

Efficacy of biopesticides for managing foliar diseases in organically-produced tomato, 2008.

The experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, in a field of Haven loam soil. Non-fungicide-treated tomato seed was planted in Sunshine organic soil-less mix on 12 May in a greenhouse. Seedlings grew slowly and poorly suggesting inadequate fertilizer in the mix. Therefore Biolink 5-5-5 Organic fertilizer (2 fl oz per 1 gal water) was applied on 5 and 26 Jun. Seedlings were no-till transplanted on 1 Jul into straw mulch from spring-planted triticale. Flail chopping did not kill the triticale as expected, therefore the herbicide Roundup was applied on 26 Jun. The field was fertilized with Pro-Grow 5-3-4 organic fertilizer at 1000 lb/A (which provided 50 lb N/A) before seeding the triticale at 125 lb/A on 15 Apr. Fish emulsion (Neptune's Harvest Benefits of Fish 2-4-1) was poured in the transplant hole before setting the seedlings. Pro-Grow organic fertilizer at 1000 lb/A was banded across the row at planting. Drip tape was laid next to each row. Additional straw mulch was spread around plants. Plants were staked and trellised following standard procedure for fresh-market tomato production. Entrust insecticide was applied regularly to control worm pests. Most treatment applications were made using a CO₂-pressurized backpack sprayer with a boom that has a single twin-jet 110-degree nozzle that delivered 74 gal/A at 50 psi. Each side of the planted row was treated with the boom held sideways to obtain thorough coverage of foliage. Applications were made weekly beginning on 21 Jul for the conventional fungicide program and on 20-21 Aug for most of the other treatments, which was before diseases were expected to begin developing based on crop physiology. The treatments with Sporatec were started on 28 Aug. The conventional program was started earlier following the guidelines for Actigard for bacterial speck management. Application dates were 21 and 30 Jul; 7, 14, 20-21, and 28 Aug; and 4, 10, 17, 24, and 30 Sep. Kocide 3000 was selected for the copper fungicide in this experiment because the application rate is lower than other copper fungicides and it was anticipated that in the future Kocide 3000 would be listed again by OMRI. For two treatments the Kocide rate was increased over time from lowest to highest label rate (0.75 to 1.75 lb/A). BioLink, an organic surfactant and penetrant, was applied with Actinovate and with Sporatec. Sporatec was also tested tank-mixed with Saf-T-Side, an OMRI-listed spray oil emulsion with 80% petroleum oil that is labeled for use as a fungicide, insecticide, and miticide. Low rates of Kocide (0.75 and 1 lb/A) were used in the conventional fungicide program. The program used was not a true standard because Actigard was inadvertently continued in the alternation program through the marketable fruit production period, for which this product is not labeled. Disease incidence and severity were assessed on 15, 22, and 29 Sep and 6 Oct. Incidence was assessed as the proportion of leaflets with symptoms. Severity was assessed for symptomatic leaflets only. Severity for the entire canopy was calculated by multiplying the average symptomatic leaflet severity value by incidence. A square root transformation was used for all variables when needed prior to analysis to achieve homogeneity of variance. Tomato fruit were not harvested due to the anticipated confounding effect on yield of variable damage among plots that occurred during unusual severe storms. Average monthly high and low temperatures (°F) were 80/63 in Jun, 84/67 in Jul, 79/63 in Aug, 75/61 in Sep, and 63/47 in Oct. Rainfall (in.) was 3.88, 3.67, 3.76, 8.34, and 3.18 for these months, respectively.

Conditions were not ideal for tomato production in 2008 with several severe rainstorms that included hail and strong winds as well as heavy rain. Diseases developed naturally in the research field. Symptoms were not seen until around the time that the first ripe fruit were seen, which was 9 Sep. The third or fourth application was made for each of the biopesticide treatments on 10 Sep. Dates of first observations were 10 Sep for powdery mildew, 15 Sep for Septoria leaf spot and 3 Oct for late blight. All treatments provided some suppression of powdery mildew based on the incidence assessment on 6 Oct. Septoria leaf spot was suppressed by all treatments except Taegro and Sporatec. Degree of control was not as high as that obtained for powdery mildew, even with the standard organic fungicide and with the conventional fungicide program. Incidence and severity of Septoria leaf spot was numerically higher than for powdery mildew on nontreated plants for most assessments. Actinovate SP was moderately effective for powdery mildew and for Septoria leaf spot. Companion provided control of both powdery mildew and Septoria leaf spot. MOI-106 provided excellent suppression of powdery mildew (91 to 99%). Septoria leaf spot was also suppressed based on most assessments. Based on the 6 Oct assessments, level of control was significantly better when MOI-106 was applied in alternation with Kocide 3000 rather than used every week: 59% versus 20% control for severity and 84% versus 50% for incidence. Organocide provided good control of Septoria leaf spot based on incidence data (47 to 62%) and excellent control of powdery mildew (79 to 97%). Control was improved, sometimes significantly, when Organocide was applied at half the rate tank-mixed with Kocide 3000 at the lowest labeled rate. Sporatec AG applied with BioLink controlled powdery mildew but not Septoria leaf spot. Degree of control of powdery mildew ranged from 61 to 88%. However, excellent control of both diseases was obtained when Sporatec was mixed with Saf-T-Side: 65 to 91% for Septoria and 91 to 100% for powdery mildew. Degree of control was not significantly different from the organic standard. Taegro exhibited some suppression of powdery mildew based on the 6 Oct incidence data. It was ineffective for Septoria leaf spot and was the only product tested that is not labeled yet for any foliar diseases but is marketed for root diseases.

