

Efficacy of fungicides for managing powdery mildew on pumpkin, 2020.

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. One 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 which enables 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, 11, and/or U6 fungicides (testing done with single-colony isolates). Isolates resistant to FRAC code 1 and 13 fungicides have also been detected. The second objective was to determine efficacy of Cevya (mefentrifluconazole, FRAC 3), a new fungicide not registered for this use. Resistance to FRAC 3 (DMI) fungicides is quantitative and their efficacy varies. The field was mold-board plowed and urea fertilizer (46-0-0) was applied at 80 lb/A N on 6 Apr. For management of Phytophthora blight (caused by *Phytophthora capsici*), a mustard biofumigant cover crop (cv. Rojo Caliente) was seeded at 10 lb/A by drilling on 7 Apr. On 12 Jun the mustard was flail chopped, immediately incorporated by disking, and followed by a cultipacker to seal the soil surface; the field could not be irrigated to initiate biofumigation as usually done. Pumpkins were planted with a vacuum seeder at approximately 24-in. plant spacing on 24 Jun after disking on 22 Jun. Controlled-release fertilizer (N-P-K, 19-10-9) was used at 525 lb/A (101 lb/A N) and applied with the seeder in two bands about 2 in. to the side of the seed. Strategy 3 pt/A, Sandea 0.5 oz/A, and Curbit EC 1 pt/A were applied prior to seedling emergence for weed control on 24 Jun using a tractor mounted sprayer. During the season, weeds were managed by cultivating and hand weeding as needed. Drip tape was laid down along each row of pumpkin seedlings on 30 Jun. The following fungicides were applied throughout the season to manage Phytophthora blight: Orondis Ultra 7 fl oz/A on 9 Jul, 19 and 31 Aug, Omega 1 pt/A on 15 Jul and 10 Sep, Presidio 4 fl oz/A on 22 Jul and 25 Aug, Revus 8 fl oz/A on 29 Jul, and Ranman 2.75 fl oz/A on 5 and 12 Aug. Plots were three 15-ft rows spaced 68 in. apart with a 15-ft in-row untreated area between plots. The 15-ft area between plots was also planted to pumpkin. A randomized complete block design with four replications was used. The primary source of initial inoculum for powdery mildew in this area is considered to be long-distance wind-dispersed spores from affected plants. Treatments were applied six times on a 7-d IPM schedule (starting after disease detection) beginning on 5 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 3, 12, 19, and 26 Aug; and 1, 9, 16 Sep. For the first two assessments, 27 older leaves were rated in each plot. For the remaining assessments, five young, five mid-aged, and five old leaves (selected based on leaf physiological appearance and position in the canopy) were rated in each plot. 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 3 Aug through 16 Sep using the formula: $\sum_{i=1}^n [(R_i + 1 + R_{i+1})/2] [t_{i+1} - t_i]$, where R = disease severity rating (% of leaf surface affected) at the *i*th observation, *t_i* = time (days) since the previous rating at the *i*th observation, and *n* = total number of observations. Defoliation was assessed on 9, 16, and 23 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 28 Sep, 6 Oct, and 15 Oct. Handles were considered good if they were green, solid, and not rotting. Data were analyzed with one-way ANOVA and Tukey's HSD to separate means using JMP statistical software. Average monthly high and low temperatures (°F) were 86.3/69.6 in Jul, 84.3/68.2 in Aug, 75.7/60.9 in Sep, and 65/51.7 in Oct. Rainfall (in.) was 3.80, 3.33, 2.70 and 4.75 for these months, respectively.

