PUMPKIN (*Cucurbita pepo* 'Gold Challenger' and 'Bayhorse Gold')
Powdery mildew; *Podosphaera xanthii*

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Evaluation of fungicides to reduce chlorothalonil use for powdery mildew on pumpkins, 2017.

An experiment with field-grown pumpkins was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. The purpose of this experiment was to evaluate means to reduce use of chlorothalonil-based fungicides due to concern about their potential impact on bees. A resistant cultivar and two alternative multi-site mode of action, OMRI-listed fungicides, Tritek (mineral oil) and Microthiol Disperss (sulfur), were examined. These fungicides were compared to Bravo Ultrex on a powdery mildew susceptible pumpkin cultivar, Gold Challenger, and a cultivar resistant to powdery mildew, Bayhorse Gold. The field was plowed on 11 Apr. Urea fertilizer (46-0-0) was applied on 14 Apr at 163 lb/A. Mustard biofumigant cover crop (Caliente 199 and Caliente Rojo) was seeded at 10 lb/A by drilling on 14 Apr. On 15 Jun the mustard was flail chopped, immediately incorporated by disking, and followed by a cultipacker to seal the soil surface. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 5 Jul. The seeder applied fertilizer in two bands about 2 in. away from the seed. Controlled-release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A. Strategy 3 pt/A, Sandea 0.5 oz/A, and Roundup PowerMax 22 oz/A were applied prior to seedling emergence for weed control on 7 Jul using a tractor mounted sprayer. During the season, weeds were managed by cultivating and hand weeding as needed. Initial moisture for seed was provided using overhead irrigation. Drip tape was laid down along each row of pumpkin seedlings on 21 Jul. The following fungicides were applied throughout the season to manage Phytophthora blight (caused by *Phytophthora capsici*): Presidio 4 fl oz/A and K-Phite 1 qt/A on 27 Jul, Omega 1 pt/A and K-Phite 1 qt/A on 3 Aug, Omega 1 pt/A on 14 Aug, Forum 6 fl oz/A on 21 Aug, Ranman 2.75 oz/A on 28 Aug, Presidio 4 fl oz/A on 4 Sep, Forum 6 oz/A on 11 Sep, Ranman 2.75 fl oz/A on 18 Sep, Omega 1 pt/A on 25 Sep, and Ranman 2.75 fl oz/A on 2 Oct. Plots were three 15-ft rows spaced 68 in. apart. The 20-ft area between plots was also planted to pumpkin. A randomized complete block split plot design with four replications was used with cultivar as the whole plot factor and treatment as the split plot factor. Natural inoculum was relied on. Treatments were applied six times on a 7-day IPM schedule (starting after disease detection) beginning on 8 Aug using a tractor-mounted boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 72 gal/A at 50 psi and 2.3 mph. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 7, 14, and 21 Aug, and 1, 8, and 14 Sep. At each assessment, nine young, nine mid-aged, and nine old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot, except the first two assessments when 50 old leaves were examined. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 21 Aug through 14 Sep. Defoliation was assessed on 29 Sep and 5 Oct. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 5 and 11 Oct. Handles were considered good if they were green, solid, and not rotting. Average monthly high and low temperatures (^{o}F) were 83/69 in Jul, 81/66 in Aug, and 77/64 in Sep. Rainfall (in.) was 3.45, 4.95, and 3.00 for these months, respectively.

Powdery mildew was first observed in this experiment on 7 Aug in 46 of the 48 plots on less than 2% of the leaves examined. Cultivar did not have significant effect on any of the measurements taken this season, indicating the resistant cultivar did not contribute to management of powdery mildew, which is in contrast with a similar experiment conducted in 2016. There was also no significant cultivar by treatment interactions. Microthiol Disperss was as effective as Bravo Ultrex across all measurements of severity as well as defoliation and fruit handle quality, which are measures of the impact of powdery mildew. Tritek effectively managed powdery mildew, but not quite as well on upper leaf surfaces as Bravo Ultrex or Microthiol Disperss; however, it was the most effective for powdery mildew on lower leaf surfaces while Bravo Ultrex was ineffective. Obtaining control on lower surfaces with contact fungicides is important for managing resistance to single-site mode of action fungicides, which are inherently more effective due to their ability to move through leaves to the lower surface. However obtaining adequate coverage with contact fungicides is difficult, especially on large pumpkin leaves. Surprisingly, Tritek was least effective of the three while Microthiol Disperss was best for preserving handle quality. Replacement of Bravo Ultrex, in the grower's standard fungicide program, which included a rotation of Luna Experience, Vivando, and Torino, with less commonly used Tritek and Microthiol Disperss showed no reduction in effective control of powdery mildew across all measurements, including fruit quality. In fact the grower's standard replacement treatment provided significantly more control of powdery mildew on the lower leaf surface when compared to the traditional grower's standard with Bravo Ultrex. These results are promising for growers looking to reduce use of chlorothalonil fungicides due to concerns of potential impact on bees. Chlorothalonil has activity for a broader spectrum of fungal pathogens and thus is a better choice when other diseases are occurring.

Treatment and rate/A (application dates) [y]	Powdery mildew severity (%) [z,x]				Defoliation [z,x] (%)	Fruit quality [z,x] (% good handles)	
	Upper leaf surface		Lower leaf surface				
	14 Sep	AUDPC	14 Sep	AUDPC	29 Sep	5 Oct	11 Oct
Untreated control	30.20 a	300.8 a	53.1 ab	876.7 a	84.4 a	55.0 c	17.2 c
Bravo Ultrex 1.8 lb (1-6)	1.68 bc	7.8 c	59.5 a	831.4 ab	75.6 ab	73.4 bc	33.8 bc
Tritek 2 gal/100 gal (1-6)	5.40 b	41.6 b	45.9 b	562.5 c	79.4 a	66.2 c	11.1 c
Microthiol Disperss 5 lb (1-6)	1.83 b	11.1 c	50.3 ab	692.1 bc	68.8 ab	89.5 ab	54.6 ab
Luna Experience 6 oz (1,4) Vivando 15.4 oz (2,5) Torino 3.4 oz (3) Bravo Ultrex 1.8 lb/A (1-6)	0.04 cd	0.4 c	20.5 c	274.0 d	38.1 c	95.7 a	69.5 a
Luna Experience 6 oz (1,4) Vivando 15.4 oz (2,5) Torino 3.4 oz (3) Microthiol Disperss 5 lb (1,2,3) Tritek 2 gal/100 gal (4,5) Bravo Ultrex 1.8 lb/A (6)	0.01 d	0.3 c	3.8 d	41.3 e	58.8 b	94.0 a	56.2 ab
Resistant cultivar (Bayhorse Gold)	3.42	27.6	38.8	528.6	63.3	74.2	36.6
Susceptible cultivar (Gold Challenger)	3.00	26.2	38.8	564.0	71.7	83.8	44.1
P-value (treatment)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P-value (cultivar)	0.5688	0.9043	0.9985	0.3123	0.0313	0.0145	0.2347
*P-value (cultivar*treatment)*	0.9819	0.9403	0.539	0.8524	0.206	0.4867	0.9485

[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. Application dates were 1=10 Aug, 2=17 Aug, 3= 24 Aug, 4=31 Aug, 5=5 Sep, and 6=12 Sep
[x] When data were not distributed normally, values were square root transformed before analysis. Table contains de-transformed values.