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

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Efficacy of fungicides for managing powdery mildew on pumpkin, 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 objective was to determine if efficacy was lower than expected based on previous results for fungicides at risk for resistance development due to single-site mode of action. These fungicides are critical for successful control of powdery mildew due to their mobility enabling them to move to the lower leaf surface where powdery mildew develops best. In previous years at LIHREC poor control was associated with presence of *Podosphaera xanthii* isolates resistant to FRAC code 3, 7, and 11 fungicides. Isolates resistant to FRAC code 1 and 13 fungicides have also been detected. The field was plowed on 11 Apr. Urea fertilizer (46-0-0) was applied on 14 Apr at 163 lb/A (75 lb/A N). 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 (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 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. The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from affected plants. 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 five 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 4, 17, 23, and 28 Aug; and 5, 11, 18, and 25 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 at the first assessment when 45 old leaves were examined and the last 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 5 through 25 Sep. Defoliation was assessed on 2, 9, and 16 Oct. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 3, 9, and 16 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 4 Aug in 17 of the 32 plots on less than 1% of the leaves examined. The fungicides Pristine (FRAC code 7+11), Torino (U6), and Luna Sensation (7+11) failed to control powdery mildew on the underside of leaves beginning with the assessment on 11 Sep (data not shown). Failure of Luna Sensation was surprising because in laboratory bioassays isolates resistant to boscalid, FRAC 7 active ingredient in Pristine, exhibited sensitivity to fluopyram, FRAC 7 active ingredient in Luna Sensation. All of the fungicide treatments provided better control of powdery mildew on upper leaf surface, except that Pristine and Torino were not effective at the last assessment. Procure (3), Quintec (13), and Vivando (U8) all preformed as well as the growers standard treatment of a rotation of Vivando, Quintec, and Torino. Despite poor powdery mildew control on lower leaf surfaces, Pristine performed well in terms of preserving handle quality, as did Procure and Vivando. Typically the more effectively powdery mildew is controlled, the longer leaves remain alive, and the slower vines die and thus the longer until pumpkin handles shrivel and rot. This was best exemplified by Vivando. Luna Sensation and Torino were the least effective of all the fungicide treatments tested in this experiment: they provided inadequate control on the lower side of the leaf and failed to preserve fruit handle quality through 16 Oct. This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch under NYC-153409.

Treatment and rate/A (application dates) [y]	Powdery mildew severity (%) [x,z]				Defoliation [z,x] (%)	Fruit quality [z,x] (% good handles)	
	Upper leaf surface		Lower leaf surface				
	25 Sep	AUDPC	25 Sep	AUDPC	9 Oct	9 Oct	16 Oct
Untreated control	46.2 a	686.2 a	55.1 ab	1070.0 a	75.0 ab	47.9 b	16.6 d
Pristine 18.5 oz (1-6)	33.3 ab	256.8 b	58.2 ab	824.5 ab	60.0 abc	89.5 a	74.2 abc
Torino 3.4 fl oz (1-6)	32.8 ab	214.9 b	60.3 a	869.4 a	77.5 ab	91.4 a	47.9 cd
Luna Sensation 4 fl oz (1-6)	14.6 bc	138.3 bc	54.0 ab	752.8 ab	58.8 bc	84.1 a	48.7 cd
Quintec 6 fl oz (1-6)	16.3 bc	128.8 bc	43.3 bc	303.9 c	88.8 a	84.1 a	49.1 bcd
Procure 8 fl oz (1-6)	17.5 bc	140.4 bc	31.2 cd	493.1 bc	55.0 bc	95.2 a	89.5 a
Vivando 15.4 oz (1-6)	1.7 c	21.9 c	24.6 d	219.0 c	52.5 bc	100.0 a	94.5 a
Vivando 15.4 oz (1,4) Quintec 4 oz (2,5) Torino 3.4 oz (3,6)	1.6 c	10.6 c	31.1 cd	311.3 c	32.5 c	97.2 a	87.9 ab
P-value (treatment)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<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] Rate of formulated product/A. Application dates were 1=8 Aug, 2=15 Aug, 3= 22 Aug, 4=29 Aug, 5=10 Sep, and 6=13 Sep.
[x] When data were not distributed normally, values were square root transformed before analysis. Table contains de-transformed values.