

### Efficacy of fungicides for managing powdery mildew on pumpkin, 2018.

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 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, 11, and U6 fungicides. Isolates resistant to FRAC code 1 and 13 fungicides have also been detected. Second objective was to evaluate two new fungicides: Gatten (U13) was applied alone at three rates and Miravis Prime (7+12) was applied with other fungicides labeled for powdery mildew for three treatments. The field was plowed on 20 Apr. Urea fertilizer (46-0-0) was applied on 23 Apr at 163 lb/A (75 lb/A N). For management of Phytophthora blight (caused by *Phytophthora capsici*), mustard biofumigant cover crop (Caliente 199 and Caliente Rojo combined) was seeded at 10 lb/A by drilling on 23 Apr. On 11 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 27 Jun after disking. 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 29 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 3 Jul. The following fungicides were applied throughout the season to manage Phytophthora blight: Presidio 4 fl oz/A on 25 Jul, Ranman 2.75 fl oz/A on 30 Jul, Orondis Ultra 7 fl oz/A on 4 Aug, Revus 8 fl oz/A on 7 Aug, Omega 1.5 pt/A on 13 Aug, Orondis Ultra 7 fl oz/A on 23 Aug, Orondis Ultra 7 fl oz/A on 30 Aug, Omega 1.5 pt/A on 6 Sep, and Ranman 2.75 fl oz/A on 15 Sep. 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 7, 14, 21, and 30 Aug; and 5, 13, and 27 Sep. For the first three assessments, 30 or 20 old leaves were rated in each plot. For the remaining assessments, an equal number of young, mid-aged, and old leaves (selected based on leaf physiological appearance and position in the canopy) were rated for a total of 15 or 27 leaves 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 19 Oct through 8 Nov using the formula:  $\sum_{i=1}^{n-1} [(R_{i+1} + R_i)/2] [t_{i+1} - t_i]$ , where R = disease severity rating (% of leaf surface affected) at the *i*th observation, *t<sub>i</sub>* = time (days) since the previous rating at the *i*th observation, and *n* = total number of observations. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 10 Sep, 4 Oct, and 15 Oct. Handles were considered good if they were green, solid, and not rotting. Data was analyzed with one-way ANOVA and Tukey's HSD to separate means using JMP statistical software. Average monthly high and low temperatures (°F) were 85/70 in Jul, 84/72 in Aug, 77/66 in Sep, and 65/52 in Oct. Rainfall (in.) was 3.76, 6.04, 5.81 and 7.92 for these months, respectively. Due to the atypically high amounts of rainfall in Aug, Sep, and Oct Phytophthora blight was prevalent in the experiment despite efforts to control it. Handle quality ratings in particular were affected by the high amount of rotten fruit in the field in Oct.

Powdery mildew was first observed in this experiment on 3 Aug; plots were rated on 7 Aug and powdery mildew was found in all 48 plots. All of the fungicide treatments significantly reduced severity of powdery mildew on the upper leaf surface based on AUDPC values compared to the untreated control. Although five treatments were not performing significantly better than the untreated control at the final evaluation of the season, 27 Sep, which was two weeks after the final fungicide application, including Quintec (FRAC code 13) and Luna Sensation (7+11). Vivando (U8), the grower standard rotation of Vivando, Quintec, and Procure (3), as well as every rate of Gatten provided adequate disease control throughout the season. All treatments also effectively controlled powdery mildew on the lower leaf surface based on AUDPC values. Some treatments were not effective based on severity on some dates, in particular the last two assessments following the final application. Most treatments were providing effective control at the time of the last application. Vivando was the most effective treatment. The four treatments with Bravo may have been more effective if the Bravo applications were on a preventive schedule or applied with one of the other fungicides able to redistribute to the lower leaf surface. Fruit handle quality ratings were affected by Phytophthora fruit rot causing atypical variability in the data. All treatments had numerically higher percent fruit with good handles than the untreated, but only the Miravis Prime rotation treatment listed second in the table was able to significantly improve handle quality compared to the untreated control (data not shown). 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) <sup>y</sup>	Powdery mildew severity (%) <sup>x,z</sup>							
	Upper leaf surface				Lower leaf surface			
	13 Sep	27 Sep	AUDPC	30 Aug	5 Sep	13-Sep	27 Sep	AUDPC
Untreated Control	21.2 a	11.3 a	758 a	55 a	53 a	49 a	49 abc	1705 a
Quintec 6 fl oz (1-5)	4.0 b	4.9 ab	104 b	11 d	19 ef	45 ab	42 abcd	995 cde
Luna Sensation 4 fl oz (1-5)	0.9 b	4.7 ab	79 bc	30 bcd	29 cde	41 ab	54 a	1235 bc
Vivando 15.4 fl oz (1-5)	1.2 b	0.4 b	31 bc	16 cd	22 def	28 b	29 d	790 e
Gatten 4 fl oz (1-5) <sup>w</sup>	0.3 b	1.3 b	21 c	38 abc	34 bcd	43 ab	34 bcd	1233 bc
Gatten 6 fl oz (1-5) <sup>w</sup>	1.4 b	1.4 b	45 bc	45 ab	38 bc	40 ab	41 abcd	1320 b
Gatten 8 fl oz (1-5) <sup>w</sup>	1.4 b	0.6 b	34 bc	29 bcd	34 bcd	39 ab	45 abcd	1210 bc
Bravo Weather Stik 2 pt (1,2) Miravis Prime 11.5 fl oz (3) Actigard 1 oz (3) Vivando 15.4 fl oz (4) Inspire Super 20 fl oz (5)	0.7 b	3.3 ab	43 bc	39 abc	33 bcde	40 ab	51 ab	1315 b
Bravo Weather Stik 2 pt (1,2) Miravis Prime 11.5 fl oz (3) Vivando 15.4 fl oz (4) Inspire Super 20 fl oz (5)	0.4 b	1.9 b	26 bc	40 ab	29 cde	37 ab	30 cd	1120 bcd
Bravo Weather Stik 2 pt (1,2) Miravis Prime 6.4 fl oz (3) Vivando 15.4 fl oz (4) Inspire Super 20 fl oz (5)	0.5 b	4.1 ab	47 bc	44 ab	41 abc	42 ab	38 abcd	1361 b
Bravo Weather Stik 2 pt (1,2) Vivando 15.4 fl oz (3,4) Inspire Super 20 fl oz (5)	1.8 b	4.4 ab	79 bc	40 abc	44 ab	42 ab	46 abcd	1385 b
Vivando 15.4 fl oz (1,4) Quintec 4 fl oz (2,5) Procure 8 fl oz (3) (Grower Standard)	1.1 b	1.4 b	32 bc	22 bcd	14 f	31 ab	35 abcd	848 de
<i>P-value (treatment)</i>	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0004	<0.0001

<sup>z</sup> Values in each column with a letter in common are not significantly different from each other (Tukey's HSD,  $P=0.05$ ).

<sup>y</sup> 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.

<sup>x</sup> When data were not distributed normally, values were square root transformed before analysis. Table contains back-transformed values.

<sup>w</sup> Treatment applied with Induce non-ionic surfactant, 0.125% v/v.