

Evaluation of bactericides applied to seedlings and plants in the field for control of bacterial spot of tomato, 2019.

Tomato 'Pony Express' seedlings were received in 128-cell plug flats and kept under greenhouse conditions until transplanting to the field. Treatments in the greenhouse were applied as a foliar spray or a drench to flats of seedlings on 7, 13, and 19 Jun. The field was prepared by plowing and disking on 31 May. Fertilizer 46-0-0 (100 lb/A) was broadcasted and plastic mulch laid on 6 Jun. A field with sandy soil previously planted with squash at the Michigan State University Southwest Research and Extension Center located near Benton Harbor, MI was prepared with raised plant beds spaced 8 ft apart. Tomatoes were transplanted into the plant beds with a plant spacing of 18 in. and 8-ft row spacing on 21 Jun. Fields were fertilized weekly through drip irrigation with 20-20-20 NPK at 5 lb/A. Treatments were arranged in a completely randomized block design with four replicates for each treatment. A replicate consisted of a single 20-ft row plot with a 3-ft buffer between treatments within a row. Plants were staked and tied throughout the growing season and hand weeded, as necessary. Ten field treatments were applied on 2, 9, 17, 25, and 30 Jul; 7, 14, 23, and 30 Aug; and 8 Sep using a backpack sprayer with a 3-nozzle boom and XR8003 flat fan nozzles operating at 50 psi and delivering 50, 70 and 100 GPA. Plants were inoculated on 17 Aug with *Xanthomonas vesicatoria* isolates which were previously determined to be sensitive to copper hydroxide and streptomycin. Inoculum was prepared by placing a single colony of *X. vesicatoria* on nutrient broth yeast extract (NBY) agar, grown at 30°C for 24 hours, transferred into 25 ml of NBY broth and incubated overnight at 30°C on a rotary shaker at 100 rpm. After incubation, 5 ml of bacterial suspension were transferred to 500 ml of NBY broth and incubated under the same conditions. The bacterial suspension was centrifuged at 15,000 rpm for 5 min, the supernatant discarded, and the pellet re-suspended in sterile, distilled water. The bacterial concentration was adjusted to an optical density of 0.3 at 600 nm (~1x10⁸ colony-forming units/ml) using a spectrophotometer. Tomato plants were inoculated with approximately 10 ml of bacterial suspension per plant using a hand sprayer. Foliar disease (%) was evaluated on 21, 29 Aug and 5, 12 Sep and AUDPC was calculated. Fruit were harvested and weighed on 20 Sep. Data were analyzed in SAS statistical software using an analysis of variance, with mean separations performed using Fisher's protected least significant difference (LSD).

Differences among treatments were not statistically significant for foliar disease and yield. All three programs that included treatments to the transplants while in the greenhouse and also in the field (programs 2, 3 and 4) showed >5% reduction of foliar disease compared to the untreated inoculated control on 12 Sep. According to the area under the foliar disease progress curve (AUDPC) values, these programs also showed a trend of limiting disease over the course of the season compared to the untreated inoculated control. Differences in a rate response was not observed among Actigard rates (programs 3 and 4) when applied as a drench to the transplants while in the greenhouse followed by foliar applications alternated with Kocide O WG in the field. Kocide O WG and Nordox DG, industry standards for control of bacterial disease, did not differ from the untreated inoculated control for foliar disease. Treatment 4 produced the highest yield of tomato whereas treatment 9 produced the lowest yield.

Treatment and rate/A, application schedule, 50 GPA except where specified, applied at 7-day intervals in the field except where specified ^z	Foliar disease (%) ^y				AUDPC ^x	Yield (lb/plot)
	21 Aug	29 Aug	5 Sep	12 Sep		
1. Untreated inoculated control	2.0 ^w	9.0	12.3	26.3	253.1	60.2
2. GH: Manzate Flowable SC 76.8 fl oz + Kocide O WG 1.75 lb + Induce SL 0.25% v/v + Agri Mycin WP 111g, three sprays, 1,2,3 Field: Manzate Flowable SC 76.8 fl oz + Kocide O WG 1.75 lb + Induce SL 0.25% v/v, apps A-H	3.0	10.3	9.8	20.0	227.1	57.8
3. GH: Actigard WG 9.4 g, two drenches, 2,3 Field: Actigard WG 9.4 g + Induce SL 0.25% v/v, apps A,C -alt- Kocide O WG 1.75 lb, apps B,D,F,H,J -alt- Actigard WG 14 g + Induce SL 0.25% v/v, apps E,G, 70 GPA -alt- Actigard WG 21 g + Induce SL 0.25% v/v, app I, 100 GPA	2.3	6.5	12.5	21.3	219.6	56.6
4. GH: Actigard WG 7 g, two drenches, 2,3, 100 GPA Field: Actigard WG 9.4 g + Induce SL 0.25% v/v, apps A,C -alt- Kocide O WG 1.75 lb, apps B,D,F,H,J -alt- Actigard WG 14 g + Induce SL 0.25% v/v, apps E,G, 70 GPA -alt- Actigard WG 21 g + Induce SL 0.25% v/v, app I, 100 GPA	1.8	5.5	10.0	20.0	188.3	61.6
5. Kocide O WG 1.5 lb, apps A-H	3.5	8.3	14.3	28.8	276.3	55.9
6. Kocide O WG 1.5 lb, 14-day intervals, apps A,C,E,G	1.5	9.0	9.3	23.8	221.4	55.2
7. AgriPhage SC 2 pt, apps A-H	2.0	8.5	11.0	25.0	236.3	58.8
8. ManKocide WG 2 lb, apps A-H	4.0	12.8	13.8	27.5	304.1	58.2
9. LifeGard DG 4.5 oz/100 gal, apps A,C,E,G -alt- Kocide O WG 1.5 lb, apps B,D,F,H	4.3	12.0	12.8	28.8	296.9	51.5

Treatment and rate/A, application schedule, 50 GPA except where specified, applied at 7-day intervals in the field except where specified ^z	Foliar disease (%) ^y				AUDPC ^x	Yield (lb/plot)
	21 Aug	29 Aug	5 Sep	12 Sep		
10. LifeGard DG 4.5 oz/100 gal + Kocide O WG 1.5 lb, apps A,C,E,G -alt- Kocide O WG 1.5 lb, apps B,D,F,H	3.5	11.0	10.5	21.3	244.4	55.5
11. AgriLife SL 2 pt, apps A-H	4.5	13.0	15.5	33.8	342.1	52.7
12. Nordox DG 2.5 lb, apps A-H	3.8	10.0	10.8	20.0	235.3	54.0

^zapps=applications. GH=Greenhouse. -alt-=alternate. GH apps dates: 1-7 Jun, 2- 13 Jun,3-19 Jun. Field apps dates: A-2 Jul, B-9 Jul, C-17 Jul, D-25 Jul, E-30 Jul, F-7 Aug, G-14 Aug, H-23 Aug, I-30 Aug, J- 8 Sep.

^yBased on a visual estimation of the percentage of necrotic foliage.

^xArea under the disease progress curve.

^wThere were no significant differences among treatments for any parameter measured (LSD t Test; $P=0.05$).