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

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Efficacy of biopesticides for powdery mildew in pumpkin, 2016.

An experiment with field-grown pumpkin of a susceptible cultivar was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. The main objective was to evaluate biopesticides in development for organic production. OMRI-listed Serenade Opti was included as an organic standard. K-Phite is a biopesticide not allowed in organic production that is labeled for cucurbit powdery mildew. The field was plowed on 13 Apr. Ammonium nitrate fertilizer (34-0-0) was applied on 14 Apr at 235 lb/A (80 lb/A N). Mustard biofumigant cover crop ('Caliente 199') was seeded at 10 lb/A by drilling on 19 Apr. On 15 Jun the mustard was flail chopped, immediately incorporated by disking, followed by a cultipacker to seal the soil surface. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 23 Jun. 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 (101 lb/A N). 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 25 Jun using a tractor-mounted sprayer. Select Max 16 oz/A was applied on 20 Jul to control grasses. During the season, weeds were controlled by cultivating and hand weeding as needed. Initial moisture for seed was provided using overhead irrigation. Drip tape was laid along each row of pumpkin seedlings on 30 Jun. The following fungicides were applied throughout the season to control Phytophthora blight (caused by *Phytophthora capsici*): K-Phite 1 qt/A on 16 Jun, Forum 6 oz/A and K-Phite 1 qt/A on 24 Jun, Presidio 4 oz/A and K-Phite 1 qt/A on 30 Jun, Presidio 4 oz/A on 12 Aug, Ranman 2.75 oz/A on 20 Aug, Revus 8 oz/A on 29 Aug, Ranman 2.75 oz/A on 2 Sep, Forum 6 oz/A on 12 Sep, and Presidio 2 oz/A on 21 Sep. 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 design with four replications was used. Treatments were applied four times on a 7-day preventive schedule beginning on 5 Aug using a tractor-drawn 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 9, 17, 19, 24, and 31 Aug. At the first assessment 30-50 older leaves were examined in each plot. For subsequent assessments, 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 at the last assessment when five leaves were rated. 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 17 Aug through 31 Aug. Defoliation was assessed on 14 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 2 and 14 Oct. Handles were considered good if they were green, solid, and not rotting. Average monthly high and low temperatures (^{o}F) were 86/70 in Jul, 86/71 in Aug, and 77/61 in Sep. Rainfall (in.) was 2.93, 2.19, and 3.23 for these months, respectively.

Powdery mildew was first observed in this experiment on 9 Aug in 46 of the 48 plots on less than 6% of the leaves examined. This was 4 days after the first treatment application. K-Phite was the only biopesticide that performed significantly different from the non-treated control when tested alone. It was effective only on upper leaf surfaces, providing 67% control based on AUDPC values. The other biopesticides were ineffective at all assessments (not all data shown). While Howler was ineffective tested alone, when applied in rotation with Vivando and Quintec, control achieved was not significantly different from the conventional grower recommended rotation of Vivando, Quintec, and Torino despite half as many applications of these conventional fungicides (94% versus 99% control on upper leaf surfaces, respectively, based on AUDPC values). AUDPC values for severity on lower leaf surfaces also did not differ significantly between these two treatments; however, only the conventional rotation differed significantly from the non-treated control. Only these two treatments had significantly less defoliation than the non-treated control. Fruit quality was improved only with the rotation that included Howler based on the 14 Oct assessment. No phytotoxicity was observed.

Treatment and rate/A (application dates) [x]	Powdery mildew severity (%) [y,z]				Defoliation (%) [y,z]	Fruit quality (% good handles) [y,z]	
	Upper leaf surface		Lower leaf surface				
	31 Aug	AUDPC	31 Aug	AUDPC	14 Sep	2 Oct	14 Oct
Non-treated control	12.9 a	50.9 a	19.1 ab	71.2 ab	63.3 a	50.6 ab	25.7 bc
K-Phite 7LP 3 qt (1-4)	3.9 bc	16.8 bc	10.9 ab	42.2 ab	62.5 a	55.0 ab	37.4 abc
Serenade Opti 26WP 20 oz (1-4)	7.4 abc	30.7 ab	19.8 ab	73.9 ab	66.3 a	39.0 ab	14.0 c
Mildor Max 0.2 lb/100 gal (1-4)	12.8 a	50.0 a	27.1 a	101.3 a	70.5 a	36.5 b	22.8 bc
Howler 5 g/L (1-4)[w]	10.6 ab	43.3 ab	27.4 a	103.0 a	61.5 ab	46.6 ab	22.3 bc
Howler 7.5 g/L (1-4)[w]	4.9 abc	23.5 ab	17.2 ab	67.2 ab	77.5 a	36.5 b	17.1 bc
Exp Bio H 1 g/L (1-4)[w]	11.1 ab	47.0 a	21.9 ab	89.2 a	63.8 a	45.0 ab	21.3 bc
Exp Bio H 2 g/L (1-4)[w]	11.1 ab	44.3 a	28.0 a	103.5 a	58.3 abc	35.3 b	16.2 c
Exp Bio I 2.5 g/L (1-4)[w]	9.8 ab	41.9 ab	17.1 ab	65.5 ab	67.5 a	60.2 ab	30.0 abc
Exp Bio I 5 g/L (1-4)[w]	6.8 abc	28.3 ab	13.8 ab	52.9 ab	58.8 abc	44.2 ab	23.5 bc
Howler 7.5 g/L (1,3)[w] Vivando 2.5SC 15.4 oz (2) Quintec 2.08SC 4 oz (4)	0.6 c	3.2 cd	6.5 ab	25.9 ab	23.3 bc	75.5 a	53.4 a
Vivando 2.5SC 15.4 oz (1,4) Quintec 2.08SC 4 oz (2) Torino 0.85SC 3.4 oz (3)	0.1 c	0.5 d	0.4 b	1.6 b	21.3 c	63.9 ab	41.2 ab
P-value (treatment)	<0.0001	<0.0001	0.002	0.0016	0.0001	0.0125	<0.0001

[z] Numbers in each column with a letter in common are not significantly different from each other (Tukey's HSD, P=0.05).
[y] When needed, values were square root transformed before analysis. Table contains de-transformed values.
[x] Rate of formulated product/A. Application dates were 1=5 Aug, 2=12 Aug, 3=19 Aug, and 4=26 Aug.
[w] Applied with Capsil 0.125% v/v (non-ionic surfactant).