

Evaluation of biopesticides for managing *Phytophthora* blight in cucurbits, 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 cucurbits. 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 nontreated 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 pepper next to the experiment with squash. The same treatments were applied to pepper and squash in the two experiments at the same time with the exception that pepper received transplant treatments. Squash seeds were planted at approximately 24-in. plant spacing within rows with a vacuum seeder on 3 Jul. During seeding, fertilizer was applied in two bands about 2 in. away from the seed. Controlled release fertilizer (N-P-K, 15-5-15) was used at 625 lb/A. The herbicides Strategy (3 pt/A), Curbit EC (1 pt/A) and Sandea (0.5 oz/A) were applied over the entire plot area on 3 Jul. Powdery mildew was managed by selecting a resistant variety and routinely applying fungicides with targeted activity for this disease, alternating among Pristine (18.5 oz/A on 25 Aug and 1 Sep), Quintec (6 fl oz/A on 31 Aug), and Nova (5 oz/A on 7 Sep). 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 10 plants in a single row at 68-in. row spacing. There was 8-ft spacing between plots in a row. Squash plants received their first directed spray to soil at emergence. 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 a single TJ60-8006vs nozzle delivering 50 gal/A operated at 54 psi and 2.4 mph. When plants became too large to be covered by spray from the nozzle held over the top of the plant, each side of the plots was sprayed in two passes mimicking coverage achieved with a two-nozzle boom. Plants and their fruit were examined every one to two weeks for disease symptoms. Fruit with classic symptoms of *Phytophthora* fruit rot that included visible pathogen sporulation were counted separately from fruit that likely were infected but lacked definitive symptoms. Fruit that appeared to have rotted because of another cause were also counted. 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 of *Phytophthora* blight were first observed in this experiment on 23 Aug in non-treated control plants and some of the treatment plots, including both the organic standard (copper applied weekly to foliage) and the conventional fungicide program (copper applied weekly with fungicides with targeted activity for oomycetes). Disease development was slow and incidence of affected fruit remained low. For some plots, it appeared that the treatment applied to the plot had less of an effect 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. Foliar symptoms were not observed until 1 Oct in plots receiving either of the Serenade Soil treatments, the organic standard, or the conventional standard. Symptoms of *Phytophthora* fruit rot were not seen on 23 Aug. Most treatments had symptoms on 12 Sep, with the exception of one of the Regalia treatments, the SoilGard treatment, and the organic standard. Incidence of fruit with symptoms remained low for these three treatments. On 12 Sep, incidence of *Phytophthora* fruit rot was 26-44% in three plots in the fourth replication: non-treated control, Regalia + Serenade Soil + Badge, and conventional standard. This replication was nearest the low end of the field. Affected fruit were seen in five additional plots on 12 Sep. No symptoms were observed through the last assessment date in 20 of the 40 plots. Symptoms were observed in all four replications only for the Regalia + Serenade Soil + Badge treatment. Significant differences were detected among treatments only for incidence of affected plants on 23 Aug.

Treatment and rate (application dates) ^y	Phytophthora blight incidence (%)					
	Plant incidence (%) ^z		Fruit rot incidence (%)			
	23 Aug	12 Sep	12 Sep	21 Sep	1 Oct	12 Oct
Non-treated control.....	13.8 a	23.8	7.6	6.8	14.5	18.6
Actinovate 12 oz/A (1-11).....	5.0 ab	21.3	3.8	0.0	0.0	0.0
Regalia 2 qt/100 gal (1); Regalia 2 qt/A (3-11); Badge X2 1.25 lb/A (4-11).....	3.8 ab	20.0	0.0	0.0	0.5	0.0
Regalia 2 qt/100 gal (1); Serenade Soil 2 qt/50 gal (2,3); Regalia 2 qt/A + Badge X2 1.25 lb/A (4-11).....	1.3 ab	6.3	0.7	3.0	7.6	8.3
Regalia 2 qt/100 gal (1); Regalia 2 qt/A (2-11); Revus ^x 8 fl oz/A (4,6,8,10); Presidio 4 fl oz/A (5,7,9,11).....	1.3 ab	5.0	10.9	12.0	15.5	22.5
SoilGard 2 lb/100 gal (1-3); Badge X2 1.25 lb/A (4-11).....	1.3 ab	2.5	0.0	1.2	0.0	0.0
Serenade Soil 2 qt/50 gal (1-3); Badge X2 1.25 lb/A (4-11).....	0.0 b	0.0	2.7	0.5	0.0	2.3
Serenade Soil 2 qt/50 gal (1-3); Badge X2 1.25 lb/A (4-11); Revus ^x 8 fl oz/A (4,6,8,10); Presidio 4 fl oz/A (5,7,9,11).....	0.0 b	0.0	0.8	7.1	12.5	7.1
Badge X2 1.25 lb/A (4-11) (Organic Standard).....	0.0 b	0.0	0.0	0.0	1.2	0.5
Badge X2 1.25 lb/A (4-11); Revus ^x 8 fl oz/A (4,6,8,10); Presidio 4 fl oz/A (5,7,9,11) (Conventional Std.).....	0.0 b	0.0	7.2	4.6	5.1	6.6
<i>P-value (treatment):</i>	0.0211	0.6869	0.6193	0.5049	0.4562	0.1512

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

^y Rate of formulated product. Application dates for soil drenches around plant stem were 1=11 Jul, 2=17 Jul, and 3=31 Jul. Foliar application dates were 4=24 Jul, 5=31 Jul, 6=8 Aug, 7=16 Aug, 8=29 Aug, 9=6 Sep, 10=17 Sep, and 11=25 Sep.

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