Powdery mildew was first observed in this experiment on 3 Aug in 22 of the 48 plots on only 26 of the 1296 leaves examined. Fungicide treatment applications started 2 days later. All of the treatments provided excellent control on upper leaf surfaces: 95 – 100% based on AUDPC values. Proline (FRAC code 3) was the most effective fungicide. Significantly less severe powdery mildew had developed on lower leaf surfaces by 16 Sep than all other treatments and it provided 99.5% control based on AUDPC values. Proline was significantly more effective than Procure, another DMI fungicide tested, based on powdery mildew severity on lower leaf surfaces on 9 Sep (data not shown), 16 Sep, and AUDPC. Procure provided 89% control based on AUDPC values. Other fungicides that provided similar control to Procure (90-95%) were Vivando (50), Quintec (13), Luna Experience (3+7), and Luna Privilege (7). They were as effective as Procure alternated with Vivando, the grower recommended program for Long Island in 2020 (93% control); Quintec was not included in the grower program as in previous years because of reduced efficacy in a similar experiment in 2019 (PDMR 14:V081) associated with resistant isolates. Luna Privilege is not labeled for powdery mildew but was tested to determine efficacy of fluopyram, the FRAC 7 active ingredient in Luna pre-mix fungicides. Cevya (3) at all three rates was less effective than most of the other fungicides, especially for powdery mildew on lower leaf surfaces, which was evident starting with the 26 Aug assessment. Cevya treatments were ineffective on lower leaf surfaces based on 9 and 16 Sep assessments. The seven treatments providing the best control of powdery mildew generally had least defoliation and most fruit with good quality handles. No phytotoxicity was observed. This report includes 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 (%) ^z					Defoliation (%) ^z	Fruit quality (% good handles) ^z	
	Upper leaf surface ^x		Lower leaf surface ^x				28 Sep	15 Oct
	16 Sep	AUDPC	1 Sep	16 Sep	AUDPC			
Untreated Control	15.64 a	494.90 a	41.55 a	57.4 a	940 a	75 a	40 d	2 d
Cevya 4 fl oz ^w (1-6)	3.09 b	26.21 b	20.55 b	54.7 a	573 b	29 bcd	68 c	27 cd
Cevya 5 fl oz ^w (1-6)	1.36 bc	21.25 bc	22.39 b	47.8 a	698 ab	55 ab	69 bc	33 bcd
Cevya 10 fl oz ^w (1-6)	1.18 bc	15.49 bcd	16.49 b	43.6 a	530 b	53 ab	73 abc	22 cd
Cevya 5 fl oz + Capture 6.4 fl oz/100 gal ^w (1-6)	0.42 bc	6.90 bcde	13.18 b	35.9 a	479 b	39 bc	71 abc	39 abc
Procure 8 fl oz ^w (1-6)	0.38 bc	2.59 cde	3.03 c	5.9 b	106 c	25 bcd	77 abc	37 abcd
Vivando 15.4 fl oz ^v (1-6)	0.00 c	0.28 e	0.44 c	11.3 b	99 c	10 cd	95 ab	56 abc
Quintec 6 fl oz ^w (1-6)	0.29 bc	1.87 de	0.28 c	6.0 b	59 c	29 bcd	77 abc	36 bcd
Luna Experience 17 fl oz ^w (1-6)	0.05 c	0.19 e	0.25 c	7.6 b	51 c	4 d	92 abc	65 ab
Luna Privilege 6.84 fl oz ^w (1-6)	0.03 c	0.72 e	0.18 c	6.0 b	49 cd	29 bcd	81 abc	48 abc
Proline 5.7 fl oz ^w (1-6)	0.00 c	0.01 e	0.02 c	0.4 c	4 d	6 cd	90 abc	57 abc
Procure 8 fl oz ^v (1, 3, 5), Vivando 15.4 fl oz ^v (2, 4, 6)	0.02 c	0.18 e	0.49 c	9.0 b	69 c	7 cd	96 a	72 a
<i>P</i> -value (treatment)	<0.0001	<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 Application dates were 1=5 Aug, 2=14 Aug, 3=20 Aug, 4=28 Aug, 5=3 Sep, and 6=9 Sep.

^x Values were square root transformed before analysis because raw data were not distributed normally. Table contains de-transformed values.

^w Treatment applied with Latron B-1956 6.4 fl oz/100 gal.

^v Treatment applied with Silwet L-77 0.125% v/v.