SQUASH (*Cucurbita maxima* 'Thunder')
Phytophthora crown rot; *Phytophthora capsici*

D.E. Perla, J.R. Spafford and M.K. Hausbeck
Michigan State University, Department of Plant, Soil, and Microbial Sciences, East Lansing, MI 48824

Efficacy of conventional and biorational products to control Phytophthora crown rot using a partially resistant *Cucurbita maxima* cultivar, 2023.

This study was conducted at the Michigan State University Southwest Research and Extension Center located near Benton Harbor, MI on sandy soil previously planted to squash. The field was plowed, disced, and preplant fertilizer (potassium 180 lb/A, sulfur 25 lb/A, and boron 2.0 lb/A) was applied on 19 May. On 26 May, 6-in raised plant beds covered with black polyethylene plastic were laid and spaced 16-ft apart. A single drip tape (0.65 gpm/100 ft) was installed under the plastic mulch for plot irrigation. On 2 Jun, 3-week-old 'Thunder' winter squash plants were transplanted 18 in apart. Fertilizer (urea ammonium nitrate 28% N) was applied weekly at a rate of 1 gal/A/day through the drip tape. For each treatment, a replicate consisted of a single 20-ft row with a 5-ft buffer within the row to separate treatments. Treatments were arranged in a randomized complete block design with four replicates. On 23 Jun, plants were inoculated with *Phytophthora capsici*-infested millet (100 g sterilized millet, 72 ml distilled water, 0.08 g asparagine, and 7 7-mm plugs of *P. capsici*). *P. capsici* isolates 12889 (A1 mating type, sensitive to mefenoxam, isolated from cucumber) and SP98 (A2 mating type, sensitive to mefenoxam, isolated from pumpkin) were used to infest the millet and were mixed 1:1 prior to inoculation. Holes were made 1 cm from the plant crown and 2 g of millet was inserted. Fungicides were applied using a CO_2 backpack sprayer for soil drench applications (100 ml/plant) using a single-nozzle boom with one 8006EVS nozzle calibrated at 35 psi to deliver 100 gal/A. Foliar applications were applied using a CO_2 backpack sprayer with three XR8003 flat-fan nozzles spaced 18 in apart calibrated at 35 psi to deliver 50 gal/A. Fungicides were applied on 20, 27, 30 Jun and 7, 11, 18 Jul for the 7-day interval treatments. Fungicide treatments were applied on 20, 30 Jun and 11, 25 Jul for 14-day interval treatments. Dead plants were counted on 18, 25, 31 Jul and 7 Aug and the percentage of dead plants was calculated by dividing the number of dead plants by the total number of plants in a plot (10) and multiplying by 100. The area under the disease progress curve (AUDPC) was calculated using the percentage of dead plants. Data were analyzed using an analysis of variance using (ANOVA) SAS PROC GLIMMIX procedure of the SAS software version 9.4 (SAS Institute, Cary, NC), with mean separation performed using Fisher's protected least significant difference (LSD) at $P = 0.05$.

Disease pressure was relatively low (<28% of plant death in all treatments) at the initial rating date on 18 Jul, and no statistical differences ($P = 0.1438$) were observed among the treatments. On the following evaluation date, 25 Jul, the untreated control reached 77.5% plant death and all the treatments reduced ($P = 0.0144$) plant death (<35.0 %). On this date, Presidio had the least amount of plant death and was more effective than Theia + Howler EVO and Funibiol Gold. On 31 Jul, all treatments reduced plant death compared to the untreated control; Presidio was more effective than Theia. On the final rating date, 97.5% of the plants in the untreated control plot had died. All treatments statistically ($P = 0.0249$) reduced plant death compared to the untreated control on the final rating date, except for Theia. According to the AUDPC, all treatments had significantly ($P = 0.0008$) less disease than the untreated control. Presidio had the lowest AUDPC but was similar to all other fungicide treatments except Theia and Theia + Howler EVO. In this trial, when biorational products were combined with host resistance Phytophthora crown rot was limited.

Treatment and rate[z]/A, applied at 7- or 14-day intervals, *applications*	Plant death (%)[y]				
	18 Jul	25 Jul	31 Jul	7 Aug	AUDPC[x]
Untreated	27.5 a[w]	77.5 a	95.0 a	97.5 a	1,558.8 a
Presidio 4 fl oz, *apps AB*	0.0 a	2.5 c	15.0 c	22.5 b	192.5 c
Theia 1.5 lb., *apps BDEF* *-alt-* Presidio 4 fl oz, *apps AC*	7.5 a	7.5 bc	17.5 bc	22.5 b	267.5 bc
Theia 3 lb., apps *A-F*	7.5 a	20.0 bc	42.5 bc	45.0 b	590.0 bc
RootShield Plus 32 fl oz, *apps AB*	10.0 a	20.0 bc	42.5 bc	47.5 b	607.5 bc
MGCI 8 fl oz, *apps A-D*	12.5 a	20.0 bc	37.5 bc	57.5 b	618.8 bc
Funibiol Gold 32 fl oz, *apps A-D*	20.0 a	27.5 b	35.0 bc	47.5 b	642.5 bc
Theia 1.5 lb., *apps A-F*	10.0 a	22.5 bc	47.5 b	60.0 ab	700.0 b
Theia 1.5 lb. + Howler EVO 2.5 lb., *apps A-F*	15.0 a	32.5 b	45.0 bc	57.5 b	757.5 b
P value	0.1438	0.0144	0.0017	0.0249	0.0008

z-*alt*- = alternate. Presidio 4 fl oz: sprench applications A and B at 7 day intervals; Theia 1.5 lb. -*alt*- Presidio 4 fl oz, Theia 3 lb., Theia 1.5 lb., and Theia 1.5 lb. + Howler EVO 2.5 lb. sprench applications A to F at 7-day intervals; Funibiol Gold 32 oz: sprench applications A-D at 14 day intervals; RootShield Plus 32 oz: sprench applications A and B at 14 day intervals; MGCI 8 fl oz: foliar applications A-D at 14 day intervals.
yBased on the number of dead plants in a plot divided by the total number of plants in a plot (10) multiplied by 100.
xAUDPC = Area under the disease progress curve.
wColumn means with a letter in common are not significantly different (LSD t test; $P = 0.05$).