

Efficacy of biopesticides for managing foliar diseases in organically-produced tomato, 2009.

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 were sown in Sunshine organic soil-less mix on 1 May in a greenhouse. Biolink 5-5-5 Organic fertilizer (2 fl oz/gal water) was applied on 22 May, 10 Jun, and 16 Jun. Seedlings were transplanted on 25 Jun without tillage into straw mulch from fall-planted rye. An S-tine was used to open a slit in the soil for transplanting. Fish emulsion (Neptune's Harvest Benefits of Fish 2-4-1 at 0.094 fl oz in 6 fl oz water) was poured in the transplant hole before setting the seedlings. Pro-Grow organic fertilizer at 1000 lb/A mixed with Bio-Diversity 8-2-6 organic fertilizer at 625 lb/A (50 lb N/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. Fungicides with targeted activity for late blight were applied weekly on a preventive schedule. These were Previcur Flex, Revus, Curzate, and Ranman. Application dates were 15 and 22 Jul; 4, 11, 18, and 26 Aug; and 4, and 15 Sep. The first application of Taegro was done as a soil drench on 4 Aug. Foliar treatment applications were made using a CO₂-pressurized backpack sprayer with a boom that has a single twin-jet 180-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. Application dates were 7, 14, 21, and 28 Aug; 1, 8, 15, 22, and 29 Sep; and 5 Oct. It was intended to start applications before diseases began to develop, but conditions were evidently more favorable than in previous years as symptoms were first observed earlier than expected based on both crop physiology and calendar date. 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. Sporatec was tested tank-mixed with BioLink, an OMRI-listed surfactant and penetrant, or Saf-T-Side, an OMRI-listed spray oil emulsion with 80% petroleum oil that is labeled for use as a fungicide, insecticide, and miticide. Disease incidence and severity were assessed several times beginning on 6 Aug. 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. Mature fruit were harvested on 23 Sep, 2 Oct, and 14 Oct. Average monthly high and low temperatures (°F) were 73/58 in Jun, 80/64 in Jul, 83/68 in Aug, 74/58 in Sep, and 62/47 in Oct. Rainfall (in.) was 6.43, 4.82, 2.01, 2.39, and 5.78 for these months, respectively.

Diseases occurred naturally. Septoria leaf spot was the main disease. Symptoms were first observed on 3 Aug when plants were trellised and first immature fruit were present. Powdery mildew developed later and remained at a low level. Conditions were favorable for Septoria leaf spot. Symptoms became more severe in all treatments, including the conventional fungicide standard, than in a similar experiment conducted in 2008. Based on canopy severity on 29 Sep, the conventional fungicide standard was providing 77% control. Despite the high disease pressure, three treatments controlled Septoria leaf spot as effectively as the conventional standard: Organocide (at low label rate) + Kocide 3000, Actinovate alternated with Kocide, and Taegro alternated with Kocide (63-79%). Neither of these four fungicides was effective used alone. Taegro was the only product tested that is not labeled yet for any foliar diseases; it is marketed for root diseases. Treatments providing the best control of Septoria leaf spot generally had the highest yields; however, the means did not always differ significantly from the nontreated control. The treatments receiving an experimental product from Becker Underwood also had high yields.

Treatment + rate/A (application date) ^y	Septoria leaf spot severity ^z			Defoliation	Yield marketable fruit/plant		
	17-Sep	23-Sep	29-Sep	29-Sep	No.	lb	
Nontreated control	26.6	46.1	32.2	abc ^x	16.3	2.99 bcd	1.34 c
Actinovate 12 oz (1-10)	8.8	17.1	23.1	bcde	18.8	2.30 d	1.27 c
Actinovate 12 oz (1, 3, 5, 7, 9) alt Kocide 3000 0.75 lb (2, 4, 6, 8, 10)	16.0	17.7	10.2	e	4.3	3.30 abcd	1.61 abc
Taegro 3.5 oz/100 gal (1-10)	24.9	33.0	36.1	ab	27.5	2.60 cd	1.24 c
Taegro (1, 3, 5, 7, 9) alt Kocide 3000 (2, 4, 6, 8, 10)	7.4	10.5	11.8	de	3.0	3.69 abc	1.95 ab
Regalia SC 0.5% (2-10)	28.0	35.8	23.1	bcde	20.0	2.73 bcd	1.29 c
Companion 1 gal (1-10)	5.5	16.9	25.3	bcde	13.3	2.94 bcd	1.47 bc
Sporatec AG 2 pt + Biolink 2 fl oz/gal (1-10) .	32.8	47.3	32.4	abc	36.3	2.56 cd	1.29 c
Sporatec AG 2 pt + SafeTCide 2% (1-10)	29.6	42.8	44.8	a	5.0	2.83 bcd	1.38 bc
Organocide 2 oz (1-10)	21.7	29.3	24.1	bcde	16.8	2.88 bcd	1.40 bc
Organocide 1 oz (1, 3, 5, 7, 9) + Kocide 3000 (2, 4, 6, 8, 10)	10.1	13.1	7.2	e	7.5	3.33 abcd	1.75 abc
BU EXP 1216C 3 lb (1-10)	13.7	28.1	30.9	abcd	22.5	4.18 a	2.13 a
BU EXP 1216S 3 lb (1-10)	44.4	49.8	47.1	a	32.5	3.75 ab	1.82 abc
BU EXP 1216C (1-3, 5,7,9), Actigard 0.33 oz/100 gal (2), Flint 3 oz + Bravo Ultrex 1.3 lb (4,6,8,10)	2.4	3.2	6.6	e	0.5	3.62 abc	1.94 ab
BU EXP 1216S (1-3, 5,7,9), Actigard 0.33 oz/100 gal (2), Flint 3 oz + Bravo Ultrex 1.3 lb (4,6,8,10)	1.3	1.7	6.7	e	0.0	2.88 bcd	1.54 abc
Kocide 3000 0.75 lb (1-10)	15.5	15.9	14.3	cde	0.5	4.16 a	2.08 a
Conventional Fungicide Program: Actigard (1, 3, 5), Kocide 3000 (2, 4, 7-10), Manzate Pro-Stick 1.5-3 lb (2,4), Bravo Ultrex 1.8 lb/A (6-10), Quadris 6 fl oz (6,8,10), Rally 4 oz (7,9)	1.0	1.5	7.3	e	0.0	2.63 bcd	1.36 bc
<i>P</i> -value (treatment)	0.1602	0.0533	0.0001	0.184	0.0309	0.0246	

^z Percentage of leaves with symptoms (incidence) and severity for the affected leaves were estimated. Canopy severity was calculated from these values.

^y Rate of formulated product/A. Where rate of a product not noted, it was the same as for other treatments. Application dates were 1=7 Aug, 2=14 Aug, 3=21 Aug, 4=28 Aug, 5=1 Sep, 6= 8 Sep, 7= 15 Sep, 8=22 Sep, 9=29 Sep, and 10=5 Oct. In the Conventional Fungicide Program, rate of Actigard per 100 gal was increased over time: 0.33 oz on 7 Aug, 0.5 oz on 21 Aug, and 0.75 oz on 1 Sep. Taegro was also applied as a soil drench on 4 Aug.

^x Numbers in each column followed by the same letter or no letter are not significantly different from each other according to Tukey's HSD ($P=0.05$).