

# **Efficacy of Fungicides/Bactericides in the Management of Foliar and Fruit Diseases of Tomato**

Sally Miller, Melanie Lewis Ivey and Jhony Mera

Department of Plant Pathology, The Ohio State University  
Ohio Agricultural Research and Development Center (OARDC), Wooster, OH 44691

## **ABSTRACT**

A number of products and combinations were tested for their potential utility in management of bacterial and fungal diseases of processing tomatoes. Several product combinations significantly reduced bacterial leaf spot severity. Cuprofix, Actigard, and Tanos + Manzate + Kocide alternated with Manzate + Kocide were the most effective. The combination of Tanos + Manzate + Kocide alternated with Manzate + Kocide was also active against bacterial canker. Amistar or Reason alternated with Bravo Weather Stik performed best in reducing early blight severity.

## **INTRODUCTION**

Foliar and fruit diseases consistently cause economic loss in processing and fresh market tomato production. Early blight (*Alternaria solani*) and septoria leaf spot (*Septoria lycopersici*) are the two most common fungal foliar diseases in Ohio and other areas where high humidity and rainstorms occur during the growing season. Anthracnose (*Colletotrichum* spp.) is the most common fungal disease of tomato fruit. Bacterial spot (*Xanthomonas* spp.), bacterial speck (*Pseudomonas syringae* pv. *tomato*) and bacterial canker (*Clavibacter michiganensis* subsp. *michiganensis*) are also common, and are very difficult to manage once they are established in the field. Bacterial stem rot, pith necrosis, botrytis grey mold, late blight, buckeye rot and sclerotinia white mold occur relatively sporadically. New fungicides and bactericides are being evaluated for efficacy in controlling these diseases in tomatoes. The purpose of this study was to evaluate plant protection products for management of early blight, anthracnose and bacterial diseases of tomato.

## **MATERIALS AND METHODS**

Field trials were conducted at the Ohio Agricultural Research and Development Center North Central Experiment Station in Fremont, OH in 2004 and 2005. 'Peto 696' tomato seeds were hot water-treated and sown into 288-cell plug trays containing Metromix 360 seedling mix. Seedlings were transplanted 1 ft apart into single rows 25 ft long on the beds in late May. Starter fertilizer (N-P-K 10-34-0; 0.7 qt/50 gal water) was applied in the transplant water. Treatments were arranged in a randomized complete block design with four replications. Treatment rows were alternated with untreated border rows. Plants were overhead irrigated as needed. The bacterial spot trial was inoculated both years with *Xanthomonas campestris euvesicatoria* 767 (T1P3) at 10<sup>7</sup> CFU/ml (copper sensitive). Bacterial canker appeared naturally in the bacterial spot trial in 2005. Treatments were applied using a tractor-mounted CO<sub>2</sub>-pressurized sprayer (60 psi, 44.31 gal/A, 3 MPH) on a 7-10 day schedule. Disease severity was evaluated using a modified Horsfall-Barratt rating scale. Fruit were harvested from all plants in each plot

and weights were recorded. Weights for marketable fruit, green fruit, and fruit with anthracnose, bacterial disease, blossom end rot and other rots were determined from a 14-24 kg sub-sample from each plot. The area under the disease progress curve (AUDPC) was calculated using all ratings. Data were analyzed by ANOVA using SAS software and means were separated using Fisher's least significant difference test.

## RESULTS

All of the treatments evaluated in 2004 significantly reduced bacterial spot symptoms in processing tomatoes compared to the untreated control (Table 1). Cuprofix and Actigard (applied with Amistar alternated with Bravo for fungal disease control) and Tanos + Kocide 2000 + Manzate alternated with Kocide 2000 + Manzate were the most effective in reducing bacterial spot severity, and were significantly better than the Kocide 2000 + mancozeb standard treatment. All of the treatments except Serenade + Kocide 2000, Serenade + Kocide 2000 alternated with Kocide 2000 + Manzate, and Kocide 2000 + Manzate) significantly reduced the tonnage of tomato fruit with anthracnose symptoms (Table 1). Total marketable yield varied from 31.5 tons/A (Tanos (12 oz) + Kocide 2000 + Manzate alternated with Kocide 2000 + Manzate) to 24.3 tons/A (untreated control) but did not differ significantly among treatments and the control. The proportion of marketable fruit was significantly higher than the control for all treatments except Serenade + Kocide 2000 alternated with Kocide 2000 + Manzate (data not shown).

