

Evaluation of biopesticides for managing *Phytophthora* blight in pepper, 2012.

The objective of this study was to evaluate the efficacy of EPA-classified biopesticides used in combination treatment schedules with applications to soil and foliage. Products tested are at the demonstration (labeled) level of development for *Phytophthora* blight in pepper. All are approved for organic production. Some treatments included foliar applications of a copper fungicide approved for organic production. One treatment included oomycete-targeted fungicides for conventional production. These treatments were compared to a non-treated control, a conventional 'standard' treatment with oomycete-targeted fungicides applied to foliage, and an organic 'standard' treatment with copper fungicide applied to foliage. The experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, in a field with Haven loam soil where *Phytophthora* blight has developed most years since 1994. *Phytophthora* blight was severe and occurred throughout the field in 2011 when conditions were very favorable for the pathogen. A parallel experiment was conducted with acorn winter squash next to the experiment with pepper. The same treatments were applied to pepper and acorn squash in the two experiments at the same time with the exception of the transplant treatments to pepper. Pepper seeds were sown on 24 May in the greenhouse. A few days before transplanting, herbicide Prowl H2O at 2 pt/A was applied to the entire experiment area. Controlled release fertilizer (N-P-K, 19-9-12 with 60% ESN slow release nitrogen) at 675 lb/A was spread over the rows to be planted. Herbicide and fertilizer were incorporated by cultivating. Seedlings were transplanted on 3 Jul by hand into holes opened in the bare-ground by a waterwheel transplanter that also placed in the holes a starter fertilizer, 20-20-20 Nutri-Leaf. Plants were irrigated using drip tape laid on the soil surface running down the length of the row next to the plant main stem. During the season, weeds in the plots were controlled by hand weeding while weeds between rows were mowed. A completely randomized block design with four replications was used. Plots consisted of 20 plants in a single row with 15-in. plant spacing and 68-in. row spacing. There was 8-ft spacing between plots in a row. Some biopesticides were applied to plants before and/or after transplanting following treatment protocol. Pre-transplant treatments were drenches to seedling trays done on 2 Jul, 1 full day before transplanting, and drenches in the transplant hole the afternoon before transplanting. Two more soil applications were made along the rows directed at the base of the plants. They were done using a CO₂-pressurized backpack sprayer with a boom equipped with a single Twin-jet nozzle (TJ60-11003) delivering 57 gal/A at 54 psi. Drip irrigation was run after each soil application to incorporate. Foliar applications also were made with a backpack sprayer using Twin-jet nozzle(s) delivering 50 gal/A operated at 54 psi and 2.4 mph. A boom with a single TJ60-8006vs nozzle was used when pepper plants were small. A boom with a nozzle delivering spray over the top of the plant plus two drop nozzles (all TJ60-8006vs) was used when pepper plants were larger. Plants and their fruit were examined every one to two weeks for disease symptoms. Average monthly high and low temperatures (°F) were 78/61 in Jun, 85/68 in Jul, 83/67 in Aug, 75/60 in Sep, and 66/52 in Oct. Rainfall (inches) was 5.44, 4.35, 3.24, 3.75, and 2.17 for these months, respectively.

Symptoms were not seen in this experiment until 23 Aug whereas blight was observed on 30 Jul in pumpkin in another research field at this facility. Disease development was slow. Incidence of affected fruit remained low. For some plots, it appeared that the treatment applied to the plot had less of an affect on occurrence of *Phytophthora* blight than the location of the plot being in a section of the field where conditions appeared to be more favorable than elsewhere for this disease. No symptoms were seen in some plots. Symptoms were not observed until 1 Oct for three treatments. At the last assessment on 12 Oct, while there were no significant differences among any treatments, incidence was numerically greatest for non-treated peppers and lowest for peppers treated with the program of SoilGard + Badge X2. Incidence was 10% or less for the conventional standard, the two programs with Serenade Soil, and the Actinovate treatment.

Treatment and rate (application dates) ^y	Phytophthora blight incidence (% plants) ^z				
	12 Sep	17 Sep	21 Sep	1 Oct	12 Oct
Non-treated control.....	1.7	5.0 a	5.0	30.0 a	41.7
Actinovate 12 oz/A (2-12).....	0.0	0.0 a	1.7	6.7 b	10.0
Regalia 2 qt/100 gal (1); Regalia 2 qt/A + Badge X2 1.25 lb/A (5-12).....	0.0	1.7 a	1.7	15.0 ab	36.7
Regalia 2 qt/100 gal (1); Serenade Soil 2 qt/50 gal (2-4); Regalia 2 qt/A + Badge X2 1.25 lb/A (5-12).....	0.0	0.0 a	1.7	5.0 b	17.5
Regalia 2 qt/100 gal (1); Regalia 2 qt/A (5-12); Revus ^x 8 fl oz/A (5,7,9,11); Presidio 4 fl oz/A (6,8,10,12).....	1.7	1.7 a	3.3	12.5 ab	20.8
SoilGard 2 lb/100 gal/A (1-4) + Badge X2 1.25 lb/A (5-12)	0.0	0.0 a	3.3	3.3 b	5.0
Serenade Soil 2 qt/50 gal/A (2-4); Badge X2 1.25 lb/A (5-12)	0.0	0.0 a	0.0	3.3 b	8.3
Serenade Soil 2 qt/50 gal (2-4); Badge X2 1.25 lb/A (5-12); Revus ^x 8 fl oz/A (5,7,9,11); Presidio 4 fl oz/A (6,8,10,12).....	1.7	3.3 a	5.0	6.7 b	10.0
Badge X2 1.25 lb/A (5-12) (Organic Std.).....	0.0	0.0 a	0.0	5.0 b	21.7
Badge X2 1.25 lb/A (5-12); Revus ^x 8 fl oz/A (5,7,9,11); Presidio 4 fl oz/A (6,8,10,12) (Conventional Std.).....	0.0	0.0 a	0.0	5.0 b	6.7
<i>P-value (treatment):</i>	0.6830	0.0390	0.4775	0.0009	0.0697

^z Numbers in each column followed by the same or no letter are not significantly different from each other (Tukey's HSD, P=0.05). Means did not separate for incidence on 17 Sep.

^y Rate of formulated product/A. Application dates were 1=3 Jul (pre-transplant treatment) and 2=11 Jul (post-transplant). Soil drenches were applied on 3=17 Jul and 4=31 Jul. Foliar application dates were 5=24 Jul, 6=31 Jul, 7=8 Aug, 8=16 Aug, 9=29 Aug, 10=6 Sep, 11=17 Sep, and 12=25 Sep.

^x Revus was applied with Induce at 0.25% v/v.