TOMATO (*Lycopersicon esculentum* 'Finishline')
Powdery mildew; *Oidium lycopersicum*
Late blight; *Phytophthora infestans*
Bacterial speck; *Pseudomonas syringae* pv. *tomato*

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Comparison of organic copper fungicides for foliar diseases in tomato, 2014.

The experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, in a field with Haven loam soil. Controlled release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A (101 lb/A N). Drip irrigation tape was laid as the rows were being covered with black plastic mulch. Tomato seeds were sown on 6 May in the greenhouse. Seedlings were transplanted on 9 Jun by hand into holes opened in the plastic mulch by a waterwheel transplanter that also drenched a starter fertilizer, Black Label Zn (6-20-0 N-P-K). Plants were staked and trellised following standard procedure for fresh-market tomato production. Weeds were managed by applying post-transplant Devrinol DF 4 lbs/A plus Metribuzin 1.33 lbs/A and hand weeding especially in the transplant hole. Insects were managed by applying Assail 70 WP (1.7 oz/A) on 17 Jul, Lannate (1 pt/A) on 4 Aug and 18 Aug, and Hero (10.3 fl oz/A) on 26 Aug and 2 Sep. It was deemed necessary to apply conventional fungicides with targeted activity for late blight when symptoms were observed in the research field on 19 Aug because of the potential impact to nearby experiments if the copper fungicides alone did not effectively suppress late blight and/or this disease became severe in the untreated control plots. Because an important objective of this experiment was to compare the amount of visible residue on fruit following application of the copper fungicides, these treatments were delayed until sufficient data was collected from the other experiments to permit ending the late blight fungicide applications to this experiment. Ranman (2.75 fl oz/A) was applied on 20 Aug, 2 Sep, and 10 Sep. Actigard (0.75 oz/A) was applied on 19 Jul and 4 Aug to manage bacterial speck. Plots consisted of 10 plants in a single row with 24-in. plant spacing and 68-in. row spacing with 8-ft spacing between plots in a row. A completely randomized block design was used. Plots for each of the four replications were in single adjacent rows. There was a spreader row planted between the second and third replications. Foliar applications were made using a CO_2-pressurized backpack sprayer with a boom that has a single twin-jet nozzle (TJ60-11004VS), calibrated to deliver 50 gal/A when operated at 54 psi and 2.4 mph. Each side of the planted row was treated with the boom held sideways to obtain thorough coverage of foliage and to mimic the coverage obtained with a drop nozzle on a tractor sprayer. A 7-day application schedule was used. Applications were made on 19 Sep, 26 Sep, and 3 Oct. Leaves were examined routinely for disease symptoms. All diseases present resulted from natural inoculum; artificial inoculation was not done. Diseases were assessed by estimating the percentage of leaves in each plot with symptoms (incidence) and the severity of symptoms on affected leaves. Canopy severity was calculated by multiplying these values. Area Under Disease Progress Curve (AUDPC) was calculated for severity from 16 Sep through 7 Oct. Defoliation was assessed on 16, 22, and 29 Sep and 7 Oct as percent dead leaves. Visible residue on fruit from each application was assessed 3-4 days afterwards on 22 Sep, 29 Sep, and 7 Oct. Average monthly high and low temperatures (°F) were 79/60 in Jun, 82/67 in Jul, 81/64 in Aug, and 77/61 in Sep. Rainfall (inches) was 2.47, 2.24, 2.42, and 1.86 for these months, respectively.

All copper fungicides suppressed powdery mildew similarly based on the assessment on 7 Oct. Cueva and Basic Copper 53 were most effective based on AUDPC. Powdery mildew was widespread throughout the experiment before applications were started, thus the level of control achieved likely is not indicative of potential control with these fungicides. Copper fungicide residue was more visible on fruit of plants treated with Basic Copper 53 than all other products tested. There were no significant differences among other products. Amount of residue was numerically lowest for Nordox 75WG, which is red. There were no significant differences among all treatments in severity of other diseases or defoliation.

	Severity of disease (% canopy affected) or amount of visible fungicide residue (% fruit surface covered)[z]							
	Late blight		Powdery mildew		Bacterial speck		Visible residue	
Treatment and rate/A[y]	22 Sep	AUDPC[x]	7 Oct	AUDPC	7 Oct	AUDPC	7 Oct	AUDPC
Untreated control	0.13	66.0	66.2 a	1383.8 a	1.63	15.0	0.0 b	0.00 b
Cueva 1 gal	0.05	18.5	28.8 b	1046.5 b	2.13	22.8	0.5 b	0.68 b
Badge X2 1.75 lb	0.00	0.0	34.4 b	1139.1 ab	2.00	16.6	0.1 b	4.10 b
Nordox 75WG 1 lb	0.00	9.3	39.9 b	1161.1 ab	1.50	17.4	0.0 b	0.02 b
Basic Copper 53 WP 4 lb	0.18	51.1	26.5 b	1014.4 b	2.25	23.0	4.8 a	172.27 a
P-value (treatment)	*0.5756*	*0.7260*	*0.0016*	*0.0253*	*0.7023*	*0.6067*	*0.0018*	*0.0001*

[z] Numbers in each column with a letter in common are not significantly different from each other (Tukey's HSD, P=0.05).

[y] Rate of formulated product/A. Foliar applications were made on 19 Sep, 26 Sep, and 3 Oct.

[x] All presented AUDPC values were square root transformed before analysis. Table contains de-transformed values.