Treatment + rate (application date) ^y	Septoria leaf spot (29 Sep) ^z		Septoria leaf spot (6 Oct)		Powdery mildew (6 Oct)		Defoliation (%)							
	Severity	Incidence	Severity	Incidence	Severity	Incidence	6-Oct							
Nontreated	43.1	a ^x	30.4	ab	30.4	ab	87.5	a	21.6	a	71.9	a	27.3	a
Taegro 3.5 oz/100 gal	42.5	ab	40.0	a	40.0	a	76.6	ab	14.2	ab	50.6	b	27.1	a
Taegro 3.5 oz/100 gal alt MOI-106 1%	20.1	cd	30.6	ab	30.6	ab	53.3	bc	11.0	bc	16.1	e	12.9	ab
Actinovate 12 oz/A + BioLink 4 pt/100 gal	36.9	abc	26.3	bc	26.3	bc	44.6	c	14.8	ab	27.9	c	6.2	bc
MOI-106 1%	30.1	abc	24.4	bcd	24.4	bcd	43.4	c	2.9	efg	2.8	e	7.0	bc
MOI-106 1% alt Kocide 3000 0.75-1.75 lb/A	19.4	cd	12.5	ef	12.5	ef	13.7	d	1.9	fgh	0.5	e	1.2	c
Companion 0.5 gal/A	23.3	bcd	26.3	bc	26.3	bc	45.0	c	6.8	cde	7.5	de	7.6	bc
Companion 1 gal/A	27.5	abcd	17.5	cde	17.5	cde	50.0	bc	7.9	bcd	3.4	e	4.0	bc
Sporatec AG 2 pt/A + BioLink 4 pt/100 gal	26.4	abcd	30.0	ab	30.0	ab	63.5	c	8.5	bcd	25.9	cd	8.9	abc
Sporatec AG 2 pt/A + Saf-T-Side 1.5%	31.3	abc	10.6	ef	10.6	ef	8.4	d	1.9	fgh	0.8	e	2.7	bc
Organocide 2 oz/gal	36.9	abc	27.5	bc	27.5	bc	46.8	c	4.5	def	2.3	e	4.0	bc
Organocide 1 oz/gal + Kocide 3000 0.75 lb/A	21.3	cd	12.1	ef	12.1	ef	13.3	d	2.3	efg	0.8	e	1.1	c
Standard organic fungicide program: Kocide 3000 0.75-1.75 lb/A	23.8	abcd	15.1	def	15.1	def	12.5	d	0.6	gh	0.3	e	1.2	c
Standard conventional fungicide program: Actigard 0.3-0.75 oz/A (1,3,5,7,9,11); Kocide 3000 0.75-1 lb/A + Dithane 1.5 lb/A (2,4,6,8, 10); Flint 2.5 oz/A (4,8)	10.1	d	5.1	f	5.1	f	0.4	d	0.2	h	0.2	e	0.7	c
<i>P</i> -value	0.0599		<.0001		<.0001		<.0001		<.0001		<.0001		0.0025	

^z Severity is proportion of leaf tissue with symptoms for affected leaves. Incidence is percentage of leaflets with symptoms.

^y Applications were made weekly beginning on 21 Jul for the conventional fungicide program and 20-21 or 28 Aug for the other treatments. Application dates were 1=21 Jul, 2=30 Jul, 3=7 Aug, 3=14 Aug, 5=20-21 Aug, 6= 28 Aug, 7= 4 Sep, 8=10 Sep, 9=17 Sep, 10=24 Sep, and 11=30 Sep. For three treatments the Kocide rate was increased over time.

^x Numbers in each column followed by the same letter are not significantly different from each other according to Fisher's protected LSD ($P=0.05$) with the except of the first column.