit. The cull class consists of fruit with catfacing,blossom end rot, and blackmold.
[y] Small = 2⅛"-2¼", Medium=2¼-2½, Large=2½-2 ¾", Extra-large=>2 ¾"
[x] Numbers in parentheses indicate application timing (1= 21 Aug, 2=8 Sep, 3=20 Sep, 4=3 Oct).
[w] Data shown are the non-transformed means. Means within a column followed by the same letter are not significantly different according to Fisher's least significant difference test.

CAUTION

This publication is a report of disease and pest management trials conducted in fresh market tomatoes with local grower cooperators conducted in 2006. It should not, in any way, be interpreted as a recommendation of the University of California. Trade names are used in this report instead of chemical names because the audience targeted is more familiar with the trade names of these products. No endorsement of products mentioned or criticism of similar products is intended. The rates of pesticides in this report are always expressed as formulated product/A (the amount of formulated product per treated acre) unless otherwise indicated. The Fungicide Resistance Action Committee (FRAC) and the Insecticide Resistance Action Committee (IRAC) have coded fungicides and insecticides, respectively, based on their mode of action. To avoid resistance developing in pathogen and pest populations' chemicals with the same code should not be tank-mixed or used in alternation.

2006 Tomato Fungicide Table

Trade Name	Common or Chemical Name	Manufacturer	FRAC Code	Reduced Risk
Cabrio 20EG	pyraclostrobin	BASF	11	No
Echo 720	chlorothalonil	Sipcam Agro USA, Inc.	M5	No
Endura 70WP	boscalid	BASF	7	Yes
Flint 50WG	trifloxystrobin	BASF	11	Yes
Forum 500SC	dimethomorph	BASF	40	No
Microthiol Disperss	micronized sulfur	Cerexagri, Inc.	M2	No
Pristine 38WDG	pyraclostrobin + boscalid	BASF	11+7	No + Yes
Quadris	azoxystrobin	Syngenta	11	Yes
Rally 40WP	myclobutanil	Dow AgroSciences, LLC	3	No
Switch 62.5 WG	cyprodonil + fludioxanil	Syngenta	9+12	Yes + Yes
Topsin M 70WP	thophanate-methyl	Cerexagri	1	No
V-10118 0.41EC	not disclosed	Valent USA	*ND	*ND

* ND = not determined by EPA, yet.

2006 Tomato Insecticide Table

Trade Name	Common or Chemical Name	Manufacturer	IRAC Code	Reduced Risk
Serenade Max	*Bacillus subtilis*	AgraQuest, Inc.	11	Yes
Sonata ASO	*Bacillus pumulis*	AgraQuest, Inc.	11	Yes

Jan Mickler
Farm Advisor
Stanislaus County