Table 1. Effect of various treatments on severity of bacterial spot and anthracnose in processing tomatoes, 2004.

Treatment and rate/A	Foliar bacterial spot		Anthracnose
	% disease	AUDPC	(ton/A)
Cuprofix 40DF 2 lb + (Amistar alt. Bravo)	7.3 f	407.8 cde	0.8 fg
Actigard 50WG <sup>1</sup> (6) + (Amistar alt. Bravo)	7.3 f	626.3 c-f	0.6 g
Tanos 50DF 12 oz + Kocide 2000 2 lb + Manzate 75DF 2 lb <i>alt.</i> Manzate 75DF 2 lb + Kocide 2000 2 lb	10.8 ef	252.5 f	1.4 fg
Airone SC 1.3 pt + Manzate 75DF 2 lb	14.3 de	336.4 def	
Amistar 1.8 oz <i>alt.</i> Manzate 75DF 2 lb + Kocide 2000 2 lb	14.3 de	503.9 c-f	1.6 c-f
ManKocide 61WDG 3 lb	14.3 de	659.0 bcd	1.6 c-f
Tanos 50DF 10 oz + Kocide 2000 2 lb + Manzate 75DF 2 lb <i>alt.</i> Manzate 75DF 2 lb + Kocide 2000 2 lb	14.3 de	309.6 ef	2.0 c-f
Tanos 50WG 8 oz + Kocide 2000 2 lb + Manzate 75DF 2 lb <i>alt.</i> Manzate 75DF 2 lb + Kocide 2000 2 lb	17.9 de	249.6 ef	1.9 c-f
Serenade Max WPB 1 lb + Kocide 2000 2 lb <i>alt.</i> Kocide 2000 2 lb + Manzate 75DF 2 lb	19.0 cd	804.3 b	5.4 ab
Airone SC 2.5 pt + Manzate 75DF 2 lb	19.0 cd	801.6 bcd	1.7 efg
Kocide 2000 2 lb + Manzate 75DF 2 lb	21.4 cd	439.9 c-f	5.6 ab
Airone SC 1.9 pt + Manzate 75DF 2 lb	28.5 bc	471.3 cde	2.7 b-e
Cuprofix 40DF 2 lb	28.5 bc	701.4 bc	3.3 be
Serenade Max WPB 1 lb + Kocide 2000 2 lb	28.5 bc	716.0 bc	4.6 abc
Tanos 50DF 10 oz + ManKocide 2 lb <i>alt.</i> ManKocide 61WDG 3 lb	44.3 b	769.3 bc	3.0 b-e
Untreated control	67.6 a	1780.3 a	12.1 a

Several product combinations were also tested for bacterial leaf spot management in 2005. In that year, bacterial canker also appeared naturally in the plots late in the season. Bacterial spot was severe in this trial, with 96% of the foliage affected in the untreated control (Table 2). The 8 oz rate of Tanos combined with Manzate plus Kocide 2000 at 2lb/A or Manzate plus GFJ52 at 1 lb/A and alternated with Manzate plus Kocide 2000 or GFJ52, Manzate plus Kocide 2000 alone, and JE874-SE 7.58 fl oz/a plus Manzate plus Kocide alternated with Manzate plus Kocide significantly reduced bacterial leaf spot severity compared to the untreated control. Bacterial canker severity was low-moderate (19% severity in the untreated control), and all of the treatments except the Serenade Max + Kocide + Biotune significantly reduced its severity in the trial. Treatments containing the 3.2 and 7.58 fl oz/A rates of JE874-S, and Tanos plus GFJ 52 significantly reduced anthracnose incidence in fruit compared to the untreated control. There were no significant differences among treatments and the control in marketable yield (data not shown).

