

### **Efficacy of fungicides for managing powdery mildew in pumpkin, 2013.**

The primary objective of this study was to evaluate the efficacy of several fungicides with single-site mode of action for the cucurbit powdery mildew pathogen. Both new and currently registered products were tested in an area where in previous years strains of the pathogen were detected with resistance to FRAC code 1, 7, and 11 fungicides and moderate resistance to FRAC code 3 fungicides. An experiment was conducted in a field with Haven loam soil at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY. The field was plowed on 3 Apr. Fertilizer (N-P-K, 10-10-10) was broadcast at 500 lb/A then incorporated. Caliente 199 mustard biofumigant cover crop was seeded at 10 lb/A on 5 Apr. It was flail chopped, incorporated by disking, then the soil surface was sealed with a cultipacker on 18 Jun, which was at least 3 weeks after flowering commenced. The field was tilled on 25 Jun to prepare for planting. Pumpkin seeds were planted at approximately 24-in. plant spacing within rows with a vacuum seeder on 27 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). The herbicides Strategy (3 pt/A), Curbit EC 1 pt/A, and Sandea (0.5 oz/A) were applied over the entire plot area on 27 Jun, which was followed by irrigation to activate. During the season, weeds were controlled by cultivating and hand weeding as needed. Cucumber beetles were managed by applying the insecticide Admire Pro (2.8 fl oz/1000 ft) in a narrow band over the planted rows immediately after the herbicide application on 27 Jun. The following fungicides were applied preventively for Phytophthora blight (*Phytophthora capsici*) and downy mildew (*Pseudoperonospora cubensis*): ProPhyt (2 qt/A) on 16 Jul; Ranman 400SC (2.75 fl oz/A) on 28 Jul, 3 Aug, 24 Aug, and 7 Sep; Forum (8 oz/A) on 8 Aug, 14 Aug, 31 Aug and 14 Sep; and Presidio (4 fl oz/A) on 10 and 30 Aug. Seedlings that developed crown rot symptoms of Phytophthora blight during the second half of Jul were rogued. No Phytophthora fruit rot or downy mildew was observed in the field. Plots were three 15-ft rows spaced 68 in. apart. The 20-ft distance between plots in the row was also planted to pumpkin which received some treatment fungicide as the applications were made. Vines that grew into the driveways were re-directed into the plots. A randomized complete block design with four replications was used. Treatments were applied five times on a 7-day schedule beginning on 6 Aug using a tractor-mounted boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 68 gal/A at 65 psi and 2.3 mph. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces weekly on 1, 8, 13, 19, and 26 Aug, and 4 and 10 Sep. Initially the examined leaves were selected from the oldest third of the foliage based on leaf physiological appearance and position in the canopy. Mid-aged and young leaves were also assessed beginning on 19 Aug. At least nine leaves were examined in each plot on each assessment date. 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 Aug through 10 Sep. Defoliation was assessed on 4 Sep, 10 Sep, and 7 Oct. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 17 Sep and 7 Oct. Handles were considered good if they were green, solid, and not rotting. Average monthly high and low temperatures (°F) were 78/61 in Jun, 86/71 in Jul, 80/64 in Aug, 74/57 in Sep, and 67/51 in Oct. Rainfall (inches) was 9.92, 3.07, 2.43, 2.62, and 0.19 for these months, respectively.

Powdery mildew was first observed in this experiment on 1 Aug in 21 of the 52 plots. Most treatments were individual products evaluated alone. This is neither a labeled nor recommended use pattern for growers. Such evaluations, however, identify appropriate rates for new products and monitor efficacy of registered fungicides at risk for resistance development in order to develop management recommendations for growers. Among currently registered fungicides, Pristine (FRAC Code 7 and 11) applied at its highest label rate was effective, providing 94% and 93% control on upper and lower leaf surfaces, respectively, based on AUDPC values. In previous years at this location, pathogen isolates resistant to both components of this fungicide have been detected, and the fungicide has exhibited variable performance including failure in previous evaluations. Procure (FRAC 3) applied at its highest label rate was equally effective (97% and 95% control). Quintec (FRAC 13) was not significantly more effective (99% control on both surfaces). The grower standard program with these fungicides, which was recommended in 2013 in NY applied with a protectant fungicide, also performed very well, as did the alternation of Quintec with Fontelis, a recently-registered FRAC 7 fungicide. Similar control was obtained with the three new fungicides at all rates and combinations tested. Leaves died more slowly in all treated plots compared to the nontreated control, which is important for maintaining solid handles on pumpkin fruit. Based on these results, pathogen strains with resistance to FRAC Code 3 or 7 chemistry were not present at a frequency able to impact efficacy of these fungicides in 2013, in contrast with some previous years.

Treatment and rate/A (application dates) <sup>y</sup>	Powdery mildew severity (%) <sup>z</sup>						Defoliation (%)
	Upper leaf surface			Lower leaf surface			
	4 Sep	10 Sep	AUDPC <sup>x</sup>	4 Sep	10 Sep	AUDPC <sup>x</sup>	
Nontreated .....	76.6 a	82.1 a	1001.2 a	76.6 a	82.1 a	998.6 a	95.8 a
Pristine 38 WG 18.5 fl oz (1-5).....	1.3 b	4.1 b	57.4 b	1.3 b	4.1 b	72.7 bcd	25.0 b
Procure 8 fl oz (1-5).....	1.3 b	2.6 b	33.1 b	1.3 b	2.6 b	46.7 bcd	25.0 b
Quintec 6 fl oz (1-5).....	0.0 b	0.5 b	7.8 b	0.0 b	0.5 b	9.1 d	3.8 b
Quintec 4 fl oz (1,3,5); Procure 8 fl oz (2); Pristine 18.5 oz (4) (Grower Standard).....	0.4 b	1.9 b	11.2 b	0.4 b	1.9 b	18.9 cd	3.8 b
Fontelis 1 pt (1,3,5); Quintec 4 fl oz (2,4).....	0.7 b	2.0 b	58.6 b	0.7 b	2.0 b	97.1 bc	18.8 b
IKF-309 4 fl oz (1-5).....	1.8 b	3.0 b	28.5 b	1.8 b	3.0 b	72.2 bcd	46.3 b
IKF-309 5 fl oz (1-5).....	2.8 b	5.4 b	40.6 b	2.8 b	5.4 b	72.4 bcd	22.8 b
IKF-309 4 fl oz (1,3,5); Quintec 6 fl oz (2,4)....	0.5 b	1.1 b	17.5 b	0.5 b	1.1 b	43.2 bcd	20.0 b
IKF-309 4 fl oz (1,3,5); Procure 8 fl oz (2,4)....	4.0 b	2.6 b	42.3 b	4.0 b	2.6 b	60.9 bcd	11.5 b
IKF-5411 <sup>w</sup> 12 fl oz (1-5).....	3.6 b	7.5 b	69.7 b	3.6 b	7.5 b	103.5 b	46.3 b
Vivando 10 fl oz (1-5).....	0.2 b	1.5 b	16.2 b	0.2 b	1.5 b	44.7 bcd	15.0 b
Vivando 15 fl oz (1-5).....	0.5 b	0.9 b	7.8 b	0.5 b	0.9 b	26.8 bcd	5.3 b
<i>P-value (treatment)</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>	<i>&lt;0.0001</i>

<sup>z</sup> Numbers 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=6 Aug, 2=15 Aug, 3=20 Aug, 4=29 Aug, and 5=5 Sep.

<sup>x</sup> AUDPC values were square root transformed before analysis.

<sup>w</sup> IKF-5411 was applied with Silwet L-77 0.1% v/v.