Table 2. Effect of various treatments on severity of bacterial spot and anthracnose in processing tomatoes, 2005.

Treatment and rate/A	% foliar bacterial spot	% bacterial canker	% anthracnose
Tanos 8oz+Manzate 2 lb+ Kocide2000 2 lb alt. Manzate 2 lb+ Kocide2000 2 lb	72.3 d	2.8 d	12.0 bc
Tanos 8oz+Manzate 2 lb+ GFJ52 1 lb alt. Manzate 2 lb+ GFJ52 1 lb	76.9 cd	9.5 bc	10.5 c
Manzate 2b + Kocide2000 2 lb	80.5 bcd	7.3 cd	14.1 abc
JE874-SE 7.58fl oz+Manzate 2 lb+Kocide2000 2 lb alt. Manzate 2 lb+ Kocide2000 2 lb	80.5 bcd	9.6 bc	10.2 c
JE874-SE 3.2 fl oz+Manzate 2 lb+Kocide2000 2 lb alt. Manzate 2 lb+ Kocide2000 2 lb	84.1 a-d	7.3 cd	10.4 c
JE874-SE 19fl oz+Manzate 2 lb+Kocide2000 2 lb alt. Manzate 2 lb+ Kocide2000 2 lb	89.9 abc	9.6 bc	20.1 a
Tanos 8oz+Manzate 2 lb+ Kocide2000 1 lb alt. Manzate 2 lb+ Kocide2000 1 lb	91.1 abc	6.1 cd	12.1 abc
Serenade Max 1 lb + Kocide2000 1 lb + Biotune .25%	94.1 ab	14.3 ab	16.8 abc
Untreated control	96.0 a	19.0 a	19.4 ab

Additional products were tested in a separate trial for utility in the management of early blight in 2005 (Table 3). Amistar or Reason (5.5 oz/A rate) alternated with Bravo Weather Stik effectively reduced the severity of early blight. Bravo Ultrex alone, the 8.2 oz/A rate of Reason alternated with Bravo Weather Stick and several rates of an experimental product did not reduce early blight disease severity compared to the untreated control. There were no significant differences in marketable yield (data not shown).

Table 3. Effect of various treatments on severity early blight in processing tomatoes, 2005.

Treatment and rate/A	% early blight*	AUDPC
Amistar 2 oz alt. Bravo Weather Stik 2.75 pt	13.1 c	172.9 c
Reason 5.5 oz + Bond .1% alt. Bravo Weather Stik 2.75 pt	16.6 bc	133.5 c
Bravo Ultrex 1.5 lb	26.5 abc	279.0 abc
Reason 8.2 oz + Bond .1% alt. Bravo Weather Stik 2.75 pt	31.3 abc	243.0 abc
IR5885 CTL WP 1.35 lb	35.3 abc	214.5 abc
IR5885 CTL WP 1.1 lb	41.5 ab	254.5 abc
IR5885 CTL WP 1.6 lb	46.3 a	332.3 ab
Untreated control	43.4 a	356.3 a

\* 23 Aug 2005 – 4<sup>th</sup> rating

## CONCLUSION

Several products or combinations significantly reduced bacterial leaf spot severity. Cuprofix, Actigard, and Tanos + Manzate + Kocide alternated with Manzate + Kocide were the most effective. Products containing copper are expected have some activity in these trials, since the strain of the bacterial spot pathogen used to inoculate plants was copper sensitive. Copper-insensitive strains are widespread throughout Ohio and other tomato-producing regions, and in cases where they are predominant, the copper-containing products are likely to have significantly reduced efficacy. A treatment containing Tanos plus Manzate plus Kocide alternated with Manzate plus Kocide was also active against bacterial canker. Amistar or Reason alternated with Bravo Weather Stik performed best in reducing early blight severity.